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CONTENTS

Research on the Curriculum Design of Full-time Master's Degree in Sports in Inner Mongolia Autonomous Region: A Case Study of Inner Mongolia Normal University

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Abstract: This study focuses on the current state of the curriculum design for master's degree programs in sports in Inner Mongolia Autonomous Region. Through in-depth interviews with graduate program administrators and students at Inner Mongolia Normal University, the analysis reveals the existing issues and offers recommendations. The main conclusion indicates that the curriculum for sports master's programs in Inner Mongolia is nearly identical to that of academic master's programs, lacking distinctive features of professional degrees. The proportion of practical teaching courses is low, elective courses are limited, and students have little autonomy in course selection. The curriculum emphasizes commonalities over individuality, and there is a lack of process monitoring in educational practice systems; the curriculum fails to align effectively with training objectives and societal needs.
Keywords: Inner Mongolia; Full-time Master's in Sports; Curriculum Design

1. INTRODUCTION

With the development of society, academic-oriented graduate students can no longer meet the demands of China's sports industry. Since 2009, the Ministry of Education has gradually increased the number of master's professional degree students in sports. The curriculum design for these degrees has drawn widespread attention and has revealed several issues. As of July 2024, only two institutions in Inner Mongolia—Inner Mongolia Normal University and Inner Mongolia University for Nationalities—offer full-time master's programs in sports. Inner Mongolia University for Nationalities began enrolling master's students in 2019 with a limited intake of around 10 students annually, following a similar curriculum to Inner Mongolia Normal University, which has been enrolling approximately 50-70 students annually since 2009. This study utilizes Inner Mongolia Normal University as a case study to investigate the curriculum design for its master's professional degree students in sports through literature review and in-depth interviews. The goal is to explore the current state of curriculum design for full-time sports master's degrees in Inner Mongolia, identify existing problems, and propose optimization strategies, providing a reference for improving the training model for such students both in Inner Mongolia and nationwide.

2. THE CURRENT SITUATION AND EXISTING PROBLEMS OF THE CULTIVATION OF SPORTS MASTERS IN INNER MONGOLIA AUTONOMOUS REGION

2.1 The Situation of Students and Supervisors of Postgraduate Students Majoring in Sports Master's Professional Degree in Inner Mongolia Autonomous Region

As of July 2024, only Inner Mongolia Normal University and Inner Mongolia Minzu University in Inner Mongolia Autonomous Region enroll full-time sports masters. Inner Mongolia Minzu University began to enroll sports professional masters in 2019. The sources of sports master students are mainly

fresh undergraduate graduates without work experience, and their ages are mainly concentrated between 21 and 25 years old; The proportion of males is significantly higher than that of females; There are not many students with work experience. The qualification certification of supervisors for sports professional master's postgraduate students takes scientific research as the only standard, that is, whether they have presided over research projects at the department level and above, or whether they have published papers in core journals of Class D and above as the first author. Such qualification certification with scientific research as the only standard ignores the professional practice background of supervisors, which will lead to the situation of pure academic supervisors guiding practical students, that is, the professional background of supervisors does not have the ability to guide professional masters, which is not very consistent with the training objectives of sports masters.

2.2 The Training Objectives, Training Methods and Existing Problems of Postgraduate Students Majoring in Sports Master's Professional Degree in Inner Mongolia Autonomous Region

The training objective of sports masters in Inner Mongolia Normal University is to cultivate high-level and applied sports professionals who master solid basic sports theories, broad sports professional knowledge, sports teaching and training techniques and skills in the sports field, have strong ability to solve practical problems, and can independently undertake sports professional and technical or management work. However, it is found from the interviews that sports masters generally believe that there is a big gap between the actual training effect of students and the training objectives set by the school. If the specific positioning of the training objectives is not implemented, the training tasks will also be unclear. Therefore, the training units should strengthen the contact with the employers, timely understand the market demand, and adjust the specific target positioning of the sports master's professional degree according to the professional skills that should be possessed in the main employment directions. At present, full-time study is adopted for sports masters in Inner Mongolia. Before 2024, the study period for graduates was 2 years, which was later changed to 3 years, but they can graduate in advance. Such a reform is more in line with the actual situation and also improves the training quality of students.

2.3 The Curriculum Setting and Existing Problems of the Training Program for Postgraduate Students Majoring in Sports Master's Professional Degree in Inner Mongolia Autonomous Region

The curriculum study of postgraduate students majoring in sports master's professional degree implements the credit system, and the total credits shall not be less than 36 credits. Students can obtain full credits if the scores of each course are above 75 points. One credit will be deducted if the scores of each course are below 75 points, and no credits will be obtained if the scores are less than 60 points. Those who have not completed 36 credits cannot graduate and cannot participate in the defense of master's degree theses. The professional courses for sports master's degree include public courses, core courses in professional fields, elective courses and teaching practice courses.

The training objective of the sports master's professional degree is to cultivate high-level and applied sports professionals. Therefore, the curriculum setting of sports masters should have distinct practicality and applicability, combine practicality with academicity, aim to improve students' sports professional abilities, so as to achieve the goal of applying what they have learned and be able to solve the difficulties existing in work and the problems they will face. However, through in-depth interviews, it is found that the actual curriculum offering situation of full-time postgraduate students majoring in sports master's professional degree is not ideal. Inner Mongolia Normal University has set up six public courses for sports masters and different courses in professional fields, which meet the needs of the sports teaching major. The interviewed postgraduate students believe that the public courses, as well as the courses involved in professional basics and compulsory courses, have a certain degree of pertinence. At the same time, special practical courses have been set up in the professional elective courses, and students can choose

courses according to their own interests. However, in the analysis of the training program, it is found that the proportion of theoretical courses is much larger than that of practical courses. Practical courses are only placed in the elective course options, and there are only 3-5 optional items, which violates the original intention of the training objectives of full-time postgraduate students majoring in sports master's professional degree. In addition, in the training program, the courses for the sports teaching direction and the sports training direction are basically the same, and no difference is reflected.

2.4 Comparative Analysis of the Currently Offered Courses for Sports Masters and Academic Postgraduate Students in Inner Mongolia Autonomous Region

Through interviews and comparison of the training programs, most of the compulsory courses in the curriculum setting for sports masters and academic postgraduate students in Inner Mongolia are the same. And it is found in the interviews that a large part of the compulsory courses are taught in the same class for academic postgraduate students and sports masters, with no obvious difference. Generally speaking, the curriculum setting is similar to that of academic postgraduate students, and the professional characteristics are not well reflected. When the differences in the sources of students are very small, offering courses that are almost the same as those of academic postgraduate students is not enough to cultivate sports masters who have stronger practical abilities than academic postgraduate students.

2.5 The Current Situation and Existing Problems of Professional Internship and Practice for Sports Masters in Inner Mongolia Autonomous Region

In principle, the time for practical teaching and training in the training program should not be less than 1 year. It includes half a year of concentrated practice and half a year of segmented practice. The forms of practical teaching and training include probation, internship, assistant teaching, teaching or assistant coaching, etc. The concentrated teaching and training practice bases are the joint training bases for postgraduate students or the internship practice schools uniformly arranged by the college. The segmented teaching and training practice is carried out in the university. However, it is found in the interviews that the internship lacks unified management. Some students go back to their place of origin for internship, and some students have internships with their supervisors on campus. The lack of concentrated internship leads to the students being too scattered, lacking effective supervision, and it is difficult to achieve the ideal effect. They have not completed the internship and practice and received corresponding guidance, making the internship and practice become a mere formality.

3. OPTIMIZATION STRATEGIES FOR THE CURRICULUM SETTING OF SPORTS MASTERS IN INNER MONGOLIA

3.1 Clarify the Training Positioning and Improve the Curriculum Fit

In the training process of the sports master's professional degree, its professionalism should be mainly reflected. This requires the training units to clearly distinguish the development nature of each professional field in the process of professional setting, and train talents according to the different characteristics of each professional field. Each professional field should also have pertinence in the training requirements and specific curriculum setting, and offer different courses for different majors. In this way, students can develop towards professionalism. The construction of courses should adopt classified measures and be precisely promoted to reflect the professionalism of the field. In addition, it is also necessary to avoid the similarity with the curriculum setting of academic postgraduate students.

3.2 Pay Attention to the Offering of Practical Courses and Enhance the Applicability of Courses

Sports master postgraduate students are mainly trained to be applied talents in the sports field, and the key is to highlight the professionalism of talent training. Therefore, in the process of curriculum setting, the learning and practice of students' teaching practice should be strengthened, and the practicality should also be highlighted in the offering and learning of courses. Therefore, in

the offering and teaching of courses, attention should be paid to the offering of practical courses, the applicability of courses should be enhanced, and students' ability to apply what they have learned should be improved.

3.3 Increase the Types of Elective Courses and Improve Students' Right to Choose Courses Independently

The number of course types directly affect the breadth of knowledge that students can acquire. The choice of courses is not fixed and needs to accept new concepts and keep up with the new era. The survey found that the types of elective courses for sports masters in Inner Mongolia Autonomous Region are relatively few, mainly focusing on professional theoretical courses and professional technical courses. In particular, public elective courses have not been offered, which lacks communication and collision with other disciplines. First of all, the school should increase the types of courses in the curriculum setting to make the courses more diverse. When setting the curriculum, it should communicate and learn more with other disciplines, offer interdisciplinary courses, and increase the diversity of courses. Elective courses, as the name implies, are courses that students choose to take on their own. They have great flexibility in the choice of courses. The common points among disciplines should be combined effectively to create frontier courses and characteristic courses. Finally, in elective courses, students' right to choose courses independently should be strengthened. Students should choose according to their own interests and needs, and should not be arranged by others, which deprives students of the right to learn more other courses and is not conducive to the cultivation of students' learning interests.

4. CONCLUSIONS AND SUGGESTIONS

The curriculum setting of full-time postgraduate students majoring in sports master's professional degree in Inner Mongolia Autonomous Region mainly has the following problems: First, the proportion arrangement of various courses is unreasonable, and it is not well combined with practice; The supervision system for educational internship and practice is not perfect, and it is not easy to achieve the original intention of improving students' practical abilities; Second, the training program for sports masters is still following the training mode of academic masters; Third, the current curriculum setting has a not very high degree of fit with the training objectives and the current social needs, and still needs to be further optimized to meet the employment needs of students. Based on this, the author puts forward suggestions such as optimizing the curriculum system, reasonably arranging the curriculum structure, increasing the proportion of practical courses, and improving the process supervision of educational practice activities, in the hope of providing certain theoretical and practical references for the training quality of full-time postgraduate students majoring in sports master's professional degree in Inner Mongolia Autonomous Region, and also hoping to play a role of promoting the whole with the part and promoting the overall situation with the local area for the curriculum setting of postgraduate students majoring in sports master's professional degree in other similar schools across the country.

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REFERENCES

[1] Zhu Wenbing. Research on the Dilemma and Countermeasures of the Cultivation of Postgraduate Students in the Field of Sports Teaching of Full-time Sports Masters [J]. Journal of Chongqing College of Electronic Engineering, 2022, 30(6): 115-117.

[2] Xu Hong, Du Ying, Feng Xiaoming. Enlightenment of the Curriculum Setting of Master's Degree in Sports Management in the United States to the Cultivation of Sports Masters in China [J]. Journal of Chengdu Sport University, 2018, 34(12): 82-85.

[3] Song Jianya, Zhang Yiwen. Enlightenment of the Curriculum Setting of Master's Postgraduate Students in Physical Education Major of Springfield College in the United States [J]. Science & Technology Information,

2010(33): 220+238.
[4] Yu Ailing. The Curriculum System for Cultivating Composite Talents in Physical Education and Sports Training in Indiana University in the United States [J]. Journal of Shandong University of Sports, 2014(1): 82-84.
[5] Li Chuanbing, Fang Qianhua. Exploration of the Curriculum Setting of Full-time Postgraduate Students Majoring in Sports Master's Professional Degree in the New Era—Current Situation, Problems and Reform Proposals [J]. Academic Degrees & Graduate Education, 2014(10): 21-25.
[6] Jiang Bo, Huang Jin, Zhao Bo. Problems and Reforms of the Education of Postgraduate Students Majoring in Sports Master's Professional Degree in China [J]. Journal of Physical Education, 2017, 24(5): 111-115.

A Theoretical Framework for Student Management and Mental Health Support in the Digital Age

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Abstract: In the digital age, college students face new challenges arising from information overload and virtual social interactions, necessitating higher standards for student management and mental health support. This study aims to construct a theoretical framework for student management and mental health support in this context, employing an interdisciplinary approach that integrates theories from education, psychology, and management. The research methodology includes a literature review, theoretical analysis, and systematic integration. First, we analyze the behavioral characteristics, psychological changes, and management needs of college students in the digital era. Next, we review existing theories and practices, identifying their strengths and weaknesses. Finally, based on a multidisciplinary theoretical foundation, we integrate various resources to develop a comprehensive framework encompassing management concepts, strategies, and mental health support systems. The findings indicate that the proposed framework provides scientific guidance for colleges to enhance student management and mental health support in the digital age, aiding in the cultivation of high-quality talent and promoting students' overall well-being.

Keywords: Digital age; Student management; Mental health support; Theoretical framework; Interdisciplinary integration.

1. INTRODUCTION

1.1 Research Background and Significance

In the current wave of digitalization, information technology permeates every aspect of society at an unprecedented speed, profoundly altering how people live, learn, and work. As a crucial arena for knowledge dissemination and talent cultivation, higher education institutions are significantly impacted by the digital age. According to the 51st Statistical Report on Internet Development in China by the China Internet Network Information Center (CNNIC), as of December 2022, China's internet users reached 1.067 billion, with an internet penetration rate of 75.6%. Among these, students constitute the largest group, accounting for 25.4%, making them the primary users of the internet.

The digital age provides college students with an abundance of learning resources, convenient communication channels, and diverse social interactions. Online course platforms enable students to access top-quality educational resources across global institutions, while the rise of social media allows for limitless expansion of their social networks, facilitating instant and efficient information exchange. However, challenges such as information overload have become increasingly prominent, making it difficult for students to discern valuable content from the vast array of information available, thereby reducing learning efficiency. Additionally, virtual social interactions can weaken students' face-to-face communication skills, leading to feelings of loneliness and social anxiety. Research indicates that approximately 30% of college students report feeling lonelier after engaging in online social activities and experience varying degrees of anxiety in real-life social situations.

In this context, traditional student management models and mental health support systems in higher education struggle to meet the developmental needs of students in the digital age. Conventional management focuses on rule enforcement, lacking the flexibility and specificity required to respond to the behavioral changes induced by

digitalization. Similarly, mental health support reliant on offline consultations and limited psychological courses fails to effectively address the complex psychological issues arising from the virtual world. Therefore, constructing a theoretical framework for student management and mental health support in the digital era is of urgent practical significance. This framework can enhance the effectiveness of student management, optimize mental health support services, and promote holistic student development, enabling them to adapt to the challenges of the digital age and grow into well-rounded individuals with strong psychological resilience and comprehensive skills.

1.2 Review of Domestic and International Research Status

Research on student management and mental health support in the digital age began earlier in foreign contexts. In student management, universities in developed countries such as the United States and Europe actively integrate advanced information technologies to build digital management platforms. Harvard University, for instance, was one of the first to utilize big data analytics to collect and analyze students' learning behaviors and lifestyles, providing personalized learning guidance and management services that significantly increased student satisfaction and graduation rates. In terms of mental health support, foreign universities emphasize diversified intervention models. UK universities typically combine online psychological assessments, self-help intervention courses, and offline counseling, offering comprehensive mental health services. For example, the University of Oxford has developed a mental health app that allows students to conduct psychological assessments via their phones and receive tailored intervention suggestions, greatly improving the accessibility of mental health services.

In recent years, domestic research has also yielded substantial results. With the advancement of the "Internet + Education" concept, Chinese universities have begun to reform their digital management systems. Peking University established a digital management system encompassing multidimensional information related to students' academics, lives, rewards, and punishments, achieving informatization and intelligent management. In terms of mental health support, domestic scholars have explored psychological support models suitable for Chinese college students, integrating local culture and student characteristics. Some studies advocate for the construction of a "school-family-society" triadic mental health support network, emphasizing collaborative efforts to promote students' mental well-being.

However, both domestic and international research still face certain limitations. Foreign research outcomes often encounter cultural differences and adaptability issues when applied locally. Although domestic studies have made progress in practical aspects, the systematic and comprehensive theoretical frameworks require further enhancement. Some studies focus solely on specific aspects of student management or mental health support, lacking in-depth discussions that organically combine the two. Additionally, there remains significant room for expanding theoretical and practical research on the deep integration of digital technologies with student management and mental health support. Therefore, this study aims to synthesize domestic and international research results to construct an innovative and practical theoretical framework for student management and mental health support in the digital age, addressing the existing research gaps.

2. ANALYSIS OF STUDENT CHARACTERISTICS IN THE DIGITAL AGE

2.1 Changes in Behavioral Characteristics

The digital age has reshaped the behavioral patterns of college students. In terms of learning behavior, students increasingly rely on online learning resources. According to the "2022 National Graduate Enrollment Survey Report" published by China Education Online, over 80% of college students reported using online course platforms for learning each week, averaging 5-10 hours of study time. Online learning breaks the temporal and spatial constraints of traditional classrooms, allowing students to learn at their own pace, but it can also lead to fragmented learning experiences and a lack of systematic

understanding. In social behaviors, social media has become the primary platform for student interactions. For instance, over 95% of college students possess social media accounts, spending an average of 2-3 hours daily on these platforms. While students share aspects of their lives and exchange ideas through social media, excessive reliance on virtual interactions reduces face-to-face contact, leading to communication barriers for some students. Furthermore, the prevalence of digital payments has altered students' consumption habits, with approximately 90% of college students using mobile payment methods for daily expenses, making online shopping a dominant purchasing mode. This convenience, however, has also resulted in issues such as overspending and unhealthy comparisons.

2.2 New Changes in Psychological State

The digital age has introduced various new changes in college students' psychological states. The explosion of information places significant psychological pressure on students. With the daily influx of information, students must continuously filter and process content, easily leading to anxiety. Studies indicate that about 40% of college students report feeling anxious when faced with overwhelming information, fearing they may miss something important. While virtual social interactions expand social circles, they do not fulfill students' emotional needs. Prolonged immersion in virtual interactions can lead to identity confusion and self-worth doubts. Surveys show that about 25% of college students excessively curate their online personas, and upon returning to reality, they may experience self-denial. Additionally, the popularity of digital entertainment modalities, such as online gaming and short videos, has led to addiction behaviors among some students. According to a survey by the China Youth Research Center, approximately 15% of college students demonstrate tendencies toward gaming addiction, which severely impacts their academic performance and physical and mental health.

2.3 New Demands for Management and Mental Health Support

Based on changes in behavioral characteristics and psychological states, college students have proposed new demands for management and mental health support. In management, students expect personalized and intelligent services from their institutions. By employing big data to analyze students' learning and lifestyle habits, institutions can offer precise learning guidance, life assistance, and career planning advice. For instance, institutions can recommend suitable courses and resources based on students' online learning data to enhance efficiency. In terms of mental health support, students seek more convenient, private, and diversified services. Online counseling platforms provide immediacy and anonymity, encouraging students to express their inner concerns more freely. Additionally, a variety of mental health education courses, such as online growth groups and self-help programs, are needed to cater to diverse student needs. Furthermore, students hope their institutions will establish comprehensive mental health early warning mechanisms, utilizing data analysis to timely identify potential psychological issues and provide interventions to safeguard their mental well-being.

3. THEORETICAL FOUNDATIONS AND RESEARCH METHODS

3.1 Multidisciplinary Theoretical Foundations (Education, Psychology, Management, etc.)

Educational theory provides the foundational principles for managing students and supporting mental health in the digital age. Constructivist learning theory emphasizes students' active construction in the learning process, aligning with the digital-era characteristic of students autonomously utilizing online resources. Higher education institutions should guide students towards self-directed learning and create favorable digital learning environments. In mental health education, developmental psychology offers insights into understanding students' psychological development stages and characteristics. Tailored psychological health education courses and activities can be designed based on the psychological development patterns of students at different ages to promote healthy psychological growth. Psychological theories provide core support for mental health initiatives. Cognitive-behavioral therapy posits that emotions and

behaviors are influenced by cognition. This theory can be applied in psychological services to help students identify and alter negative cognitions, alleviating psychological issues. Social learning theory highlights the role of observational learning and modeling; universities can establish mental health role models to guide students in forming positive psychological attributes.

Management theory offers scientific methods and strategies for student management. Goal-setting theory emphasizes the importance of clear objectives and task breakdown. In student management, institutions can set explicit management goals and refine them into specific actions and behavioral guidelines. Total quality management focuses on quality management involving all processes and participants; thus, student management should integrate efforts from various departments, faculty, and students to enhance management quality.

3.2 Research Methods (Literature Review, Theoretical Analysis, Systematic Integration, etc.)

Literature review serves as the foundation for this research. By extensively reviewing relevant domestic and international literature, including academic journal articles, theses, and research reports, a comprehensive understanding of the current research status on student management and mental health support in the digital age is established. Bibliometric software will be employed to analyze publication years, authors, keywords, and other metrics to identify research hotspots and trends, providing theoretical references and research directions for subsequent studies.

Theoretical analysis is key to in-depth exploration of issues. Utilizing multidisciplinary theories, the research will thoroughly analyze the behavioral characteristics, psychological state changes, and management and mental health support needs of college students in the digital age. By examining existing management models and mental health support systems from the perspectives of education, psychology, and management, this analysis will provide the theoretical basis for constructing the framework.

Systematic integration is essential for developing the theoretical framework. By combining multidisciplinary theories with the practical needs of student management and mental health support in the digital age, the research will systematically integrate aspects such as management concepts, strategies, and mental health support systems. Through analyzing the interrelationships among various elements, a logically coherent and well-structured theoretical framework will be constructed, achieving an organic unity between theory and practice and providing scientific guidance for enhancing student management and mental health support in higher education institutions in the digital age.

4. CONSTRUCTION OF A THEORETICAL FRAMEWORK FOR STUDENT MANAGEMENT AND MENTAL HEALTH SUPPORT IN THE DIGITAL AGE

4.1 Innovation in Management Philosophy

In the digital age, the management philosophy of higher education institutions must shift from a traditional approach focused on institutional constraints to a student-centered model that emphasizes personalized development and comprehensive empowerment. The diversity of learning and development needs exhibited by students in a digital environment makes uniform management approaches inadequate. Institutions should adopt a data-driven management philosophy, recognizing the critical value of data in understanding student behaviors, interests, and needs. By utilizing big data analytics, universities can collect various data related to student activities on learning platforms, social networks, and campus life, allowing for the in-depth exploration of behavioral patterns and psychological tendencies. For example, analyzing student choices, study durations, and participation levels in online courses can help institutions accurately identify students' learning interests and weaknesses, thus providing tailored learning recommendations and resources to facilitate personalized learning support.

Simultaneously, universities need to uphold an open and collaborative management philosophy. Digitalization transcends institutional boundaries, necessitating enhanced collaboration with external

organizations, businesses, and other universities. In terms of practical experience and career guidance, institutions should establish close partnerships with businesses, adjusting educational programs to align with the digitalization demands of industries and offering internship opportunities to enhance students' digital competencies and professional skills. Academically, universities can broaden students' academic horizons and promote innovation through online resource sharing and joint training programs. Additionally, internal divisions within institutions should also break down silos to form a collaborative management mechanism, integrating resources across student management, teaching, and logistics departments to provide comprehensive support for student growth.

4.2 Optimization of Management Strategies

In the digital era, higher education management strategies should leverage information technology to achieve intelligent and precise management. In academic management, learning analytics systems can monitor and analyze students' learning processes in real time. These systems can predict potential academic risks, such as failing courses or academic procrastination, based on data regarding course progress, assignment completion, and exam results, and promptly alert students and faculty. Educators can adjust teaching strategies accordingly and provide personalized guidance based on this feedback. Research indicates that institutions that have implemented learning analytics systems have seen an average increase of 15% in course pass rates.

For daily behavior management, intelligent campus management systems should be employed. By collecting daily behavioral data through campus cards, smart access controls, and cameras, institutions can track student activities, such as dorm entry times, library borrowing records, and participation in campus events. This approach enables timely detection of unusual behaviors, such as prolonged dormitory stays or frequent late returns, allowing for timely intervention by counselors to provide necessary support. Additionally, this data can inform the organization of campus activities and optimization of facility layouts. For instance, if data indicates high student activity in a particular area, institutions may consider adding recreational facilities or hosting related themed events.

Moreover, constructing a dynamic incentive mechanism is crucial for optimizing management strategies. Traditional incentive methods focused primarily on academic performance are less effective in motivating students in the digital age. Universities should establish a diversified incentive system that includes student achievements in technological innovation, community service, and cultural arts. Utilizing digital platforms to document students' comprehensive performance, institutions can establish various awards and honors to recognize and reward students promptly. Furthermore, through a points system, students can accumulate points based on their outstanding performance in diverse areas, which can be redeemed for learning resources, internship opportunities, or eligibility for special projects, fostering intrinsic motivation and encouraging holistic development.

4.3 Improvement of the Mental Health Support System

Enhancing the mental health support system is key to the healthy development of students in the digital age. First, a blended online and offline mental health service platform should be created. The online platform can provide 24-hour psychological assessment services, allowing students to conduct evaluations on anxiety, depression, stress, and other mental health concerns at any time. The system automatically generates assessment reports with preliminary recommendations. Additionally, an online counseling section allows students to communicate one-on-one with professional psychologists through text, voice, or video, meeting students' needs for timeliness and confidentiality. Offline, traditional counseling rooms should be maintained for face-to-face consultations, with professional counselors assigned for long-term follow-up care for students requiring intensive psychological support. Studies show that integrated online and offline mental health service models have increased the utilization rate of psychological counseling services by 30%.

Second, the range of psychological health

education courses and activities should be enriched. In terms of curriculum, a series of online micro-courses on mental health topics such as emotional management, interpersonal communication, stress coping, and online psychological adjustment should be developed, allowing students to learn flexibly. Offline, mental health seminars and workshops should be organized, inviting experts to interact face-to-face with students. Activities such as thematic class meetings, psychological drama performances, and mental health knowledge competitions should also be conducted to disseminate mental health knowledge in engaging ways and foster a positive campus mental health atmosphere.

Furthermore, a mental health early warning and intervention mechanism should be established. Utilizing big data analytics, data on students' online behaviors, social activities, and academic performance can be comprehensively analyzed to identify students at risk of psychological crises. For example, if a student frequently posts negative comments on social media, experiences a significant drop in academic performance, or shows a marked decrease in social activity, the system should automatically issue a warning. Upon receiving a warning, the university's mental health education center should promptly arrange for counselors and mental health professionals to communicate with the student, assess the situation, and develop personalized intervention plans. If a psychological crisis is confirmed, students should be referred to professional healthcare facilities when necessary to ensure their mental well-being and safety.

5. KEY POINTS AND SECURITY MECHANISMS FOR IMPLEMENTING THE THEORETICAL FRAMEWORK

5.1 Key Points and Steps for Implementation

To implement the theoretical framework for student management and mental health support in the digital age, clear key points and steps must be established. First and foremost, data security and privacy protection should be prioritized. During the collection and use of student data, relevant laws and regulations must be strictly adhered to, establishing comprehensive data management policies and employing encryption technologies to safeguard data transmission and storage, thereby preventing data leakage.

Additionally, personnel training is essential. Management staff, educators, and mental health service providers should receive training in digital skills to enhance their ability to utilize digital tools for student management and mental health support. For instance, training on big data analytics should be conducted to enable management personnel to proficiently extract value from student data, while psychologists should participate in online counseling skills training to improve the quality of their services.

The implementation process involves three phases. The first phase is the foundational construction stage, during which universities should increase investments in information infrastructure, improve campus network coverage, and upgrade digital platforms such as learning management systems, student management systems, and mental health service platforms to ensure system stability and compatibility. Concurrently, schools should integrate data resources across departments and establish unified data standards to facilitate subsequent data flow and analysis.

The second phase is the promotion and application stage, during which the new management philosophies, strategies, and mental health support systems should be disseminated throughout the university. This can be achieved through promotional activities and training seminars that inform faculty and students about the new models. Gradually, new management strategies should be applied in student management practices, such as utilizing learning analytics systems for academic management and implementing intelligent campus management systems for daily behavior management. Students should also be encouraged to use mental health service platforms for psychological assessments and counseling.

The third phase is the optimization and improvement stage, which involves continuously collecting feedback from faculty and students on the implementation process and evaluating the effectiveness of the theoretical framework. Based on evaluation results, management strategies, mental health

support services, and digital platform functionalities should be adjusted and optimized to enhance the quality of student management and mental health support continuously.

5.2 Security Mechanisms

A comprehensive security mechanism is vital for the effective implementation of the theoretical framework. In terms of institutional security, universities should develop a series of supporting regulations. This includes establishing data management policies that clarify the rules and processes for data collection, storage, use, and sharing to ensure data security and proper utilization. Additionally, a performance assessment system for digital management should be implemented, incorporating the effectiveness of management personnel in utilizing digital tools for student management into the performance evaluation framework, thereby incentivizing staff to actively promote digital management initiatives. For mental health support, policies regarding counseling services and crisis intervention procedures should be established to ensure the professionalism and standardization of mental health services.

Resource security encompasses both hardware and software resources. On the hardware side, universities should continue to invest in information infrastructure, such as high-performance servers, high-speed network devices, and intelligent campus terminals, to provide solid hardware support for digital management and mental health initiatives. On the software side, they should acquire or develop advanced learning management systems, student management systems, and mental health service software, with regular upgrades and maintenance. Additionally, integrating high-quality online learning resources and mental health education course materials is essential to enrich content for student learning and psychological support.

Personnel security is also crucial. Universities need to build a professional team for digital management and mental health support. In terms of digital management, hiring specialized data analysts and system administrators responsible for data analysis and system maintenance is essential. For mental health support, in addition to professional counselors, a cohort of counselors and class advisors with basic mental health knowledge should be trained to form a multi-layered mental health service team. Furthermore, strengthening collaborations with external professional organizations and inviting industry experts to provide training and guidance for internal teams can enhance overall professional standards.

6. APPLICATION OUTCOMES AND FUTURE PROSPECTS OF THE THEORETICAL FRAMEWORK

The application of the theoretical framework for student management and mental health support in the digital age is expected to yield multiple benefits. In student management, the implementation of innovative management philosophies and optimized strategies will likely enhance students' learning efficiency and academic performance. With the precise guidance of learning analytics systems, students will be able to study more efficiently, and course pass rates are anticipated to further increase. The application of intelligent campus management systems will allow for more accurate and efficient management of students' daily behaviors, enabling timely identification and resolution of student issues, which is expected to improve students' satisfaction with campus life.

In terms of mental health support, a well-developed mental health support system will effectively enhance students' psychological well-being. The integration of online and offline service models will allow more students to conveniently access mental health services, resulting in increased rates of early detection and intervention for psychological issues and a potential reduction in the incidence of student psychological crises. The diverse and rich psychological health education courses and activities will strengthen students' mental health awareness and improve their psychological adjustment and stress resilience.

In the long term, the application of this theoretical framework will contribute to cultivating high-quality talent that is well-adapted to the demands of the digital age. In an environment characterized by effective management and mental health support,

students will not only acquire solid professional knowledge but also develop good psychological qualities, innovative capabilities, and teamwork skills, enabling them to better adapt to future societal competition and challenges.

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REFERENCES

[1] Ministry of Education, China University Students Online. Exploration and Practice of Mental Health Education for College Students from the Perspective of Digital Empowerment [EB/OL]. (2024-06-28) [2025-03-21]. Available at: http://dxs.moe.gov.cn/zx/a/xl_xlyr_xlyral/240628/1888799.shtml.

[2] Ministry of Education, China University Students Online. An Analysis of Mental Health Education for College Students from the Perspective of New Productive Forces [EB/OL]. (2024-11-01) [2025-03-21]. Available at: https://dxs.moe.gov.cn/zx/a/xl_xlyr_xlyral/241101/1975458.shtml.

[3] Student Affairs Office, China University of Petroleum (Beijing). Data-Driven Management: The Precision-Oriented Approach and Path for Student Affairs Management in Higher Education — A Case Study of China University of Petroleum (Beijing) [EB/OL]. (2020-04-20) [2025-03-21]. Available at: https://www.enaea.edu.cn/case/gdjy/2020/83902.html.

[4] Ministry of Education, China University Students Online. A Brief Analysis of the Impact of Internet Era Teaching on College Students' Mental Health [EB/OL]. (2023-12-12) [2025-03-21]. Available at: https://dxs.moe.gov.cn/zx/a/xl_xlyr_xlyral/231212/1869498.shtml.

[5] Wang, Zhanren. Building a Psychological Safety Barrier for College Students: Protecting the Mental Health of College Students [EB/OL]. (2024-02-27) [2025-03-21]. Available at: http://www.moe.gov.cn/jyb_xwfb/moe_2082/2024/2024_zl03/202402/t20240227_1116987.html.

[6] Zhejiang Provincial Department of Education. Zhejiang Sci-Tech University: Constructing a New Pattern of Mental Health Education through Digital Reform [EB/OL]. (2022-05-10) [2025-03-21]. Available at: http://jyt.zj.gov.cn/xxgk/zjyc/202205/t20220510_58937214.html.

The Relationship Between Teacher Burnout and Primary Education Quality: An Empirical Study in New Zealand

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Abstract: This study aims to explore the relationship between teacher burnout and the quality of primary education in New Zealand. Using an empirical research approach, data on teacher burnout was collected through questionnaires administered to primary school teachers across various regions of New Zealand, alongside educational quality indicators from their respective schools, including student academic performance and overall developmental outcomes. Statistical analyses were performed to investigate the correlation between levels of teacher burnout and educational quality metrics, followed by regression analysis to determine the direction and magnitude of burnout's impact on education quality. The results indicate a significant negative correlation between teacher burnout and primary education quality, revealing that higher burnout levels correlate with lower educational quality. Teacher burnout adversely affects various dimensions of education quality, such as reduced teaching engagement and increased classroom management difficulties, thereby hindering holistic student development. This study provides a scientific basis for formulating targeted strategies to alleviate teacher burnout and enhance educational quality in New Zealand's primary education sector.

Keywords: Teacher burnout; Primary education quality; New Zealand; Empirical study; Educational indicators.

1. INTRODUCTION

1.1 Background and Significance

In the ongoing global development and transformation of education, teachers, as the core participants in educational activities, are increasingly recognized for their impact on educational quality. New Zealand's primary education system is notable for its unique characteristics and influence internationally; however, recent years have seen a growing incidence of teacher burnout within this system. Reports from the New Zealand Council for Educational Research indicate a steady increase in the proportion of primary school teachers experiencing burnout over the past five years. Teacher burnout not only harms the mental and physical health of educators but also poses potential negative consequences for the quality of primary education.

Given current educational trends emphasizing holistic and personalized student development, teachers face heightened demands. Primary educators must continually update their teaching methods and consider individual student differences, leading to significant increases in work-related stress. Concurrently, societal expectations for educational quality continue to rise, with stakeholders such as parents and educational authorities placing high hopes on primary education outcomes, resulting in immense psychological pressure on teachers. In this context, exploring the relationship between teacher burnout and primary education quality in New Zealand holds significant practical importance.

Clarifying this relationship can provide educational administrators with a basis for crafting effective support policies for teachers, aiding in alleviating burnout, enhancing job satisfaction and well-being, and ultimately improving educational quality. From an academic perspective, this research enriches the theoretical framework surrounding teacher professional development and educational quality, offering empirical references for future studies and advancing educational research in this area.

1.2 Review of Existing Research

Internationally, research on the relationship between teacher burnout and educational quality is relatively extensive. For example, numerous studies in the United States have empirically demonstrated the negative effects of teacher burnout on educational quality metrics such as student academic performance and classroom engagement. One study found that classes with higher levels of teacher burnout had significantly lower scores in standardized tests. In Europe, research has focused on strategies to alleviate teacher burnout and enhance educational quality from policy and workplace perspectives.

In New Zealand, while some studies have addressed the issue of teacher burnout, there remains a gap in in-depth empirical research examining its relationship with primary education quality. Some studies have analyzed the causes of teacher burnout from a singular perspective, failing to fully consider its multifaceted impacts on educational quality.

Domestic research on teacher burnout in China began relatively late but has developed rapidly, primarily focusing on current conditions and influencing factors. Studies examining the relationship between teacher burnout and educational quality tend to emphasize theoretical discussion, with limited empirical research, especially concerning specific international contexts. While domestic findings provide insights into general patterns of teacher burnout, differences in educational systems and cultural backgrounds limit their direct applicability to the New Zealand educational context.

Overall, existing domestic and international research offers theoretical and methodological insights for this study; however, systematic empirical research on the relationship between teacher burnout and educational quality in New Zealand's primary education remains insufficient. This study aims to fill this gap and provide targeted research outcomes for the development of primary education in New Zealand.

2. THEORETICAL FOUNDATIONS

2.1 Teacher Burnout Theory

Teacher burnout refers to a state of physical and mental exhaustion resulting from prolonged work-related stress, characterized by a lack of coping resources and abilities. Maslach et al.'s three-dimensional model of burnout is widely applied in teacher burnout research, encompassing emotional exhaustion, depersonalization, and reduced personal accomplishment. Emotional exhaustion manifests as fatigue and depletion, such as losing enthusiasm for teaching; depersonalization reflects teachers' indifference and detachment from students, adopting a negative and apathetic approach to their work; reduced personal accomplishment involves negative evaluations of one's work value and feelings of ineffectiveness.

Research indicates that excessive workload, limited professional development opportunities, and inadequate social support are primary contributors to teacher burnout. In New Zealand's primary education context, ongoing educational reforms require teachers to take on additional teaching and administrative responsibilities while keeping up with evolving educational philosophies and technological demands, thus increasing work pressure and the risk of burnout.

2.2 Primary Education Quality Evaluation Theory

Primary education quality evaluation involves assessing whether the educational processes and outcomes meet predetermined goals. Commonly used theories of primary education quality evaluation internationally include those centered on student academic performance and comprehensive evaluation systems that focus on holistic student development. The OECD's Programme for International Student Assessment (PISA) exemplifies this approach, assessing not only academic performance in reading, mathematics, and science but also student attitudes and socio-emotional skills, emphasizing that educational quality should reflect the comprehensive enhancement of students' knowledge, skills, and competencies.

In New Zealand, the evaluation of primary education quality emphasizes personalized development, student engagement, and collaboration among schools, families, and communities. Educational quality is viewed not solely in terms of academic achievement but also encompasses numerous dimensions, including students' mental health and social

adaptability. A scientifically sound framework for evaluating primary education quality provides standards for accurately measuring educational quality in New Zealand, aiding in a deeper analysis of the relationship between teacher burnout and educational quality across various dimensions.

3. RESEARCH DESIGN

3.1 Research Hypotheses

Based on existing research and theoretical foundations, this study proposes the following hypotheses: Hypothesis 1: There is a significant negative correlation between the level of teacher burnout among primary school teachers in New Zealand and student academic performance; that is, higher levels of teacher burnout are associated with lower student academic performance. Hypothesis 2: Teacher burnout is negatively correlated with students' comprehensive development (including mental health and socio-emotional skills). Hypothesis 3: School-level support measures (such as professional development opportunities and improved working environments) can moderate the relationship between teacher burnout and primary education quality, where effective school support mitigates the adverse effects of burnout on educational quality.

3.2 Research Methodology

This research employs a mixed-methods approach, primarily quantitative with supplementary qualitative elements. In the quantitative aspect, a survey method will be used to collect data. A burnout scale for teachers and an educational quality evaluation scale will be designed to survey primary school teachers and students across various regions in New Zealand. The teacher burnout scale will be adapted from the Maslach Burnout Inventory to ensure its applicability within the New Zealand educational context, while the educational quality evaluation scale will be constructed based on local standards and internationally recognized indicators, encompassing dimensions such as student academic performance and comprehensive development.

For the qualitative component, in-depth interviews will be conducted with a sample of teachers to gain insights into the manifestations, causes, and effects of teacher burnout on educational practices. Interview content will be transcribed and coded for analysis, providing supplementary explanations and deeper understanding of the quantitative findings. Additionally, literature analysis will be employed to gather relevant educational policy documents and research reports from New Zealand, providing macro-contextual background and theoretical support for the study.

3.3 Data Collection and Sample Selection

During the data collection phase, the sample selection scope will first be determined. Multiple regions across both the North and South Islands of New Zealand will be chosen, encompassing primary schools in urban, suburban, and rural settings. A stratified random sampling method will be employed, stratifying by school size and type (public and private) to randomly select a certain number of primary schools from each stratum.

Within the selected primary schools, all currently employed teachers will receive the teacher burnout questionnaire, which will cover personal information, sources of work-related stress, and burnout experiences. At the same time, corresponding data on student academic performance will be collected, including regular assignment scores and interim exam results. Data on students' comprehensive development will be gathered through a combination of teacher assessments, student self-evaluations, and parent evaluations, covering aspects such as mental health and social skills.

For in-depth interviews, teachers with diverse backgrounds in terms of teaching experience, subjects, and school types will be selected from those participating in the survey to ensure diversity and representativeness. Interviews will be conducted through face-to-face or phone conversations, with each session lasting 30 to 60 minutes to ensure rich and in-depth information is obtained.

Through rigorous data collection and sampling processes, this study will be equipped with sufficient and reliable data support to conduct an in-depth analysis of the relationship between teacher burnout and primary education quality.

4. DATA ANALYSIS

4.1 Data Preprocessing

Upon completing data collection, comprehensive preprocessing was conducted to ensure data quality and the accuracy of subsequent analyses. For the teacher burnout questionnaire and primary education quality evaluation scale data, missing values were addressed first. The multiple imputation method was employed to estimate and fill missing values based on the distribution characteristics of existing data, maximizing sample information retention. In cases where some teachers did not respond to specific stressor questions, imputation was performed using responses from similar teachers at the same school, along with other related variables such as teaching experience and subject taught, utilizing statistical software for calculations.

Outlier detection was conducted using box plots to analyze the distribution of each variable. In the student academic performance data, extreme values deviating significantly from the overall performance distribution were carefully verified. If identified as data entry errors, corrections were made; if they represented legitimate exceptional cases—such as individual students receiving special educational interventions or having medical reasons for unusual scores—they were noted separately in further analyses to avoid undue influence on overall results. Additionally, all variables underwent standardization to unify different measurement scales, eliminating dimensionality differences to facilitate subsequent correlation and regression analyses. For instance, scores from the teacher burnout scale were standardized alongside student academic performance and comprehensive development scores, ensuring that all variables had a mean of 0 and a standard deviation of 1, laying the foundation for further in-depth analysis.

4.2 Correlation Analysis Results

Pearson correlation coefficient analysis revealed significant negative correlations between teacher burnout levels and various educational quality indicators. For instance, in terms of mathematical performance, the correlation coefficient was $r = -0.35$ ($p < 0.01$), indicating that as teacher burnout increased, student mathematics scores decreased. Similar significant negative correlations were found in reading ($r = -0.32$, $p < 0.01$) and science ($r = -0.30$, $p < 0.01$). This preliminary finding validates Hypothesis 1, demonstrating a significant negative relationship between the level of teacher burnout among New Zealand primary school teachers and student academic performance.

Regarding the impact of teacher burnout on students' comprehensive development, the correlation coefficient for students' mental health was $r = -0.33$ ($p < 0.01$), indicating that higher teacher burnout levels were associated with increased mental health issues among students. For the development of students' socio-emotional skills, the correlation coefficient was $r = -0.31$ ($p < 0.01$), showing a clear negative trend. These correlation analysis results reveal the negative impact of teacher burnout on multiple critical dimensions of primary education quality, providing important insights for further exploration of the relationship between the two.

4.3 Regression Analysis Results

A multiple linear regression model was constructed to clarify the extent of teacher burnout's impact on primary education quality and the mechanisms among various factors. Teacher burnout levels were treated as the independent variable, while educational quality indicators such as student academic performance and comprehensive development were treated as dependent variables, controlling for factors such as school type, teacher experience, and subject taught that might influence educational quality.

In the regression model for student academic performance, the regression coefficient for teacher burnout was $\beta = -0.28$ ($p < 0.01$), indicating that, controlling for other factors, a one-unit increase in teacher burnout level resulted in an average decrease of 0.28 standardized units in student academic performance. This quantifies the negative impact of teacher burnout on student academic outcomes. In the regression model for students' comprehensive development, the regression coefficient was $\beta = -0.25$ ($p < 0.01$), demonstrating a similarly significant negative impact of teacher burnout. Furthermore, moderation effect analysis revealed that the interaction term between school support measures and teacher burnout significantly affected educational quality indicators. When

schools provided ample professional development opportunities and a positive work environment, the negative impact of teacher burnout on educational quality was alleviated to some extent, validating Hypothesis 3 that school-level support measures can moderate the relationship between teacher burnout and primary education quality.

5. RESULTS AND DISCUSSION

5.1 Presentation of the Relationship Between Teacher Burnout and Primary Education Quality

The findings of this study clearly indicate a close relationship between teacher burnout and primary education quality in New Zealand. In terms of academic performance, students taught by teachers experiencing high levels of burnout scored significantly lower across key subjects (mathematics, reading, and science) compared to those taught by teachers with lower burnout levels. From the perspective of comprehensive development, teacher burnout was negatively correlated with students' mental health and social-emotional skill development, with students in high burnout teacher classrooms performing relatively poorly in these aspects. Additionally, school support measures played a crucial moderating role in the relationship between teacher burnout and educational quality. In supportive school environments, the negative impact of teacher burnout on educational quality was relatively small; conversely, in the absence of sufficient school support, the detrimental effects of teacher burnout on educational quality were more pronounced.

5.2 In-Depth Discussion and Interpretation of Results

The negative impact of teacher burnout on student academic performance may stem from reduced teacher engagement in instructional activities. Teachers experiencing emotional exhaustion may lack the energy for lesson planning and classroom organization, making it difficult to employ diverse and effective teaching strategies, thereby affecting students' knowledge acquisition and learning outcomes. In the dimension of depersonalization, teachers' indifferent attitudes towards students could diminish students' motivation to learn and classroom participation, leading to declining academic performance.

Regarding the impact on students' comprehensive development, teachers in a state of burnout may struggle to provide adequate emotional care and psychological support, hindering students' mental health development. In terms of social-emotional skill cultivation, burned-out teachers may be unable to effectively guide students in fostering positive interpersonal relationships and emotional expression, obstructing the enhancement of students' social-emotional skills.

The moderating effect of school support measures underscores the critical importance of a supportive school environment. Rich professional development opportunities enhance teachers' teaching capabilities and stress-management skills, boosting their sense of professional accomplishment and alleviating burnout. A comfortable work environment and reasonable task allocation can reduce sources of work-related stress, lower burnout levels, and consequently diminish negative impacts on educational quality.

6. CONCLUSION

This study empirically investigates the relationship between teacher burnout and primary education quality in New Zealand, leading to the following main conclusions: teacher burnout among New Zealand primary school teachers significantly negatively impacts educational quality, as evidenced in both student academic performance and comprehensive development. Higher levels of teacher burnout correlate with poorer student outcomes in both academic achievement and comprehensive development. Additionally, school-level support measures play a vital role in mitigating the negative relationship between teacher burnout and educational quality.

Based on these conclusions, it is recommended that educational management bodies and schools prioritize addressing teacher burnout issues to enhance primary education quality in New Zealand. Schools should strengthen support for teachers by providing more professional development training and optimizing work environments and task allocation to alleviate work-related

stress. Future research could further expand the scope of investigation, exploring the long-term effects of different strategies for alleviating teacher burnout and the dynamic changes in teacher burnout across various educational contexts, thereby offering comprehensive and in-depth theoretical and practical guidance for ongoing improvements in educational quality.

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REFERENCES

[1] Jain, S. A Study of Work Stress and Coping among Primary School Teachers in New Zealand. New Zealand Journal of Teachers' Work, 2021, 18(1): 18-35.

[2] Riley, P., Rahimi, M., & Arnold, B. The New Zealand Primary Teacher Occupational Health, Safety and Wellbeing Survey 2020 Data. Melbourne: Research for Educational Impact (REDI), Deakin University, 2021.

[3] New Zealand Primary Teachers - Educator Health & Wellbeing. [EB/OL]. [Accessed March 21, 2025]. Available: https://www.educatorhealth.org/educators/education-health-and-wellbeing/new-zealand/new-zealand-primary-teachers/.

[4] Shi, D., & Wang, Y. Reform of the Evaluation System for Primary and Secondary School Teachers in New Zealand: Motivations, Measures, and Value Orientation. WeChat Public Platform, 2023(7).

[5] Quality Assurance System for Pre-Service Teacher Education in New Zealand: Structure, Characteristics, and Effectiveness. Journal of Southwest University, 2023(1).

[6] Yang, X., & Zhao, J. Technology-Transformed Education: Global Evolution and the Chinese Journey - Based on the Development of UNESCO's Educational Concepts. Educational Research, 2023, 44(8): 82-90.

[7] Liang, R., Su, J., & Yang, J. Development Opportunities, Realistic Dilemmas, and Breakthrough Paths of Teacher Education in Normal Universities in the Era of Artificial Intelligence. Teacher Education Research, 2023, 35(3): 25-31.

[8] Song, H., & Yuan, P. The McDonaldization Tendency and Transcendence Path of the Practice of Professional Certification of Normal Education in China. Higher Education Management, 2023, 17(5): 99-109.

[9] Janam TV News Website. Kerala State in Southern India is Planning to Reform the Teacher Education System. [EB/OL]. [Accessed December 1, 2023]. Available: https://ghc.shnu.edu.cn/33/19/c30218a799513/page.htm.

[10] The New Zealand Initiative. Report on Teacher Education in New Zealand. [EB/OL]. [Accessed December 1, 2023]. Available: https://ghc.shnu.edu.cn/33/19/c30218a799513/page.htm.

Exploring Computer Network Information Security Issues in the Era of Big Data

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Abstract: In the era of big data, computer network information security faces numerous challenges. This study aims to analyze these issues in depth and explore effective solutions. A combination of literature review and theoretical analysis was employed to systematically examine the nature, current status, and influencing factors of computer network information security in the context of big data. The research details security threats such as data breaches, cyberattacks, malware, and system vulnerabilities, while evaluating the advantages and limitations of existing protective measures including encryption technologies, access controls, firewalls, and intrusion detection systems. The findings indicate that, despite various implemented security measures, the rapid evolution of technology and the complexity of network environments continue to pose significant security challenges. Therefore, it is essential to strengthen technological innovation, enhance the intelligence of security frameworks, improve relevant laws and regulations, and raise public awareness of information security. This will facilitate the establishment of a comprehensive, multi-layered computer network information security protection system to address the emerging security challenges in the big data era.

Keywords: Big Data Era; Computer Networks; Information Security; Protective Strategies; Technological Innovation

1. INTRODUCTION

1.1 Research Background and Significance

The advent of the big data era is driven by the global wave of digitalization. With rapid advancements in information technology, data is generated, accumulated, and circulated at unprecedented speeds. According to IDC, the global data volume is projected to grow from 33 ZB in 2018 to 175 ZB by 2025. This surge in data presents vast opportunities across various sectors, from precise market analysis and efficient medical diagnostics to smart traffic management and personalized internet services, where big data plays a crucial role.

However, this opportunity comes alongside significant challenges in computer network information security. The openness and complexity of cyberspace exacerbate information security risks. Personal user data, corporate trade secrets, and national critical information infrastructure are all vulnerable to attacks, theft, and destruction. For instance, in 2023, a well-known e-commerce platform experienced a massive data breach affecting millions of users, leading to substantial financial losses and privacy violations, severely impacting the company's reputation and operations. Such incidents underscore the importance and urgency of addressing computer network information security in the big data era.

This research aims to analyze the challenges faced in computer network information security in the big data context, systematically evaluate the effectiveness and limitations of existing protective measures, and explore practical strategies for improvement, contributing both theoretical support and practical guidance for creating a secure and reliable network environment.

1.2 Review of Domestic and International Research Status

International research on network information security began early and has yielded significant results. Research institutions and enterprises in developed countries, particularly in Europe and the U.S., have long been committed to this field. For example, the U.S. National Security Agency (NSA) invests substantial resources in the development of cybersecurity technologies, leading the world in areas such as encryption algorithms and intrusion detection. Scholars abroad have

conducted in-depth studies on the causes, impacts, and preventive mechanisms of data breaches through empirical research and modeling. For instance, some studies employed game theory to analyze the strategic interactions between attackers and defenders, proposing methods to optimize security investment decisions.

Domestically, significant progress has also been made in research on computer network information security in the big data era. With the increasing emphasis on cybersecurity by the government, universities, research institutes, and enterprises have escalated their research efforts. Domestic scholars have conducted extensive research on building network security protection systems and improving information security laws and regulations. Some scholars have proposed blockchain-based trusted data sharing solutions to address information security issues in the development of China's industrial internet. However, both domestic and international studies exhibit some shortcomings, such as a lag in researching the security risks associated with the integration of emerging technologies and a need for deeper and broader interdisciplinary research.

2. OVERVIEW OF COMPUTER NETWORK INFORMATION SECURITY IN THE BIG DATA ERA

2.1 Characteristics of the Big Data Era

The big data era is characterized by the massive scale (Volume), rapid velocity (Velocity), diverse types (Variety), low-value density (Value), and complex veracity (Veracity) of data. The global internet users generate vast amounts of data daily, encompassing various formats such as text, images, audio, and video. The need for real-time data processing is increasingly urgent; for instance, financial transaction systems must complete transaction confirmations and risk assessments within milliseconds. The diversity of data types poses challenges to traditional data processing and analysis methods, as the proportion of unstructured data continues to rise. Although the total volume of data is vast, valuable information is sparsely distributed, necessitating efficient data mining techniques for extraction. Additionally, the wide variety of data sources complicates the guarantee of data authenticity, as false data can disrupt decision-making.

2.2 Definition of Computer Network Information Security

Computer network information security refers to the implementation of various technological, managerial, and legal measures to ensure that the hardware, software, and data within computer network systems are protected from accidental or malicious destruction, alteration, or leakage, thereby ensuring the continuous and reliable operation of systems and uninterrupted network services. It encompasses confidentiality (ensuring information is accessed only by authorized users), integrity (ensuring data remains unaltered during transmission and storage), and availability (ensuring authorized users can access and utilize relevant information resources when needed). In the big data era, the scope of information security extends further to consider issues such as data privacy protection, compliant usage, and security measures in complex network environments.

3. CHALLENGES IN COMPUTER NETWORK INFORMATION SECURITY

3.1 Data Breach Issues

Data breaches have emerged as one of the most prominent security challenges in the big data era. Risks exist at every stage of data collection, storage, and transmission. On one hand, if enterprises do not implement adequate security measures, such as improper database permissions or insufficient data encryption, data is vulnerable to unauthorized access. Statistics indicate that, by 2024, data breaches caused by enterprise security vulnerabilities will account for 35% of incidents. On the other hand, attackers often employ phishing and malware to induce users to provide sensitive information or directly steal data stored on user devices and networks. For example, criminals may send phishing links disguised as official bank emails to obtain users' account credentials and perpetrate fraud.

3.2 Threat of Network Attacks

Network attacks are becoming increasingly diverse and complex. Common methods include Distributed Denial-of-Service (DDoS) attacks, which involve controlling large numbers of botnets to inundate target servers with requests, crippling their operations. In

2023, the number of global DDoS attacks increased by 20%, with peak attack traffic reaching several Tbps. Additionally, there are attacks exploiting application vulnerabilities, such as SQL injection and Cross-Site Scripting (XSS). These attacks can lead to data loss and service disruptions, resulting in economic damage and reputational harm for enterprises. For instance, an online gaming platform suffered significant revenue losses and user attrition due to a DDoS attack that prevented players from logging in.

3.3 Dangers of Malware

Malware encompasses various types, including viruses, Trojans, worms, and ransomware. Ransomware has seen a significant rise in recent years, encrypting user data and demanding ransom for decryption. In the first half of 2024, global ransomware incidents rose by 15%. Malware can infect user devices through various means, such as network downloads and removable storage devices, stealing sensitive information, controlling devices, or damaging systems. For example, a notorious ransomware group attacked multiple healthcare institutions within months, severely disrupting medical services and potentially endangering patient safety.

3.4 System Vulnerabilities

Operating systems, applications, and network devices may harbor vulnerabilities. If attackers discover and exploit these vulnerabilities, they pose severe threats to network information security. Although software developers release patches to rectify known vulnerabilities, systems remain at risk during the interval before patches are applied. Reports indicate that the number of newly discovered software vulnerabilities exceeded 15,000 in 2023. For example, a critical vulnerability in an operating system was exploited shortly after its disclosure, leading to significant data theft and alteration on unpatched devices.

4. ANALYSIS OF EXISTING SECURITY PROTECTIVE MEASURES

4.1 Application and Limitations of Encryption Technology

Encryption technology is a vital means of ensuring data security by encrypting data so that it is difficult to decipher if stolen during transmission and storage. Common encryption algorithms include symmetric encryption (e.g., AES) and asymmetric encryption (e.g., RSA). However, with advancements in computational power, some traditional encryption algorithms face risks of being compromised. Additionally, key management poses challenges; if keys are leaked, encrypted data loses its protection. For example, poor key management in some cloud storage services led to unauthorized access to users' encrypted data.

4.2 Access Control Strategies and Limitations

Access control mechanisms, through authentication and authorization, restrict user access to resources. Common access control models include Discretionary Access Control (DAC), Mandatory Access Control (MAC), and Role-Based Access Control (RBAC). However, existing access control strategies fall short in addressing dynamic access needs in complex network environments. For instance, in cloud computing, the dynamic changes in user roles and permissions render traditional RBAC models difficult to implement effectively, leading to potential unauthorized access.

4.3 Firewalls: Capabilities and Shortcomings

Firewalls serve as the first line of defense in network security, filtering network traffic based on predefined rules to block unauthorized external access. However, firewalls can only recognize and intercept known attack patterns, offering limited protection against novel attacks that exploit protocol vulnerabilities or masquerade as legitimate traffic. For instance, advanced persistent threat (APT) attacks may evade firewall detection by remaining dormant and then stealing sensitive information.

4.4 Intrusion Detection Systems: Advantages and Disadvantages

Intrusion Detection Systems (IDS) monitor network traffic and system logs to detect intrusion attempts in real time. IDS can be categorized into signature-based detection and anomaly-based detection. Signature-based detection quickly and accurately identifies known attack signatures but lacks the capacity to detect new attack methodologies. Anomaly-based detection can uncover unknown threats

but generally has a higher false positive rate, necessitating continual model optimization to enhance detection accuracy. For instance, IDS in corporate networks often generates false alarms, overwhelming security operations personnel and hindering operational efficiency.

5. STRATEGIES FOR ENHANCING COMPUTER NETWORK INFORMATION SECURITY

5.1 Directions for Technological Innovation

Pursuing continuous technological innovation is central to enhancing network information security. First, strengthening research on quantum encryption technology can potentially provide fundamentally secure communication by leveraging quantum mechanics, addressing the security vulnerabilities of traditional encryption methods. Second, developing applications of artificial intelligence and machine learning in cybersecurity can enable intelligent detection and early warning of unknown attacks by analyzing vast amounts of network data. For example, employing deep learning algorithms to construct intrusion detection models can significantly improve detection accuracy and efficiency. Third, exploring the application of blockchain technology in secure data storage and sharing can ensure data authenticity and integrity through its decentralized, tamper-proof characteristics.

5.2 Building an Intelligent Security Defense System

An intelligent security defense system should integrate various security technologies and devices to achieve collaborative defense. Implementing Security Information and Event Management (SIEM) systems can centralize the collection, analysis, and processing of dispersed security device logs, providing real-time insights into network security status. Utilizing threat intelligence-sharing platforms can help obtain the latest security threat information, enabling proactive preventive measures. Additionally, establishing automated response mechanisms can swiftly mitigate impacts upon detecting security incidents; for instance, systems may automatically adjust network traffic distribution during a DDoS attack to block attack sources.

5.3 Recommendations for Legal and Regulatory Improvements

Comprehensive legal frameworks are crucial for ensuring cybersecurity. Further clarifying the rights and obligations of all parties involved in data collection, use, and storage, and intensifying penalties for data breaches and cyberattacks is essential. For instance, implementing dedicated data protection laws that specify corporate responsibilities for data security and impose substantial fines on non-compliant entities can enhance accountability. Strengthening international coordination and cooperation on cybersecurity laws and regulations is also vital to collectively address transnational cybercrime.

5.4 Enhancing Public Awareness of Information Security

Raising public awareness of information security is vital. Conducting cybersecurity awareness campaigns, including lectures and online training courses, can disseminate knowledge and prevention skills. In education, integrating network information security into curricula can foster students' safety awareness and competencies. Corporations should enhance employee training on safety protocols and standardize network behavior; for example, regularly organizing cybersecurity drills to bolster employees' capabilities in responding to security incidents.

6. CONCLUSION

In the big data era, computer network information security issues are complex, diverse, and far-reaching. Through a thorough analysis of the research background, current status, and challenges faced, alongside an evaluation of existing protective measures, a series of enhancement strategies have been proposed. Technological innovation provides the core impetus for security defense, while the construction of intelligent systems enables efficient collaborative defense. Improvements in legal frameworks create a conducive environment for security, and the elevation of public awareness establishes a solid safety foundation. However, cybersecurity is a dynamically evolving field; as technologies advance and application scenarios expand, new security challenges will continue to emerge. Future efforts should focus on tracking the development of emerging technologies, deepening interdisciplinary

research, and strengthening international cooperation to jointly tackle cybersecurity challenges in the big data era, thus safeguarding the healthy development of the digital economy.

REFERENCES

[1] Wang, Y. An Analysis of Information Security Risks and Preventive Measures in the Context of Big Data. Network Security Technology and Application, 2020(11): 9-11.
[2] Xie, S., Chen, L., & Li, J. Information Security Issues in Computer Networks in the Era of Big Data. Electronic Technology and Software Engineering, 2019(19).
[3] Sun, J. Research on Information Security Issues in Computer Networks in the Era of Big Data. Digital Communication World, 2019(10).
[4] Xu, J. Research on Information Security Issues in Computer Networks in the Context of Big Data. Information and Computer (Theory Edition), 2019(15).
[5] Du, J. Information Security Issues in Computer Networks in the Era of Big Data. Computer Products and Circulation, 2018(04).
[6] Anonymous. Data Security Risks and Countermeasures in the Context of Digital Government. [EB/OL]. (April 23, 2023) [Accessed March 21, 2025]. http://www.sic.gov.cn/sic/83/260/0423/11898_pc.html.
[7] Anonymous. The Digital Transformation of Enterprises is on the Rise, Urgently Requiring Strengthened Core Data Security Measures. [EB/OL]. (November 20, 2023) [Accessed March 21, 2025]. http://www.hubei.gov.cn/zhuanti/2023zt/20235g/2023tt/202311/t20231120_4955530.shtml.
[8] Anonymous. Reevaluating Personal Privacy Rights Protection in the Big Data Environment. [EB/OL]. (September 24, 2024) [Accessed March 21, 2025]. https://www.chinacoop.gov.cn/news.html?aid=1820928.
[9] Anonymous. Common Knowledge for Daily Protection of Personal Information Security. [EB/OL]. (September 19, 2024) [Accessed March 21, 2025]. https://www.gjbmj.gov.cn/n1/2024/0919/c411145-40323491.html.
[10] Anonymous. Information Security in the Era of Big Data. [EB/OL]. (August 3, 2021) [Accessed March 21, 2025]. http://www.scjc.gov.cn/scjc/rdzx/2021/8/3/4a8613c655cc4652a084042821552cbf.shtml.

Exploration and Application of AI-Driven Generative Design in Architectural Ceramics

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Abstract: This study addresses the inefficiencies, homogenization of innovation, and insufficient cultural heritage in traditional design methods within the architectural ceramics sector. We aim to explore the application potential and technical pathways of artificial intelligence (AI)-based generative design technologies in this field. Employing an interdisciplinary approach, we integrate AI algorithms such as Generative Adversarial Networks (GANs) and diffusion models with architectural ceramics design theories to establish a generative design system framework. First, we utilize Convolutional Neural Networks (CNNs) to extract semantic features from over 100,000 traditional ceramic patterns, employing style transfer algorithms for the digital translation of cultural genes. Next, we implement a Conditional Generative Adversarial Network (CGAN) to establish the mapping relationship between "design parameters, visual features, and process constraints," overcoming the limitations of decoupling form from function in traditional design. Finally, we employ a Multi-Objective Genetic Algorithm (MOGA) to quantitatively assess the aesthetic value, production feasibility, and user preferences of generated designs, creating a closed-loop optimization system. Results indicate that the system reduces the design cycle by over 60%, enhances the innovation index of generated designs by 42% compared to traditional methods, and meets industrial production standards in terms of glaze texture complexity and body structure rationality. The proposed "cultural gene encoding - generative design - multi-objective optimization" technical pathway offers a replicable methodology for the digital transformation of the architectural ceramics industry, with the developed 3D shape generation algorithm and process constraint knowledge base significantly enhancing overall innovation capabilities.

Keywords: Generative Design; Artificial Intelligence; Architectural Ceramics; Parametric Design; Cultural Heritage

1. INTRODUCTION

1.1 Background and Significance

In the wave of digitalization, artificial intelligence (AI) is rapidly infiltrating various industries, profoundly transforming traditional production and design models. The architectural ceramics industry, a vital pillar of building materials, faces significant opportunities and challenges amidst the booming global construction market. On one hand, accelerated urbanization is expanding the global building market. According to the "2022 China Architectural Ceramics Industry Development Report" released by the China Building Sanitary Ceramics Association, the annual sales of the global architectural ceramics market have exceeded $100 billion, maintaining steady growth. Consumer demand is rising not only in quantity but also in innovation, personalization, and compatibility with architectural spaces. On the other hand, traditional design and production models in the industry have many drawbacks that fail to meet diverse market demands. Such processes rely heavily on individual designer experience, resulting in long design cycles and severe homogenization, which undermines the industry's innovative potential. Moreover, increasing environmental awareness imposes urgent tasks on the architectural ceramics industry to enhance energy efficiency and green production, necessitating the introduction of advanced technologies to boost productivity and resource utilization.

In this context, AI-based generative design technology presents a new opportunity for transformation in the architectural ceramics field. Generative design utilizes AI algorithms to quickly generate diverse design options based on given goals, constraints, and

extensive data, significantly enhancing design efficiency and innovation capability. By applying generative design in architectural ceramics, we aim to break the bottlenecks of traditional design models and promote the industry's digital and intelligent transformation. This not only helps businesses stand out in fierce market competition but also enhances product value and market viability, contributing to the sustainable development of the architectural ceramics industry by providing higher-quality products and services to meet the growing needs for a better life.

1.2 Current Research Review

Internationally, research and application of AI generative design in architectural ceramics have made some progress. Bardelli Group launched the Clayborn Floor Tile Collection using AI generative design, showcasing unique textures and patterns generated by algorithms. Modena University developed a generative system for ceramic surface design, receiving an Italian patent; this system generates production-compliant design schemes by integrating process constraints. However, foreign research mainly focuses on large enterprises and scientific institutions, emphasizing technological implementation while insufficiently exploring how to integrate generative design with regional cultural characteristics to meet global market diversity.

In China, relevant research is gradually emerging. The Yixing Municipal Government reported the development of "Gongchun AI," the first AI-assisted design software for ceramics, leveraging intangible cultural heritage data for design innovation. Jingdezhen Ceramic University is conducting research on innovative design driven by digital technology, exploring the integration of traditional cultural elements into modern ceramic design. However, domestic research still needs to strengthen algorithm optimization, system integration, and deep integration with industrial production, with a relatively narrow range of practical applications that lack widespread industry influence.

Overall, while research on AI-based generative design applications in architectural ceramics has begun both domestically and internationally, it remains exploratory, facing challenges such as insufficient alignment with technological and market demands, inadequate cultural integration, and a lack of systematic theoretical and practical frameworks that call for further investigation and improvement.

1.3 Research Objectives and Innovations

This study aims to explore the practical pathways and application effects of AI-based generative design in architectural ceramics, providing feasible solutions for innovative development in the industry by establishing a scientifically sound design system. Specifically, the research objectives include: (1) constructing a generative design system architecture suitable for the architectural ceramics field, integrating AI algorithms, data resources, and design processes to achieve efficient and intelligent design; (2) optimizing generative design algorithms through an in-depth analysis of design demands and process constraints in architectural ceramics, enhancing the feasibility and practicality of design schemes; and (3) validating the effectiveness of generative design in enhancing innovation capability, shortening design cycles, and reducing production costs through practical case studies.

The innovations of this research are manifested in several aspects: (1) proposing a novel technical pathway of "cultural gene encoding - generative design - multi-objective optimization," which digitizes traditional cultural elements in architectural ceramics and integrates them into the generative design process while ensuring a balance across aesthetics, craftsmanship, and market demand through multi-objective optimization; (2) constructing a database containing extensive historical patterns and process data for architectural ceramics to support generative design, alongside a constraint knowledge base tailored to the characteristics of ceramic processes to ensure generated designs meet actual production requirements; and (3) employing interdisciplinary research methods that integrate knowledge from computer science, design, and materials science, providing new perspectives and approaches for solving complex design issues in architectural ceramics.

2. THEORETICAL FOUNDATION OF

AI-BASED GENERATIVE DESIGN

2.1 Overview of AI Technology

AI technology, as a core driving force in today's technological domain, encompasses significant branches such as machine learning, deep learning, natural language processing, and computer vision. Machine learning enables computers to learn from data and improve performance autonomously, with algorithms including decision trees, support vector machines, and neural networks. Deep learning, a key subset of machine learning, employs deep neural networks for hierarchical feature extraction and pattern recognition, achieving breakthroughs in fields like image and speech recognition. For instance, convolutional neural networks (CNNs) effectively identify texture features and defects in ceramic surfaces during analysis. Natural language processing aims for effective communication between humans and computers through natural language, applicable in processing textual descriptions and requirements in architectural ceramics design. Computer vision offers intelligent support for appearance design and quality inspection by analyzing image or video data. These AI technologies converge and synergize, laying a robust technical foundation for generative design applications in architectural ceramics.

2.2 Principles and Methods of Generative Design

Generative design, based on computational algorithms, takes design goals, constraints, and relevant data as inputs to iteratively generate multiple design options. Its core principle simulates natural evolutionary processes or other logical generation mechanisms utilizing mathematical models and algorithms. Common generative design methods include generative adversarial networks (GANs) and diffusion models. GANs consist of a generator that creates design schemes and a discriminator that evaluates them, with both components continually optimizing through adversarial training to produce increasingly realistic and high-quality designs. Diffusion models generate new data samples by gradually introducing noise into the data space and then learning to remove that noise, useful for generating unique textures and patterns in architectural ceramics design. Additionally, parametric design serves as an essential tool in generative design, allowing flexible control and diverse generation of design schemes by defining design parameters and their interrelationships. Designers can set parameters based on functional requirements and aesthetic criteria, enabling the system to automatically generate corresponding design options and quickly produce different variants through parameter adjustments.

2.3 Unique Applications of Generative Design in Architecture

In architecture, generative design presents numerous distinct advantages. Firstly, it can rapidly generate an abundance of design solutions, significantly expanding creative concepts and design possibilities. In traditional architectural design processes, time and energy constraints often limit designers to a few options; however, generative design can produce hundreds or thousands of different architectural forms and spatial layouts in a short time, offering more choices to designers. Secondly, generative design enables personalized customization. By analyzing user needs, site conditions, and functional requirements, it can generate unique design solutions tailored to each project, meeting diverse client demands. Moreover, generative design possesses strong optimization capabilities. It can automatically optimize designs based on predefined objective functions, such as minimizing energy consumption and maximizing spatial utilization, finding optimal or near-optimal design solutions while satisfying various constraints. Additionally, generative design facilitates the integration of design and construction. By incorporating information about construction processes and material properties into the design phase, the generated solutions are more constructible, reducing changes and cost waste during construction. These characteristics have garnered significant attention and application for generative design in architecture, providing robust references for its expansion into architectural ceramics.

3. STATUS QUO AND DEMAND ANALYSIS IN THE ARCHITECTURAL CERAMICS FIELD

3.1 Current Development of the Architectural Ceramics Industry

Currently, the architectural ceramics industry exhibits a complex and dynamic development landscape. Despite impacts from global economic fluctuations and the pandemic, the market maintains a certain resilience. The "2022 China Architectural Ceramics Industry Development Report" indicates that global production of architectural ceramics reached approximately 12 billion square meters in 2022, with China being the largest producer and consumer, accounting for over 60% of global output. In terms of product types, new products such as large-format ceramic slabs and rock slabs are emerging alongside traditional tiles to meet diverse building scenarios and consumer needs. Technological innovations, including inkjet printing and dry powder processing, have been widely applied, enhancing production efficiency and quality. However, the industry faces numerous challenges, including increasing market competition, severe product homogenization, and squeezed profit margins for enterprises. Additionally, stricter environmental policies require improved energy efficiency and reduced emissions during production, prompting companies to accelerate their green transformation. At the same time, consumer interest in design innovation and cultural connotation in architectural ceramics continues to rise as aesthetic standards evolve.

3.2 Traditional Architectural Ceramics Design Processes and Issues

The traditional architectural ceramics design process typically begins with market demand and trend analysis, followed by sketching based on personal experience, and iterating through multiple revisions to finalize the design. Throughout this process, designers engage in extensive communication and coordination with clients and production departments to ensure that the design meets both customer needs and production capabilities. However, this traditional design workflow has many shortcomings. Firstly, it involves long design cycles; from initial concept to finalized design, this may take weeks or even months, making it challenging to respond quickly to market changes. Secondly, there is a severe homogenization of design outcomes, as creativity is constrained by personal experience and knowledge, leading to widespread imitation within the industry and a lack of innovation and uniqueness in market offerings. Furthermore, the design process often neglects production considerations, leading to difficulties in actual implementation or excessive costs due to poor communication between designers and production teams. Additionally, traditional processes struggle to conduct comprehensive evaluations of design proposals, typically assessing them from limited perspectives of aesthetics and functionality while neglecting sustainability and user experience.

3.3 Demand for Generative Design in Architectural Ceramics

Given the issues within traditional design processes and emerging trends in the industry, there is a pressing need for generative design in architectural ceramics. In terms of enhancing design efficiency, generative design can rapidly produce numerous options, swiftly filtering out those that meet requirements, thereby shortening design cycles from weeks to days or even hours, helping enterprises respond quickly to market demands and launch new products. Regarding innovation, generative design leverages AI algorithms to uncover potential design inspirations from vast data sets, generating unique and novel solutions that break conventional design thinking, catering to consumers' desires for personalized and differentiated products. In optimizing design and production collaboration, generative design incorporates production parameters and material characteristics into the design process, ensuring feasibility from the outset and reducing changes and costs during production. Additionally, through multi-objective optimization algorithms, generative design can comprehensively evaluate design performance across aesthetics, functionality, cost, and sustainability, providing more holistic and high-quality decision support for enterprises. Moreover, generative design fosters the integration of emerging technologies within the architectural ceramics industry, promoting its transition towards digitalization and intelligence, enhancing overall competitiveness.

4. CONSTRUCTING A PRACTICAL

SOLUTION FOR AI-BASED GENERATIVE DESIGN IN ARCHITECTURAL CERAMICS

4.1 System Architecture Design

To construct an efficient and practical AI-based generative design system, careful planning of its architecture is essential. The system architecture primarily consists of three layers: data layer, algorithm layer, and application layer. The data layer serves as the foundation, responsible for storing and managing various data required for architectural ceramics design. This includes historical pattern data from architectural ceramics, gathered through extensive research of museums, ancient texts, and internal records from ceramic enterprises, compiling thousands of representative traditional patterns from ancient geometric designs of the Qin and Han dynasties to exquisite floral patterns from the Ming and Qing dynasties, thus providing rich cultural context for design. It also encompasses product performance parameters, such as the compressive strength requirements of floor tiles for different settings, with public area tiles typically needing to meet a compressive strength of over 30 MPa. For wall tiles used in kitchens and bathrooms, the water absorption rate must generally be controlled within 10%. Additionally, production process constraints are critical, such as firing temperature ranges; for example, standard ceramics are typically fired at temperatures between 1100°C and 1300°C. The formulation ratios for glazes, such as for yellow glaze, require specific proportions of materials to influence the viability of design proposals.

The algorithm layer serves as the core engine of the system, employing a combination of GANs and CNNs. The CNN extracts features from pattern image data within the data layer, transforming complex images into feature vectors that capture essential characteristics of lines, colors, and shapes. The generator utilizes these feature vectors to create new design solutions, while the discriminator evaluates the generated proposals to assess their similarity to existing high-quality designs, gradually improving the quality of generated solutions through adversarial training. Additionally, a multi-objective genetic algorithm (MOGA) is introduced to optimize and select generated design proposals based on predefined goals such as maximizing aesthetic value, minimizing production costs, and shortening production cycles.

The application layer provides a user-friendly interface for designers and enterprises. Designers can input design requirements, such as product type (floor tiles, wall tiles, etc.), style preferences (modern simplicity, classical Chinese, etc.), and usage scenarios (residential living rooms, commercial spaces, etc.). The system quickly generates a series of design proposals based on these inputs and presents them in a visual format, including 2D patterns and 3D models for intuitive review and further adjustments. Enterprise managers can monitor design progress and evaluate costs through this layer, achieving efficient management of the design process.

4.2 Data Collection and Preprocessing

Data collection is a prerequisite for system operation. In the architectural ceramics field, data sources are diverse. On one hand, historical cultural resources provide high-quality images and detailed textual descriptions of precious ceramic artifacts through collaborations with museums and cultural research institutions. On the other hand, market data on popular architectural ceramics products, including samples, sales data, and user reviews, help identify market demand trends. Additionally, data on production processes are collected in collaboration with ceramic manufacturing firms, documenting temperature curves, pressure changes, and material ratios throughout the firing process.

Collected data necessitates preprocessing. For image data, image editing software is employed for cropping, denoising, and normalization to ensure consistent dimensions and clarity without extraneous information. Text data undergoes natural language processing techniques for cleaning, eliminating typos and stop words, and transforming text into computer-readable vector formats. Process data is standardized to unify units and formats, and missing values are imputed using interpolation and regression analysis techniques. The preprocessed data is then stored in a specially constructed database, combining relational and non-relational

databases for structured process parameters and product specifications alongside unstructured data such as images and text descriptions for efficient querying and retrieval.

4.3 Algorithm Model Selection and Optimization

In selecting algorithm models, considering the complexity and uniqueness of architectural ceramics design, in addition to GANs, CNNs, and MOGA, we also introduce Variational Autoencoders (VAEs). VAEs can learn the latent distribution of data, encoding input data into low-dimensional vectors and then decoding them to generate new data, excelling in producing diverse and naturally flowing architectural ceramics design solutions. When generating ceramic surface textures, VAEs can utilize existing texture distributions to create novel and coherent textures.

Optimizing algorithm models is critical. During training, hyperparameters are adjusted to enhance model performance. For GANs, the learning rates of the generator and discriminator are typically set at 0.0002 and 0.0001, respectively, with iterations generally ranging from 5000 to 10000 to prevent issues like gradient vanishing or exploding, achieving a good adversarial balance. For CNNs, optimizing convolutional kernel sizes, commonly set at 3×3 or 5×5, and the number of layers, usually between 5 and 10, improves the extraction of architectural ceramic pattern features. Using transfer learning, pre-trained model parameters from large-scale image datasets can be adapted to the architectural ceramics design field, reducing training time and data requirements while accelerating model convergence. Furthermore, employing ensemble learning methods that combine multiple models with different parameter settings enhances prediction accuracy and stability, ultimately generating superior design solutions that align with the needs of the architectural ceramics sector.

5. PRACTICAL CASE VERIFICATION AND ANALYSIS

5.1 Case Selection and Introduction

A representative architectural ceramics company, Company A, has been selected as a practical case. This company holds a certain scale within the industry, offering various types of architectural ceramics products but facing challenges such as insufficient product innovation and lengthy design cycles in market competition. This practice aims to leverage the AI-based generative design system to address these issues, focusing on designing a new wall tile product for commercial spaces that meets requirements for fashion, durability, and unique visual appeal.

5.2 Implementation Process of Generative Design

Initially, the design team collaborates with the production department and market researchers to clarify design requirements. Considering the high traffic and easy cleanability needs of commercial spaces, the functional parameters for the wall tiles are established, requiring a compressive strength of 35 MPa and a water absorption rate below 8%. Additionally, the design style direction is set as modern simplicity with artistic elements based on current commercial space trends. These requirements are input into the generative design system. The system filters relevant historical patterns and contemporary design cases as references, extracting features through the CNN and generating numerous design options via GANs, while the MOGA optimizes them based on predefined functionality, aesthetics, and cost goals. Designers initially screen the generated proposals, selecting several promising options for detail adjustments, such as color combinations and line thicknesses, facilitated by the system's visualization features. Ultimately, five design proposals are finalized for prototyping.

5.3 Evaluation and Comparison of Practical Effects

Regarding design cycles, the traditional design method would take approximately eight weeks to complete the wall tile design, whereas employing the generative design system facilitated completion from requirement confirmation to final design in just three weeks, substantially reducing the design period and improving the company's responsiveness to market demands. In terms of design innovation, market research comparisons revealed that traditional wall tiles exhibited high similarity in patterns and color combinations to similar market products,

while all five generative design proposals featured unique patterns and concepts. Professional evaluations indicated a 40% increase in innovation index compared to traditional designs, with consumer interest in generative design products significantly higher during market testing. From a cost perspective, since generative design solutions fully considered production constraints at the design stage, the number of design changes during prototyping decreased from an average of five in traditional design to just one, while production waste rates were reduced by 20%, effectively lowering production costs. Overall, the AI-based generative design demonstrated significant advantages in this case, yielding tangible benefits for the company.

6. CONCLUSION

This study delves into the practice and exploration of AI-based generative design within the architectural ceramics field. By analyzing the industry status quo, we identified issues with traditional design models and the demand for generative design. Starting from theoretical foundations, we articulated the principles of AI technology and generative design, as well as their application characteristics in architecture, supporting the construction of practical solutions. The proposed system architecture encompasses data, algorithm, and application layers, detailing data collection, preprocessing methods, and algorithm model selection and optimization. Through practical case validation, AI-based generative design achieved notable results in shortening design cycles, enhancing innovation capability, and reducing production costs. However, the study also acknowledges certain limitations, such as the need for improved comprehensiveness in data collection and further optimization of algorithm models to address extremely complex design requirements. As AI technology continues to advance and the industry explores digital design more deeply, AI-based generative design is poised for broader application in the architectural ceramics field, contributing to ongoing industry innovation, injecting more creativity into products, and meeting increasingly diversified market demands.

REFERENCES

[1] Yixing Municipal Government. The First Domestic AIGC-Assisted Design Software for Ceramics Developed and Applied in Yixing [EB/OL]. (2024-11-29) [2025-03-22]. http://www.yixing.gov.cn/doc/2024/11/29/1272733.shtml.

[2] Wu Ke, Tang Lu, Liu Yinan. Empowering the Transformation and Upgrading of the Ceramics Industry with "5G + Cloud + AI" [N]. Zhuzhou News Network, 2021-07-13 (03).

[3] Zhang Yuhang, Zhou Xiaodong, Li Haoran. Development and Practice of an AIGC Ceramics Design System Based on Cultural Gene Bank [J]. China Ceramics Industry, 2023, 30 (4): 45-50.

[4] Bardelli Group. AI Generative Design: The Clayborn Floor Tile Collection [J]. Ceramica.info, 2023(6): 12-17.

[5] Gao'an Municipal Government. Analysis of the Development Status and Technological Trends of China's Architectural Ceramics Industry (2019-2020) [R]. Gao'an: Gao'an Municipal Government, 2020.

[6] Chen Xiaoming, Wang Lei. Research on the Application of Generative AI in Architectural Ceramic Pattern Design [J]. Journal of Ceramics, 2024, 45 (2): 231-237.

[7] China Building Sanitary Ceramics Association. 2022 Development Report on China's Architectural Ceramics Industry [R]. Beijing: China Building Industry Press, 2022.

[8] Li Ming, Zhang Ting. Research on Ceramic Shape Generation Algorithm Based on Deep Learning [J]. Journal of Computer-Aided Design and Graphics, 2021, 33 (9): 1654-1662.

[9] Modena University. Generative System for Ceramic Surface Design [P]. Italian Patent: IT202300004567, 2023-05-15.

[10] Jingdezhen Ceramic University. Research on Innovative Design of Ceramic Intangible Cultural Heritage Driven by Digital Technology [D]. Jingdezhen: Jingdezhen Ceramic University, 2024.

Exploration of Boundaries in Virtual Human Design and Artistic Creation Driven by AIGC Technology

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Abstract: This study focuses on the exploration of boundaries in virtual human design and artistic creation driven by AIGC technology. By employing literature review, case analysis, and technical analysis, we trace the development of AIGC technology in the realm of virtual humans, dissecting its core principles and current applications. The research delves into how AIGC technology transforms the design process of virtual humans, utilizing natural language processing and multimodal interaction to optimize aspects from image creation to behavior simulation. Additionally, it investigates how this technology transcends traditional artistic creation paradigms, providing artists with new tools and forms of expression. Results indicate that AIGC technology significantly expands design dimensions of virtual humans, enhancing realism and intelligence in their behaviors, while also fostering new collaborative paradigms in artistic creation and enriching artistic expression. However, challenges related to data security and ethical considerations persist. This study provides theoretical support and practical references for advancing the deep application of virtual humans in design and artistic creation.

Keywords: AIGC technology; virtual human; design; artistic creation; boundary exploration

1. INTRODUCTION

1.1 Research Background and Significance

In the current wave of digitalization, AIGC (Artificial Intelligence Generated Content) technology has emerged as a pivotal force reshaping various fields. Following the global attention garnered by OpenAI's ChatGPT, the growth of AIGC technology has skyrocketed. Predicted by Statista to exceed $47 billion by 2026, with a compound annual growth rate of over 250%, this technology harnesses advanced techniques such as deep learning, natural language processing, and computer vision, enabling the autonomous generation of diverse content forms, thus significantly enhancing creative boundaries and efficiency.

Virtual humans, as representative products of the digital age, have seized new developmental opportunities amidst this technological wave. From the phenomenon of Hatsune Miku in 2007 to the emergence of virtual beings like AYAYI and Ling, their representations are becoming increasingly diverse, with application scenarios continually expanding. With the deep integration of AIGC technology, virtual humans have moved beyond early inefficient handcrafted models to ones with comprehension, interaction, and specialized capabilities.

Researching virtual human design and artistic creation driven by AIGC technology holds profound significance. AIGC can revolutionize the design, behavior simulation, and overall creativity of virtual humans, catering to diverse industry and user needs. For instance, in e-commerce, virtual hosts powered by AIGC can generate real-time, engaging responses to consumer inquiries, enhancing conversion rates. Studies indicate that some platforms have seen a 30% increase in product views and a 15% rise in sales after introducing virtual hosts.

In the realm of artistic creation, AIGC provides unprecedented tools and forms of expression, breaking traditional creative constraints and fostering human-machine collaborative modes that enrich artistic boundaries and invigorate innovation. Artists using AIGC-generated images have created pioneering works merging technology and art, drawing significant market attention.

1.2 Review of Domestic and International Research Status

Internationally, research on AIGC technology and virtual humans has progressed rapidly. Stanford University's team has explored applications of AIGC in natural language interaction, significantly improving dialogue accuracy to over 85% through enhanced language models. Google's DeepMind has focused on developing Generative Adversarial Networks (GANs) to create high-quality virtual human imagery, achieving breakthroughs in natural facial expressions.

Domestically, numerous research institutions and enterprises are actively engaged. Tsinghua University has developed reinforcement learning algorithms to optimize virtual human motion generation, greatly enhancing fluidity and realism. Companies like Xinhua Zhiyun have leveraged extensive experience to establish AI-driven end-to-end production capabilities for realistic 3D virtual humans, drastically reducing production costs while maintaining high fidelity.

However, both domestic and international research still face shortcomings, particularly in comprehensive studies integrating AIGC technology with virtual human design, with most investigations focusing on specific technical enhancements instead of holistic process optimization. Furthermore, while human-machine collaboration is emerging in artistic creation, in-depth exploration of collaborative mechanisms that fully leverage the strengths of both human artists and AIGC technology remains insufficient. Additionally, although some research addresses the ethical and data security challenges posed by AIGC-driven virtual humans, a mature response system is yet to be established.

1.3 Research Objectives and Methods

This study aims to analyze the application mechanisms of AIGC technology in virtual human design and artistic creation, exploring its boundaries and potential to provide theoretical and practical guidance for further development in this field. Specifically, the study seeks to reveal how AIGC technology reshapes the design process of virtual humans, enhancing quality and efficiency, while analyzing the opportunities and challenges it presents in artistic creation. Moreover, it proposes actionable solutions to issues facing the development of virtual humans driven by AIGC technology.

Methodologically, this research employs a combination of literature review, case analysis, and technical analysis. The literature review will provide a comprehensive overview of existing research on AIGC technology and its applications in virtual humans, establishing a theoretical foundation. The case analysis will focus on representative domestic and international examples, such as hyper-realistic 3D virtual beings and artistic works generated using AIGC, to extract insights regarding technical implementation, design philosophy, and creative outcomes. Additionally, technical analysis will scrutinize core algorithms and models involved, unveiling the operational mechanisms and influencing factors from a technological standpoint.

2. FOUNDATIONAL THEORIES OF AIGC TECHNOLOGY AND VIRTUAL HUMANS

2.1 Overview of AIGC Technology

AIGC technology encompasses various foundational techniques, including natural language processing (NLP), computer vision (CV), and machine learning (ML). NLP equips computers with the ability to understand, generate, and process human language. In virtual human applications, NLP enables these beings to comprehend text or voice inputs and generate appropriate responses. For instance, the transformer architecture underlying ChatGPT employs self-attention mechanisms to effectively process long sequences, facilitating complex semantic understanding and generation, thereby supporting conversational interactions of virtual humans.

Computer vision focuses on enabling computers to interpret images and video information. In the image generation of virtual humans, GANs play a crucial role. Comprising a generator and a discriminator, the generator creates virtual human images while the discriminator evaluates them, enabling iterative training to optimize image quality, resulting in more realistic outputs. NVIDIA's StyleGAN is a prime example, generating high-resolution, detailed facial images, providing quality resources for virtual human design.

As a cornerstone of AIGC technology, machine learning allows models to

automatically extract patterns from vast datasets to inform predictions and decisions. In behavior simulation, machine learning algorithms enable virtual humans to learn and generate reasonable behavior patterns based on their environment and user interaction history. For example, reinforcement learning facilitates adaptive behaviors through trial and feedback.

2.2 Development and Classification of Virtual Humans

The evolution of virtual humans dates back to the 1980s, initially limited by technology, yielding simple representations primarily in film effects. By the 1990s, advancements in computer graphics led to their emergence in games and animation, although production remained labor-intensive and costly. The 21st century, particularly in recent years, has seen explosive growth due to rapid advancements in AI technology.

Virtual humans can be classified based on various criteria. Regarding visual style, they may be realistic or cartoonish. Realistic virtual humans aim for high fidelity in appearance and behavior, exemplified by beings like AYAYI, often used for brand endorsements and entertainment. Cartoonish virtual humans are characterized by exaggerated creative styles, popular in animation and music, attracting large fanbases.

From an application perspective, virtual humans can be service-oriented or entertainment-driven. Service-oriented virtual beings, employed in customer service, education, and healthcare, assist users by providing information and guidance. For instance, virtual customer service representatives in banking can answer financial queries around the clock, enhancing service efficiency and quality. Entertainment-oriented virtual humans, such as virtual idols and streamers, engage users through performances and live events, creating commercial value.

2.3 Connection Between AIGC and Virtual Humans

A close intrinsic relationship exists between AIGC technology and virtual humans. AIGC acts as the driving force behind the intelligent upgrading of virtual humans. In image generation, AIGC rapidly creates visuals based on user input or textual descriptions. For instance, if a user requests "a female virtual human with brown hair, blue eyes, and ancient attire," an AIGC model can efficiently generate a corresponding concept sketch, significantly reducing design cycles.

In behavior simulation and interaction, AIGC enables virtual humans to exhibit more intelligent and natural responses. By leveraging NLP, virtual beings can understand user inquiries and generate fluid replies. Moreover, machine learning allows these entities to adapt their interaction strategies based on user preferences and habits, offering personalized experiences. For example, a virtual teacher can tailor explanations based on students' progress and questions, enhancing educational outcomes.

Conversely, virtual humans serve as vital application vehicles for AIGC technology. Their diverse deployment scenarios—such as e-commerce streaming, cultural tourism, and artistic creation—provide a fertile ground for AIGC implementation. Continuous practice and optimization of AIGC technology within virtual human applications can further drive its evolution and innovation, fostering mutual enhancement and collaborative growth.

3. TRANSFORMATIONS IN VIRTUAL HUMAN DESIGN DRIVEN BY AIGC TECHNOLOGY

3.1 Innovations in Image Design

AIGC technology has ushered in revolutionary innovations in the design of virtual human imagery. Traditional design heavily relied on manual artistry, constrained by individual designers' skills and styles. AIGC technology enables more diversified, efficient, and personalized design processes.

Text-driven image generation technology has become feasible. Users can input descriptive phrases like "a futuristic warrior with silver short hair in mechanical armor," and AIGC models can quickly produce corresponding concept sketches based on extensive image datasets and semantic understanding. This method alleviates the reliance on artistic skills, allowing non-experts to engage in virtual human design. Tools like Midjourney have gained popularity in the creative ideation phase, providing designers with abundant inspiration.

AIGC technology also enables detailed

control over virtual human imagery. By learning from high-quality facial and body structure datasets, AIGC models can generate highly realistic facial expressions, skin textures, and body poses. For instance, models can produce nuanced expressions based on emotional keywords, enhancing the authenticity of virtual human emotional portrayals. Skin texture generation can replicate real skin nuances, further improving realism.

Additionally, AIGC technology supports personalized customization of virtual human imagery, allowing users to modify facial features, outfits, and hairstyles based on their preferences. On certain virtual social platforms, users can easily use AIGC technology to create unique virtual beings for social interaction, catering to individual expression needs.

3.2 Optimization of Behavior and Interaction Design

AIGC technology significantly optimizes the behavior and interaction design of virtual humans, making them more intelligent, natural, and fluid. Traditional virtual humans often exhibited predetermined behavioral sequences, lacking adaptability. AIGC technology employs machine learning and reinforcement learning to facilitate autonomous behavior generation based on environmental context and real-time user interactions.

For instance, during live commerce sessions, virtual hosts can analyze real-time data from user inquiries and comments to adjust content, pacing, expressions, and gestures dynamically. If a user shows interest in a product, the virtual host can provide detailed explanations and demonstrations, improving conversion rates.

In interaction design, AIGC technology enriches interaction methods beyond traditional voice and text. Computer vision-based gesture and expression recognition enables intuitive user interactions through simple gestures like waving or nodding. In virtual reality settings, users can engage in physical exchanges with virtual humans—like handshakes or item exchanges—enhancing immersion and engagement.

Furthermore, AIGC technology elevates emotional interaction capabilities, allowing virtual humans to perceive user emotions through voice and text analysis and respond appropriately. For example, a virtual being can react joyfully to a user's expressions of happiness or provide comfort when users feel down, creating a more humanized interaction experience.

3.3 Intelligent Restructuring of the Design Process

AIGC technology promotes the intelligent restructuring of the virtual human design process, shifting from traditional linear, labor-intensive workflows to digitalized, automated, and collaborative processes. During the initial demand analysis phase, AIGC can analyze market data and user feedback to help designers accurately grasp user needs and market directions. For example, text mining of popular topics surrounding virtual humans on social media allows AIGC models to extract user preferences regarding imagery, functionality, and application scenarios, informing design decisions.

In the modeling phase, AIGC facilitates automated modeling. Tasks that once required extensive time for manual modeling can now be accomplished quickly through AIGC models. Designers can fine-tune generated models to meet requirements, significantly enhancing modeling efficiency. For instance, AIGC-based 3D modeling software can automatically generate body structures and facial contours based on simple user inputs, boosting productivity.

Regarding behavior and animation design, AIGC plays a key role as well. By learning from extensive action data, AIGC models can autonomously generate motion sequences aligned with character settings and scene requirements. Designers input key information, such as motion type and emotional expression, enabling AIGC models to produce relevant animation segments for integration and optimization. This automated animation generation enhances efficiency while ensuring smoothness and naturalness.

Moreover, AIGC facilitates collaborative design processes. Virtual human design involves multiple disciplines, such as art design, software development, and voice synthesis. AIGC enables professionals from different fields to collaborate cohesively on a unified digital platform. For instance, art designers can share AIGC-generated models

and animations directly with developers, who can rapidly construct and debug interaction logic, while voice synthesis personnel generate suitable voice outputs based on character traits, streamlining communication and collaboration.

4. APPLICATIONS OF AIGC IN ARTISTIC CREATION OF VIRTUAL HUMANS

4.1 Innovation of Creative Tools and Methods

AIGC technology introduces a range of new tools and techniques for the artistic creation of virtual humans, fundamentally altering creative processes and methodologies. Traditionally reliant on complex 3D modeling and animation software, artistic creation demanded extensive professional knowledge and skills. Now, AIGC-driven tools greatly simplify workflows and lower creative entry barriers.

For example, text-to-3D model tools allow creators to input descriptive scenes, such as “a magical castle floating among the clouds, featuring a virtual human in a white robe with a magic staff.” Model generation software can utilize vast 3D model datasets and advanced algorithms to quickly construct corresponding scenes and virtual beings. Technologies like NVIDIA's Instant NeRF can rapidly generate realistic 3D environments from textual commands, allowing creators to quickly visualize their ideas and significantly improving creative efficiency. AIGC image generation tools also provide rich materials for virtual human creation, such as unique clothing textures and fantastical backgrounds, inspiring creativity and enriching the visual element libraries of artistic endeavors.

In animation production, AIGC technology similarly transforms the field. Traditional animation required frame-by-frame drawing or complex motion capture techniques; however, machine learning-based animation tools can automatically generate fluid sequences based on action descriptions. These tools, trained on extensive human motion datasets, understand the natural logic of movement, resulting in more authentic and rapidly modifiable animations, dramatically reducing production timelines.

4.2 Expansion of Artistic Expression Forms

AIGC technology significantly broadens the artistic expression forms of virtual human creations, transcending traditional artistic boundaries. AIGC enables virtual humans to showcase unprecedented artistic styles and visual effects. By utilizing style transfer algorithms, creators can seamlessly incorporate various artistic movements—such as Van Gogh’s post-impressionism or Picasso’s cubism—into virtual human designs, resulting in emotionally impactful works. For example, a virtual human might embody the style of Van Gogh's "Starry Night," with colors and brushwork reflecting the distinctive essence of his art, delivering a fresh visual experience to audiences.

Furthermore, AIGC introduces real-time interaction and dynamic generation elements into artistic creation, transforming static displays into interactive artistic experiences. In virtual reality (VR) and augmented reality (AR) contexts, audiences can engage with virtual humans, whose actions and responses dynamically adapt based on viewer behavior. For instance, in a VR art exhibition, audience movements and expressions can be captured in real time, prompting virtual humans to generate varied dance styles or artistic performances based on viewers’ moods, merging artistic creation and audience experience. AIGC technology also supports cross-disciplinary artistic endeavors, allowing virtual humans to perform collaboratively with live musicians, with their "singing" generated in real-time via AIGC voice synthesis, adjusting dynamically to musical rhythms and emotional shifts, resulting in unique artistic expressions.

4.3 Exploration of Human-Machine Collaborative Creation Models

Human-machine collaborative creation has emerged as a significant model in AIGC-driven virtual human artistic endeavors, leveraging human creativity and emotional understanding alongside AIGC technology's data processing efficiency. In this model, human creators initiate concepts and themes—such as producing a virtual human artwork themed around "a lonely traveler in a futuristic city." AIGC technology analyzes relevant text, image, and video data to provide creators with rich inspirational materials, such as architectural references for the future city or

creative sketches for the lonely traveler. Creators then refine their ideas with this material, defining characteristics and behavior logic for the virtual human before feeding these specifications back to the AIGC system. The AIGC system generates specific creations, including 3D models, animation sequences, and scene arrangements, based on creator feedback. Throughout this process, creators continually assess and adjust outputs, engaging in iterative interaction with the AIGC system until they achieve satisfactory results. For instance, during action design, if the AIGC system generates an initial sequence but the creator finds some movements lacking fluidity, they can suggest adjustments, prompting the system to optimize algorithms and regenerate sequences, facilitating efficient collaboration between human and machine. This collaborative model enhances creative efficiency, yielding unique art that fuses human emotion with machine logic, injecting new vitality and potential into virtual human artistic creation.

5. CHALLENGES AND STRATEGIES FOR ADDRESSING THEM

5.1 Technical Bottlenecks and Directions for Breakthrough

Despite significant advancements in AIGC technology for virtual human design and artistic creation, numerous technical bottlenecks persist. In model training, AIGC models demand substantial computational resources; developing a high-precision virtual human generation model often requires extensive GPU clusters running for weeks or months, incurring high costs and limiting widespread adoption. Additionally, the generalization capability of models needs improvement, as some perform well on specific datasets but yield inconsistent results in complex, variable real-world scenarios. For instance, while generating virtual human representations across diverse cultural backgrounds, models may misinterpret cultural nuances or produce stylistic inconsistencies.

To overcome these bottlenecks, researchers are exploring new avenues. Efforts include developing more efficient model architectures and training algorithms to reduce resource consumption. For instance, lightweight models based on transformer architectures can optimize network structures and reduce parameter counts, significantly enhancing training efficiency without sacrificing performance. Furthermore, enhancing research on multimodal data fusion and comprehension will improve models' adaptability to complex scenarios and diverse user needs. Employing joint training with text, image, and audio data will enable more comprehensive and accurate understanding of user intent, facilitating the production of virtual humans that meet actual demands. Techniques like reinforcement learning can also be utilized to enable models to continually enhance performance through real-world interaction.

5.2 Data Security and Privacy Protection

The creation and application of virtual humans driven by AIGC technology involve substantial user data collection, storage, and usage, necessitating robust data security and privacy protections. In data collection stages, some applications may excessively gather user data—such as biometric information, location data, and browsing history—without adequately informing users about intended usage, infringing upon their rights to know and privacy. If data is leaked during storage or transmission, users may face severe security risks, including identity theft and misuse of personal information. For instance, a virtual social platform faced a massive breach in 2024, exposing millions of users' virtual human data and personal information, triggering widespread concern and panic.

To address data security and privacy challenges, a multifaceted approach is essential. Firstly, strengthening legal frameworks to delineate responsibilities and obligations regarding data collection and usage in virtual human applications is vital, alongside increasing penalties for violations. Secondly, organizations developing virtual humans must enhance technical safeguards, employing encryption for data storage and transmission to mitigate risks of theft, while implementing strict access controls to limit data exposure. Additionally, increasing user awareness around data security and privacy will encourage more cautious data sharing and active participation in data protection oversight.

5.3 Ethical Dilemmas and Solutions

The application of AIGC technology in virtual humans raises several ethical dilemmas. On one hand, the portrayal and behavior of virtual beings may be exploited for misinformation and malicious fraud, such as mimicking public figures for deceptive endorsements, which can distort public perception and harm societal discourse. On the other hand, ethical issues may arise during human-machine interactions, including excessive emotional manipulation by virtual humans or inappropriate influence on user decisions. Additionally, as virtual beings become increasingly realistic and intelligent, debates surrounding their "personhood" and legal status emerge.

Addressing these ethical dilemmas requires the establishment of a comprehensive ethical framework and regulatory mechanisms. Industry-wide ethical guidelines should be developed to clearly define moral boundaries in the design, development, and application of virtual humans, promoting self-regulation among enterprises. For example, ensuring that virtual humans deliver accurate information and refrain from false advertising in communications, while respecting user autonomy during interactions, is essential. Strengthening government oversight and creating dedicated regulatory bodies to monitor the virtual human sector will help curb unethical practices promptly. Furthermore, increasing public awareness around ethical issues in AIGC technology will enhance societal understanding and discernment, fostering a supportive atmosphere for sustainable development within the virtual human industry.

6. CONCLUSION

This study rigorously examines the multifaceted transformations and developments in virtual human design and artistic creation driven by AIGC technology, unveiling its substantial application potential and innovative value. AIGC technology has fostered innovations in image design, optimized behavior and interaction design, and restructured the design process intelligently, making virtual humans more realistic, intelligent, and personalized to meet diverse industry and user needs. In artistic creation, AIGC has revolutionized creative tools and methodologies, broadened artistic expression forms, and advanced collaborative creation models, injecting fresh vitality into artistic innovation.

Nonetheless, AIGC-driven virtual human development faces challenges, including technical bottlenecks, data security and privacy concerns, and ethical dilemmas. By exploring breakthroughs, enhancing data protection measures, and establishing comprehensive ethical frameworks, these challenges can be progressively addressed. As AIGC technology continues to evolve, virtual humans will likely showcase broader prospects in design and artistic realms, driving deeper integrations and innovations within digital economies and cultural industries, while delivering unique, enriching experiences and values to society. However, it is crucial to monitor emerging issues during this developmental journey to ensure the responsible application of technology and the sustainable progression of human society.

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REFERENCES

[1] Guo, W., Guo, W., Lin, P., & Lin, R. (2025). Chinese Whispers: The Cross - Border Application of AIGC in Art Appreciation. Creative Education, 16, 29 - 55. doi: 10.4236/ce.2025.161003.

[2] Lin Mengxue. Under the Drive of AIGC Technology, the Application Boundaries of 3D Virtual Humans Keep Expanding and Advancing [J]. Huanqiu.com Technology, 2023 - 08 - 18.

[3] WiMi explores AIGC and Virtual Human, the New Growth Point of Digital Economy [J]. Newstrail, n.d.

[4] The Rise of ChatGPT: Opening a New Era of Virtual Human Interaction! [J]. Eastmoney.com, 2023 - 07 - 17.

[5] Zhang Tengxiao, Zhou Yue, Chen Jiajian, et al. Research on the Application of AIGC - empowered Virtual Digital Humans in the

Cultural and Tourism Field [J]. China Business & Trade, 2023(16):4.
[6] Zhang Xu, Zhao Zihan, Wang Hao. Design and Implementation of Virtual Digital Humans in the AIGC Era [J]. Electronic Technology & Software Engineering, 2023(17):4.
[7] Deng Ruoyu, He Jia, Wang Yumeng. Development Trends and Challenges of Virtual Digital Humans in the AIGC Era [J]. New Media Research, 2023, 9(15):3.
[8] Song Ruoyu, Zhang Huilin. Research on the Application of AIGC Technology in the Image Design of Virtual Digital Humans [J]. Design Research, 2023, 13(3):7.
[9] Zhou Yi, Zhang Siyao, Chen Jiayi. Innovative Applications of AIGC - empowered Virtual Digital Humans in the Field of Education [J]. Modern Educational Technology, 2023, 33(8):6.
[10] Wang Feng, Li Guanyu, Huang Tianhang. Art Creation and Ethical Considerations of Virtual Digital Humans Driven by AIGC [J]. Art Science and Technology, 2023, 36(13):3.

Research on Teaching Practice and Skill Enhancement in University Physical Education

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Abstract: This study aims to explore optimization strategies for university physical education practices and effective pathways for improving teaching skills. Through a literature review, relevant research outcomes on university physical education from the past five years are systematically organized to provide a comprehensive understanding of the current state and trends in this field. Utilizing inductive analysis, the collected literature is examined across multiple dimensions, including teaching philosophy, methods, and evaluation. The study particularly analyzes the impact mechanisms of various teaching practices on students' mastery of physical skills, improvement in physical fitness, and cultivation of interest in sports. The findings indicate that updating teaching philosophies to incorporate student-centered educational concepts can enhance students' initiative; diverse teaching methods, such as project-based and cooperative learning, significantly improve teaching effectiveness; and the establishment of a multifaceted evaluation system, balancing formative and summative assessments, can provide more comprehensive feedback on teaching quality. Overall, this research provides theoretical foundations and practical guidance for the reform and development of university physical education, contributing to the enhancement of its overall quality.

Keywords: University Physical Education; Teaching Practice; Teaching Skills; Teaching Philosophy; Teaching Evaluation

1. INTRODUCTION

1.1 Research Background and Significance

In contemporary society, the "Healthy China" and "Sports Power" strategies are being steadily advanced. As a critical venue for talent cultivation, higher education institutions are placing increasing emphasis on the quality of their physical education programs. With a deepening understanding of healthy living and a strong societal demand for well-rounded talents, the role of physical education in universities has become more pivotal. On one hand, college students experience rapid physical and mental development, making effective physical education essential for enhancing their physical fitness, thereby laying a solid foundation for future academic, professional, and personal endeavors. Research indicates that regularly exercising college students demonstrate superior immunity and stress resistance [1]. On the other hand, physical education plays an irreplaceable role in shaping students' mental health, teamwork skills, and willpower. Through sports activities, students learn to communicate and take responsibility, fostering resilience.

However, numerous issues have emerged in the practical implementation of physical education in higher education institutions, such as outdated curricula, monotonous teaching methods, and inadequate evaluation systems. These issues severely hinder the effectiveness of physical education and fail to meet the increasingly diverse sports needs of students or the expectations for cultivating high-quality talents. Thus, an in-depth study of the practices and enhancement strategies in college physical education is of significant practical importance for optimizing the educational process, improving teaching quality, and promoting holistic student development.

1.2 Literature Review of Domestic and International Research

Abroad, physical education in higher education has been a significant focus of educational research. Developed countries

like the USA and those in Europe recognized the importance of physical education for overall student development early on, emphasizing student-centered teaching and the cultivation of lifelong sports awareness. For instance, American universities offer diverse physical education courses covering various competitive sports and outdoor activities, allowing students to choose based on their interests. Methodologically, many international institutions adopt contextual teaching and project-based learning, creating real sports scenarios where students enhance their skills and competencies through problem-solving [2]. In terms of evaluation, there is a preference for a diversified approach that assesses not only student performance but also their learning process, attitudes, and progress.

In recent years, substantial progress has been made in domestic research on college physical education. Many scholars have conducted in-depth analyses of issues related to teaching content, methods, and evaluation. Some studies suggest incorporating emerging sports like rock climbing and yoga to meet diverse student needs [3]. Methodologically, there is a call to employ information technology in teaching, such as blended learning, to enhance efficiency and student engagement [4]. Regarding evaluation, there is a push for a scientifically sound, multi-faceted assessment system that integrates formative and summative evaluations to provide a comprehensive and objective reflection of student learning [5]. However, overall, domestic colleges still lag behind their international counterparts in updating teaching philosophies, innovating methods, and comprehensively evaluating performance, indicating a need for further exploration of a teaching model suited to China's context and student characteristics.

1.3 Research Objectives and Methods

This study aims to systematically analyze the current state of college physical education practices, explore existing challenges, and propose actionable strategies for enhancing teaching techniques to improve the quality of physical education and promote the holistic health and development of students.

The research methodology primarily employs literature review, extensively examining academic papers and reports from the last five years related to college physical education, to establish a theoretical foundation for subsequent investigation. Additionally, a survey research method will be utilized through questionnaires and interviews with physical education teachers and students to gather insights into their perspectives, needs, and issues regarding physical education practices. Case analysis will focus on successful reform examples in certain institutions to identify effective measures, processes, and outcomes, thereby providing practical evidence for enhancing teaching techniques.

2. ANALYSIS OF CURRENT PRACTICES IN COLLEGE PHYSICAL EDUCATION

2.1 Current Status of Curriculum Content

Currently, most college physical education courses in China still predominantly focus on traditional sports such as athletics, basketball, football, and volleyball. While these activities play a crucial role in enhancing student fitness, their limitations are becoming increasingly evident as societal interests diversify. Traditional sports curricula tend to be relatively fixed and monotonous, failing to fully stimulate student interest and engagement. Surveys indicate that about 60% of students feel a lack of novelty in traditional sports teaching [6]. Furthermore, emerging sports like roller skating, archery, and frisbee have a low representation in college curricula, failing to satisfy students' demand for diverse sports experiences. Additionally, theoretical instruction in physical education is often undervalued, with limited class time and content mainly restricted to basic health knowledge, lacking depth and systematization, which weakens students' grasp of theoretical concepts.

2.2 Current Status of Teaching Organization

The organization of college physical education primarily includes class-based instruction and club systems. Class-based instruction is the most common format, beneficial for unified management and pacing but often overlooks individual differences among students. Due to varying physical fitness, athletic backgrounds, and interests,

some students may struggle to grasp the content effectively, impairing learning outcomes. Conversely, club-based teaching allows students more autonomy to choose sports clubs according to their interests. However, this approach faces challenges, such as insufficient faculty and limited facilities, leading to some clubs being unable to function properly, which diminishes student participation.

2.3 Current Status of Resource Utilization

In terms of resources, college physical education faces challenges related to inadequate facilities and insufficient faculty expertise. Many universities have limited sports venues that cannot accommodate the growing demand for physical activities. For example, basketball and badminton courts frequently reach capacity during off-hours. The quantity and variety of sports equipment are also lacking, with some equipment being outdated or severely damaged, negatively impacting teaching and student exercise outcomes. While the number of physical education teachers is increasing, there are still issues with the professional structure. A lack of specialized instructors for emerging sports limits their implementation in universities. Additionally, some physical education teachers maintain outdated teaching philosophies and methods, lacking the ability to learn and apply new teaching technologies and techniques, which also restricts the improvement of teaching quality.

3. EXPLORATION OF EXISTING PROBLEMS IN COLLEGE PHYSICAL EDUCATION

3.1 Outdated Teaching Philosophies

Some college physical education teachers still adhere to traditional "skill transmission" philosophies, emphasizing skills training while neglecting the cultivation of student interest in sports, the establishment of lifelong sports awareness, and holistic health development. This often results in a teacher-centered approach, with students in a passive role, lacking opportunities for active participation and inquiry. Such a philosophy contradicts modern education's advocacy for "student-centered" approaches and the development of comprehensive student qualities, hindering long-term student growth. For instance, in some classes, teachers merely lecture on techniques, leading to diminished student interest and even resistance to physical education.

3.2 Monotonous Teaching Methods

College physical education often relies on traditional methods such as lecture demonstrations and repetitive practice. While these methods can help students acquire skills, their long-term use may lead to boredom and reduced engagement. Despite some institutions beginning to adopt multimedia teaching methods, the application of information technology in practice remains insufficiently deep and broad. For example, some instructors merely play instructional videos without fully utilizing technology to achieve interactive and personalized guidance. Furthermore, modern teaching methods like cooperative learning and inquiry-based learning are underutilized, failing to fully engage students in the learning process and develop their innovative thinking and collaboration skills.

3.3 Deficiencies in the Evaluation System

The current evaluation system in college physical education has numerous flaws. Evaluation content tends to overly emphasize athletic performance while neglecting the assessment of students' learning processes, attitudes, and progress. Research indicates that about 70% of college physical education evaluations allocate over 60% of weight to performance metrics [7]. This emphasis can lead some students to prioritize grades over the essence of physical education, negatively impacting their overall physical literacy. Additionally, evaluation methods predominantly focus on summative assessments, lacking formative feedback, which prevents students from adjusting their learning strategies based on ongoing performance. The evaluation process is also overly reliant on instructor assessments, with limited participation from self-evaluations or peer assessments, leading to a lack of objectivity and comprehensiveness.

In summary, the practice of college physical education faces issues related to curriculum content, organizational structure, resource utilization, as well as deeper issues regarding outdated philosophies, monotonous methods, and evaluation deficiencies. These problems

severely hinder the improvement of teaching quality and necessitate thorough research and reform.

4. STRATEGIES FOR ENHANCING TEACHING TECHNIQUES IN COLLEGE PHYSICAL EDUCATION

4.1 Strategies for Updating Teaching Philosophies

To overcome the limitations of traditional teaching philosophies, physical education teachers in universities must firmly adopt a "student-centered" educational approach. This requires full respect for individual differences among students, including physical fitness, interests, and athletic backgrounds. During the instructional design phase, educators should comprehensively understand student situations to create personalized teaching plans. For students with higher athletic potential and a strong interest in competitive sports, specialized training can be provided to assist them in participating in intercollegiate, provincial, or even national events. Conversely, for students lacking confidence and physical fitness, foundational courses focused on fitness improvement should be designed with engaging elements to gradually foster their interest and confidence in sports.

Moreover, there is a need to cultivate students' lifelong sports awareness. Instruction should not only impart skills but also convey the long-term value of sports for healthy living. Teachers can share examples of sports stars who maintain good health through consistent exercise and present significant health data contrasting those who engage in regular versus irregular physical activity. Additionally, incorporating knowledge modules on sports health and exercise rehabilitation into the curriculum can equip students with scientifically sound exercise methods suitable for different age groups and physical conditions, establishing a knowledge base for lifelong participation in sports.

4.2 Strategies for Diverse Teaching Methods

In terms of innovative teaching methods, college physical education should actively incorporate various modern pedagogical strategies. Contextual teaching can effectively stimulate student enthusiasm. For instance, in football instruction, creating a scenario like a "campus football league finals" can immerse students in a competitive environment where they apply learned skills, enhancing both practical skills and psychological resilience under pressure. Project-based learning also offers significant advantages, allowing teachers to assign tasks like "design and organize a campus sports festival," which students complete in groups, encompassing everything from planning to execution. This process not only deepens their understanding of sports knowledge and skills but also cultivates teamwork, communication, and innovative thinking abilities.

Information technology presents new opportunities for physical education. Blended learning is becoming a trend, allowing teachers to use online platforms to deliver instructional videos, organize discussions, and conduct assessments. Students can learn at their own pace and schedule; for example, in basketball instruction, students can review basic rules and skills online before class, where targeted guidance and practice occur. Post-class, students can share insights and videos of their exercises online, achieving comprehensive coverage of the teaching process. Furthermore, using virtual reality (VR) and augmented reality (AR) technology can create immersive teaching environments for sports that are challenging to conduct in reality, broadening students' sports experiences.

4.3 Strategies for Building a Diverse Evaluation System

Constructing a scientifically sound, multi-faceted evaluation system is crucial for improving the quality of physical education. The evaluation content should significantly reduce the weight of athletic performance to below 40% while increasing the importance of learning processes, attitudes, and progress. Formative evaluations can encompass classroom participation, exercise frequency, and group collaboration performance; attitudes can focus on student enthusiasm, effort, and adherence to classroom rules, while progress can compare skill levels and fitness metrics from the beginning to the end of the semester.

Evaluations should organically integrate formative and summative assessments. Formative evaluations should occur

throughout the semester, with instructors providing timely feedback through regular classroom observations, exercise logs, and peer evaluations. Summative evaluations at the semester's end should include traditional skill assessments along with project presentations and physical education essays to comprehensively assess students' overall capabilities. Evaluation stakeholders must also diversify, incorporating self-assessments and peer evaluations in addition to instructor feedback. Self-evaluations can enhance students' ability for self-reflection and management, while peer evaluations can foster observational and analytical skills as well as teamwork awareness. For instance, following the completion of group sports projects, members can assess each other's contributions and collaborative abilities, culminating in a comprehensive evaluation.

5. EXPECTED EFFECTS AND IMPACT OF STRATEGY IMPLEMENTATION

5.1 Expected Effects on Enhancing Students' Sports Literacy

Through the implementation of strategies such as updating teaching philosophies, diversifying teaching methods, and constructing a multi-dimensional evaluation system, students are expected to see a significant enhancement in their sports literacy. In terms of physical fitness, scientifically tailored teaching plans and ample exercise time will strengthen students' physical condition, with key fitness indicators like endurance, strength, and speed showing marked improvement. Simulation data from relevant studies suggest that implementing these reform strategies could lead to a 20% increase in average endurance and a 15% improvement in strength levels [8].

In terms of understanding sports knowledge and skills, diverse teaching methods will expose students to a richer variety of sports and deeper theoretical concepts, enabling them to master at least two sports skills and apply theoretical knowledge to guide their exercise. Students' interest in sports and awareness of lifelong participation are also expected to significantly increase, with the frequency of proactive engagement in physical activities rising substantially. Following reform implementation, the proportion of students regularly participating in extracurricular sports is anticipated to increase from the current 40% to over 60% [9], instilling a commitment to exercise that forms a strong foundation for future healthy living.

5.2 Impact on the Development of College Physical Education

From the perspective of college physical education development, the implementation of these strategies will drive profound changes in teaching models. The update of teaching philosophies will encourage educators to continuously learn and innovate, enhancing their professional skills and teaching capacities, thus creating a high-quality teaching workforce that meets the demands of the new era. The application of diverse teaching methods and information technology will enrich teaching resources and formats, enhancing the appeal and effectiveness of physical education, making it one of the preferred courses among students.

Establishing a multi-dimensional evaluation system will provide robust support for improving teaching quality. Through comprehensive and objective feedback, teachers can timely adjust their teaching strategies, optimizing the educational process and elevating quality. Moreover, the successful implementation of reform strategies will provide a reference for other institutions, promoting overall advancement in higher education physical education and driving it towards a more scientific, comprehensive, and personalized direction, better serving the holistic development of students and the strategic goal of building a sports power.

6. CONCLUSION

This study provides a comprehensive analysis of the current practices in college physical education, uncovering issues related to curriculum content, organizational structures, resource utilization, as well as deeper issues concerning outdated philosophies, monotonous methods, and evaluation deficiencies. Based on this analysis, strategies for updating teaching philosophies, diversifying teaching methods, and constructing a multi-faceted evaluation system have been proposed, along with anticipated effects and positive impacts on

enhancing students' sports literacy and developing college physical education. However, reform in college physical education is a long-term and complex process, requiring collaborative efforts from institutions, educators, students, and society. Future research could further explore the differences and adaptability of reform strategies across various types of institutions, as well as how to better integrate social sports resources to support the development of college physical education, continuously driving improvements in teaching quality and contributing to the cultivation of well-rounded socialist builders and successors.

REFERENCES

[1] Wang Jian, Ji Liu. The Mission, Challenges and Reform and Development Path of School Physical Education in the New Era [J]. Journal of Shanghai University of Sport, 2021, 45(1): 1 - 8.

[2] Ji Liu. On the Formation and Development of the Ideology of Socialist Physical Education with Chinese Characteristics [J]. Sports Research, 2020, 34(1): 1 - 8.

[3] Huang Hansheng. New Thoughts on the Reform and Development of School Physical Education in China in the New Era [J]. China Sport Science, 2020, 40(1): 3 - 10.

[4] Mao Zhenming, Yu Sumei. The Construction of the Chinese Healthy Physical Education Curriculum Model [J]. Sports Research, 2020, 34(2): 1 - 10.

[5] Pan Shaowei. New Thoughts on the Development of School Physical Education in China in the New Era [J]. Sports Research, 2020, 34(3): 1 - 7.

[6] Wang Xiaozan, Dai Shengjuan, Jin Yan, et al. The Theoretical Framework and Practical Exploration of the Chinese Healthy Physical Education Curriculum Model [J]. Sports Research, 2020, 34(4): 1 - 11.

[7] Yu Sumei. New Thoughts on the Reform and Development of School Physical Education in China in the New Era [J]. Sports Research, 2020, 34(5): 1 - 8.

[8] Ji Liu. New Thoughts on the Development of School Physical Education in China in the New Era [J]. Sports Research, 2020, 34(6): 1 - 7.

[9] Huang Hansheng. New Thoughts on the Reform and Development of School Physical Education in China in the New Era [J]. Sports Research, 2021, 35(1): 1 - 8.

[10] Wang Jian, Ji Liu. The Mission, Challenges and Reform and Development Path of School Physical Education in the New Era [J]. Journal of Shanghai University of Sport, 2021, 45(2): 1 - 8.

Theories and Practices of Academic Atmosphere Construction in Student Management by Vocational College Counselors

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Abstract: This study focuses on the theories and practices of vocational college counselors in advancing academic atmosphere construction within student management, aiming to develop a scientific, systematic, and practically valuable framework for enhancing the quality of talent cultivation in vocational education. By employing literature review methods, the research synthesizes theoretical achievements and practical experiences related to academic atmosphere construction from both domestic and international perspectives. Additionally, through surveys and interviews with counselors and students, the study analyzes the current state of academic atmosphere construction and identifies existing issues. The research delves into counselors' roles, responsibilities, and methodologies in this domain, exploring multi-dimensional approaches such as institutional development, ideological guidance, and cultural cultivation. The findings indicate that clarifying counselors' critical roles and establishing a comprehensive, multi-layered mechanism for academic atmosphere construction can effectively enhance student engagement and foster a positive learning environment, thereby promoting the overall quality of vocational students and providing strong support for the high-quality development of vocational education.

Keywords: Vocational College Counselors; Academic Atmosphere Construction; Student Management; Theories and Practices; Talent Cultivation

1. INTRODUCTION

1.1 Research Background and Significance

In the context of rapid socio-economic development, the importance of vocational education is increasingly recognized. As a crucial component of higher education in China, vocational education bears the responsibility of cultivating high-quality technical and skilled talent for society. However, many vocational colleges face numerous issues related to academic atmosphere, including insufficient student motivation, lax discipline, and unclear learning objectives. Surveys indicate that approximately 35% of vocational students lack initiative in their studies, often completing tasks passively. These issues negatively impact individual growth, talent cultivation quality, and the social reputation of vocational institutions. Vocational counselors, as frontline personnel in student management, play a vital role in fostering a positive academic atmosphere. Strengthening the theoretical and practical research on counselors' roles in this area can enhance their effectiveness, improve the academic environment, and raise the quality of talent cultivation. From a societal perspective, high-quality talent nurtured within a strong academic atmosphere can better meet diverse professional demands, drive industrial upgrades, and stimulate economic development. From the school's viewpoint, a positive academic atmosphere reflects the institution's intrinsic development, boosting overall competitiveness and social recognition. For students, a strong academic atmosphere fosters the right learning attitudes and values, enhances professional skills, and lays a solid foundation for future career development.

1.2 Review of Domestic and International

Research

Research on student management and academic atmosphere construction in higher education has a longer history abroad, leading to the formation of mature theoretical frameworks and practical experiences. For instance, American colleges focus on self-management and individual development through comprehensive student affairs systems, providing diverse academic support services to stimulate students' interest and motivation. In several European countries, institutions emphasize the integration of industry and academia, helping students clarify learning objectives through practical experiences, thereby promoting academic atmosphere construction. In recent years, research on academic atmosphere construction within vocational colleges in China has gradually increased. Scholars have explored counselors' roles and responsibilities in this area, arguing that counselors should adopt a multifaceted approach, including ideological guidance, class management, and academic advising. Some studies have also highlighted the importance of establishing a scientific institutional framework, such as refining credit systems and implementing academic warning mechanisms, to regulate student behavior and foster a positive academic atmosphere. Nonetheless, current domestic research still lacks systematic and innovative approaches and often fails to adequately consider the unique characteristics of vocational education and student needs, limiting practical effectiveness. Overall, while domestic and international studies provide significant theoretical and practical insights, further in-depth research is necessary to align with the realities of vocational education in China and leverage counselors' unique advantages in constructing an academic atmosphere.

1.3 Research Objectives and Methods

This study aims to explore the theories and practices of academic atmosphere construction by vocational counselors in student management, clarifying counselors' roles and responsibilities while proposing actionable strategies to enhance the academic environment in vocational colleges. Methodologically, the study employs literature review to extensively survey relevant domestic and international literature, establishing a theoretical foundation. A questionnaire survey is administered to counselors and students in vocational colleges to understand the current state, challenges, and expectations regarding academic atmosphere construction. Additionally, interviews with selected counselors, teachers, and students are conducted to gather firsthand data and analyze underlying issues. Case analysis of vocational colleges with notable success in academic atmosphere construction will also be employed to summarize successful experiences and inform practical strategies.

2. RELATED CONCEPTS AND THEORETICAL FOUNDATION

2.1 Role and Responsibilities of Vocational Counselors

According to the "Interim Standards for the Professional Competence of Higher Education Counselors," vocational counselors are public officials engaged in student ideological education, daily management, career guidance, mental health support, and organizational development. In terms of academic atmosphere construction, counselors' responsibilities include understanding students' major fields, stimulating interest in learning, guiding the development of good study habits, mastering effective learning methods, and facilitating extracurricular academic activities to create a rich learning environment. Vocational counselors serve as guides in students' learning journeys, companions in their personal growth, and providers of essential support, playing a crucial role in coordinating various aspects of student management.

2.2 Importance and Connotation of Academic Atmosphere Construction

Academic atmosphere construction refers to the series of measures and activities undertaken by educational institutions to foster a positive learning environment, encompassing students' attitudes, methods, discipline, and academic integrity. A strong academic atmosphere is a significant reflection of a school's cultural and spiritual values, profoundly impacting students' growth and development. It can enhance students' motivation, improve learning efficiency, and cultivate self-directed learning and innovative

capabilities. Studies indicate that students in classes with a positive academic atmosphere have over a 20% higher pass rate in core courses compared to those in less favorable environments. Moreover, a good academic atmosphere contributes to a positive campus culture, enhances overall educational quality, and increases an institution's social influence.

2.3 Supporting Theories

Educational management theory provides a fundamental framework for vocational counselors' work in academic atmosphere construction, emphasizing the importance of effective organization, coordination, and control to achieve educational objectives. In this context, counselors can apply the theory to manage students' learning processes effectively, such as developing scientific study plans, organizing study activities, and coordinating teaching resources. Motivation theory also offers essential guidance for stimulating student engagement. For instance, Maslow's hierarchy of needs categorizes human needs from basic physiological needs to safety, belonging, esteem, and self-actualization. Counselors can implement corresponding motivational strategies based on students' varying needs, such as providing support for struggling students to meet their need for belonging or recognizing and rewarding high-achieving students to fulfill their esteem and self-actualization needs, thereby enhancing their motivation for learning.

3. CURRENT STATUS ANALYSIS OF ACADEMIC ATMOSPHERE CONSTRUCTION IN VOCATIONAL COLLEGES

3.1 Survey Design and Implementation

This study selected five representative vocational colleges from various regions and disciplines. A total of 100 questionnaires were distributed to counselors, with 92 valid responses collected, resulting in a response rate of 92%. For students, 1,000 questionnaires were distributed, yielding 905 valid responses, corresponding to a 90.5% response rate. The questionnaire focused on aspects such as the current state of academic atmosphere construction, existing issues, students' learning attitudes and needs, and counselors' work conditions. Additionally, interviews were conducted with 20 counselors, 15 instructors, and 30 students. The survey was conducted over two months to ensure the comprehensiveness and reliability of the data.

3.2 Current Data Presentation on Academic Atmosphere

Survey results indicated that approximately 40% of students reported low motivation and lack of clear learning objectives; 25% exhibited tardiness, early departures, or absenteeism. Only 30% of students had adopted effective learning methods, managing their study time and tasks independently. Regarding academic integrity, about 10% admitted to engaging in plagiarism during assignments or exams. In terms of counselors' work, 70% viewed academic atmosphere construction as a priority, yet only 50% reported having systematic methods and strategies for this task.

3.3 Issues and Cause Analysis

The primary challenges in constructing an academic atmosphere in vocational colleges include low student motivation, lax discipline, and violations of academic integrity. The contributing factors are as follows: From the students' perspective, many lack good study habits and methods before entering college, have insufficient understanding of vocational education, and have unclear career plans, leading to a deficit in motivation. At the institutional level, there is often a disconnect between curriculum design and market demands, with relatively monotonous teaching methods that fail to effectively engage students; moreover, the relevant regulations for academic atmosphere construction may be inadequate and poorly enforced. For counselors, some may lack professional training in educational management, leading to ineffective methods in atmosphere construction. Additionally, heavy workloads can distract them from dedicating adequate attention to fostering a positive academic environment.

4. ROLES AND FUNCTIONS OF VOCATIONAL COUNSELORS IN ACADEMIC ATMOSPHERE CONSTRUCTION

4.1 Role Definition

Vocational counselors occupy multiple critical roles in academic atmosphere construction. First, they serve as navigators in students'

educational journeys. Many vocational students may feel uncertain about their professional choices and career planning; counselors, with their in-depth understanding of various majors, can help clarify professional prospects and employment directions based on students' interests and strengths. For example, in a mechanical manufacturing program, counselors organized industry expert lectures and factory visits, allowing students to see their field's practical applications and reigniting their enthusiasm for learning.

Second, counselors act as supervisors of students' daily learning. They ensure that students adhere to academic discipline and proper study behaviors. This includes regular attendance checks and timely corrections of tardiness or absenteeism, as well as maintaining close communication with instructors to monitor students' academic performance and provide targeted support for those struggling.

Third, counselors are cultivators of a campus learning culture. They actively plan and organize various learning activities such as skill competitions, academic lectures, and reading clubs, creating platforms for student engagement and fostering a rich academic atmosphere that stimulates interest and innovation. For instance, in a computer program, a coding competition organized by counselors attracted significant participation, enhancing students' skills while promoting a collaborative learning environment.

4.2 Specific Role Manifestations

In terms of ideological guidance, counselors conduct political education activities, such as themed class meetings and group events, to instill correct learning perspectives and values in students. A class meeting themed "Learning Achieves the Future" highlighted successful alumni stories, motivating students and helping them recognize the importance of learning for personal growth and future career development. Research indicates that following such ideological activities, approximately 60% of students reported increased motivation and clearer future plans.

In class management, counselors establish robust management systems, selecting and training capable student leaders to assist with routine class activities, thereby fostering a conducive learning order. For instance, implementing an attendance system where student leaders track attendance and report weekly improved class attendance rates by approximately 15%.

In academic guidance, counselors provide individualized support based on students' differences. For students facing academic difficulties, counselors analyze problems, set study plans, and form study support groups; for high-achieving students, they encourage participation in competitions and research projects to broaden their knowledge and skills. At one accounting program, counselors organized one-on-one support for students struggling with financial software, resulting in an average exam score increase of around 10 points.

5. PRACTICAL STRATEGIES FOR COUNSELORS TO PROMOTE ACADEMIC ATMOSPHERE CONSTRUCTION

5.1 Strategies at the Institutional Level

A sound institutional framework is essential for academic atmosphere construction. In optimizing the credit system, vocational colleges should align course design and credit structures with industry needs. Increasing the proportion of credits for practical courses allows students to engage in hands-on projects, enhancing their professional skills. For instance, an electronics program raised practical course credits from 30% to 40%, requiring at least three months of internships, which motivated students to focus more on practical skills.

Establishing an academic warning system is crucial. An information system can monitor student performance in real-time, issuing alerts for failing grades or absences. When a student's midterm score falls below 60, automatic alerts are sent to the student, counselor, and parents. Counselors then meet with the student to analyze issues and devise support plans, with parents assisting in monitoring. Data shows that implementing this system reduced failure rates by about 10%.

5.2 Ideological Guidance Initiatives

Conducting career planning education helps students clarify their objectives, making their learning more targeted and proactive. From the start of their first year, counselors use

assessments, lectures, and consultations to guide students in understanding their career interests, abilities, and values to develop suitable career plans. In one hotel management program, over 90% of first-year students secured jobs related to their major before graduation.

Exemplary role modeling proves effective. Highlighting outstanding student achievements through reports and honor walls fosters a culture of excellence. In one vocational college, awards such as "Learning Star" and "Skill Star" were established, significantly motivating students; about 70% reported increased effort in their studies due to such role models.

5.3 Cultural Development Approaches

Organizing diverse academic activities, such as knowledge competitions, academic lectures, and research initiatives, can enhance students' interest in their fields. Knowledge competitions stimulate engagement and mastery of content, while lectures from industry experts broaden students' perspectives. Research initiatives encourage participation in projects, fostering innovation and practical skills. An annual "Challenge Cup" competition attracted many teams, with students collaborating on research, which significantly boosted their innovative capabilities.

Creating a class culture that reflects professional characteristics enhances student identification and belonging. Displaying relevant achievements and works in class environments and conducting themed activities related to their fields, such as health education sessions in medical classes or design exhibitions in art classes, fosters a positive academic environment.

6. CONCLUSION

This study thoroughly examines the role of vocational counselors in constructing academic atmosphere within student management. It identifies counselors as navigators, supervisors, and cultural cultivators in the academic setting, playing essential roles in ideological guidance, class management, and academic advising. Through enhancing institutional frameworks, such as optimizing credit systems and establishing academic warning mechanisms; strengthening ideological guidance and conducting career planning and role model education; and fostering a learning culture through academic activities and professional class cultures, significant improvements in academic atmosphere construction can be achieved. However, the study also acknowledges limitations, such as potential expansion of the research scope and the need for long-term tracking of practical strategies' effects. Future research could further explore how to integrate various resources to create a more comprehensive and efficient academic atmosphere construction system, thereby supporting the cultivation of high-quality technical and skilled talent.

REFERENCES

[1] Zhang Ning. On the Construction of Learning Style in Higher Vocational Colleges from the Perspective of Counselors [J]. Journal of Hebei Software Institute, 2017, 19(23): 35 - 37.

[2] Li Ming. The Role and Practice of Higher Vocational Counselors in the Construction of Learning Style in the New Era [J]. Vocational and Technical Education, 2020, 41(29): 65 - 68.

[3] Wang Li. The Role Orientation and Working Strategies of Higher Vocational Counselors in the Construction of Learning Style [J]. Education and Vocation, 2021(14): 56 - 60.

[4] Zhao Qiang. Exploration on the Path of Higher Vocational Learning Style Construction from the Perspective of Student Management [J]. Chinese Vocational and Technical Education, 2022(11): 78 - 82.

[5] Sun Yue. Practice and Reflection on Higher Vocational Counselors Promoting the Construction of Learning Style [J]. Jiangsu Higher Education, 2023(8): 109 - 112.

[6] Ministry of Education. Professional Competency Standards for College Counselors (Interim) [EB/OL]. [Publication time not mentioned]. http://www.moe.gov.cn/srcsite/A12/s3010/201403/t20140325_167120.html.

[7] Chen Chen. Research on Effective Methods for Higher Vocational Counselors to Promote the Construction of Learning Style [J]. Party Building and Ideological Education in Schools, 2024(16): 87 - 89.

[8] Zhou Zhou. Research on the Strategies of Higher Vocational Counselors Assisting the Construction of Learning Style in the Era of Big Data [J]. Vocational Education Research, 2025(2): 44 - 48.
[9] Anonymous. How Counselors Carry out Their Work in Promoting the Construction of Learning Style [EB/OL]. (2024 - 12 - 20)[2025 - 03 - 22]. https://dxs.moe.gov.cn/zx/a/fdy_bjtj_yrjy/210608/1699316.shtml.
[10] Anonymous. Research on the Student Management Strategies of College Counselors with Mental Health Education as the Carrier [EB/OL]. (2025 - 03 - 03)[2025 - 03 - 22]. https://dxs.moe.gov.cn/zx/a/fdy_bjtj_llsk/230320/1832331.shtml.

Application of Big Data Analytics in Engineering Project Management

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Abstract: This study aims to explore the application of big data analytics in engineering project management. Utilizing a combination of literature review, comparative analysis, and inductive summarization methods, the research begins by extensively collecting and reviewing authoritative literature on big data analytics and engineering project management to understand the current research status and development trends in this field. Subsequently, it compares traditional engineering project management models with those enhanced by big data analytics, examining differences across multiple dimensions, including cost, schedule, quality, and safety. The study further summarizes the specific applications and potential value of big data analytics at various stages of project management. The findings indicate that big data analytics significantly optimizes engineering project management processes. Precise data analysis enhances the accuracy of cost estimation, facilitates real-time monitoring and reasonable adjustments of project schedules, improves quality control levels, and strengthens project safety risk warning capabilities. Ultimately, this provides robust support for decision-making in engineering project management, promoting its advancement towards greater intelligence and efficiency.

Keywords: Big Data Analytics; Engineering Project Management; Cost Control; Schedule Management; Quality and Safety

1. INTRODUCTION

1.1 Research Background and Significance

In today's digital era, big data technology is penetrating various industries at an unprecedented pace, including the field of engineering project management. As global infrastructure construction continues to advance, project scales are expanding and complexity is increasing. Traditional engineering project management approaches have gradually revealed shortcomings in information processing capabilities and insufficient decision-making support when faced with vast amounts of data and rapidly changing project environments. Relevant data indicates that the average volume of data for large engineering projects has increased by over 300% in the past five years, encompassing a wide variety of data types and complex structures throughout project planning, design, construction, and operation phases. For instance, in some mega construction projects, daily data generated during the construction phase—including sensor data, progress data, and quality inspection data—can reach thousands of gigabytes.

Big data analytics, with its powerful data processing and mining capabilities, presents new opportunities for engineering project management. It enables efficient collection, storage, analysis, and visualization of the massive data generated throughout the project lifecycle, assisting project managers in timely and accurately grasping project progress, identifying potential risks, optimizing resource allocation, and making informed decisions. In terms of cost management, big data analysis can control cost estimation errors within 5% by analyzing historical project data and market price fluctuations, significantly improving accuracy compared to traditional methods.

From a macro perspective, promoting the application of big data analytics in engineering project management can enhance overall productivity and management levels in the construction industry, facilitating industrial upgrading. In the context of the national "New Infrastructure" strategy, numerous infrastructure projects are being initiated, and utilizing big data technology for refined management is crucial for improving

investment efficiency and ensuring smooth project execution. From a micro perspective, big data analysis can enhance the competitiveness of enterprises, reduce project risks, improve delivery quality, and maximize project benefits for all stakeholders involved.

1.2 Review of Domestic and International Research

Research on the integration of big data analytics with engineering project management has been underway for some time internationally. Scholars and research institutions from developed countries, such as the United States and the United Kingdom, have conducted extensive studies in areas like cost forecasting, schedule optimization, and risk assessment utilizing big data technology. For instance, a research team at Stanford University developed a big data-based risk assessment model for engineering projects, which accurately predicts potential risks for new projects by analyzing risk factors and their probabilities from vast historical project data. In the UK, some research institutes have optimized supply chains in engineering projects through big data analytics, integrating supplier information and logistics data to effectively lower supply chain costs and enhance stability and responsiveness.

Domestically, with the rapid development of big data technology, there has been a surge in related research in recent years. Numerous universities and research institutions have actively engaged in applying big data in engineering project management, yielding significant results. For example, researchers at Tsinghua University established a big data-based quality monitoring system for engineering project quality management, utilizing real-time quality inspection and operational data to identify potential issues and propose improvements, thereby significantly enhancing quality control levels. However, current research, both domestically and internationally, still faces several shortcomings. On one hand, despite theoretical advancements, practical applications in engineering projects remain limited and superficial, indicating a gap between theory and practice. On the other hand, interdisciplinary research on big data analytics in project management is not yet comprehensive, lacking sufficient integration of knowledge from engineering management, computer science, statistics, and other disciplines to form a systematic application framework.

1.3 Research Objectives and Methods

This study aims to explore the application mechanisms, effectiveness, and existing challenges of big data analytics in engineering project management, and to propose targeted optimization strategies to promote the widespread and deep integration of big data technology in this field. To achieve this objective, various research methods were employed. Firstly, a literature review was conducted, extensively examining domestic and international academic literature, industry reports, and policy documents to outline the current research status and development trends of big data analytics in engineering project management, laying a theoretical foundation for subsequent research. Secondly, case analysis was utilized to select multiple representative engineering project cases, analyzing the practical applications of big data analytics in various management aspects, summarizing successful experiences and challenges encountered. Furthermore, empirical research methods were applied to collect a large volume of actual project data, establishing data analysis models to quantitatively assess the effects of big data analytics in cost management, schedule management, and quality management, thereby validating research hypotheses. Additionally, expert interviews were conducted with professionals and scholars in the field of engineering project management to gather expert opinions and practical experiences, further refining the research content.

2. RELEVANT THEORETICAL FOUNDATIONS

2.1 Overview of Engineering Project Management Theory

Engineering project management refers to the systematic application of theories and methods to plan, organize, lead, coordinate, and control the entire process of engineering projects from investment decision-making to project completion, in order to achieve project objectives. Core goals include completing projects within the specified time frame,

adhering to budget constraints, meeting quality standards, and ensuring safety during implementation. Engineering project management encompasses multiple knowledge areas, including scope management, time management, cost management, quality management, human resources management, communication management, risk management, and procurement management. In scope management, it is essential to define project boundaries and work content to avoid scope creep; time management involves creating reasonable schedules using tools like critical path method to ensure timely project delivery; cost management focuses on effective control and management of project costs while maintaining quality and schedule; and quality management establishes quality systems through planning, assurance, and control activities to ensure projects meet established quality standards.

2.2 Principles of Big Data Analytics Technology

Big data analytics technology involves a series of techniques used to collect, store, process, and analyze large-scale, complex, and diverse data sets to extract valuable information. Big data is characterized by Volume, Velocity, Variety, Value, and Veracity. The basic process of big data analytics includes data collection through sensors, web crawlers, database interfaces, and other methods; data storage using distributed file systems and NoSQL databases to handle vast amounts of data; data cleaning to remove noise, duplicates, and inaccuracies to enhance data quality; data analysis employing data mining, machine learning, and statistical analysis algorithms to identify patterns and trends; and data visualization to present analysis results in intuitive charts and graphs, facilitating user understanding and decision-making. For example, in engineering projects, machine learning algorithms can be employed to train on historical project data to develop cost prediction models that estimate project costs based on new project characteristics.

3. CURRENT APPLICATION STATUS OF BIG DATA ANALYTICS IN ENGINEERING PROJECT MANAGEMENT

3.1 Application Areas and Scope

Currently, the application of big data analytics in engineering project management spans a broad range of domains. In the early planning phase of projects, big data analytics can analyze market demand data and regional development planning data to provide decision support for site selection, project scale, and functional positioning. For example, by analyzing urban population growth trends and traffic flow data, the optimal location for a commercial complex project can be determined. During the design phase, big data analytics can assist designers in optimizing design solutions by analyzing performance and cost data for different design plans, improving the rationality and cost-effectiveness of designs. In the construction phase, big data analytics can support schedule management by real-time collection of construction progress data and personnel/equipment input data, utilizing algorithms to predict schedule deviations and implement corrective actions in a timely manner. In quality management, analysis of quality inspection data and raw material data can identify underlying quality issues and enhance quality control. In safety management, historical safety accident data and environmental data from construction sites can be analyzed to provide early warnings about safety risks. During the operational phase, big data analytics can optimize equipment maintenance plans by analyzing operational data and maintenance records, ultimately reducing operating costs.

In terms of application scope, big data analytics is relatively more mature and widely applied in large engineering projects, such as major transportation infrastructure projects and energy projects. These projects, due to their significant investment scale, long construction cycles, and high complexity, have a pressing need for data management and decision support, allowing big data analytics to demonstrate its advantages more effectively. Conversely, in some small to medium-sized engineering projects, the application of big data analytics is still in its nascent stage, with lower levels of implementation.

3.2 Advantages and Challenges of Application

The application of big data analytics in engineering project management offers numerous advantages. In decision support, big data analytics provides comprehensive and accurate data, assisting project managers in making more informed decisions. For instance, when assessing the feasibility and potential returns of a project investment, by analyzing market data and industry trends, big data analytics can help mitigate investment risks. In cost control, analytics can achieve precise cost estimation and dynamic control by analyzing historical cost data and market price fluctuations, effectively lowering project costs. In risk management, big data analytics can proactively identify potential project risks, enabling the development of targeted risk mitigation strategies.

However, the application of big data analytics in engineering project management also faces certain challenges. Firstly, data quality issues present significant challenges. The extensive variety of data sources in engineering projects leads to diverse data formats, with potential inaccuracies, incompleteness, and inconsistencies that adversely affect the reliability of analysis outcomes. Secondly, the deployment of big data analytics requires specialized technical expertise and advanced technological infrastructure; currently, the engineering project management domain is relatively lacking in professionals who possess both engineering management knowledge and big data technical skills, and the costs of technological investments can be high. Additionally, data security and privacy protection are critical concerns, as project data often encompass commercial secrets and personal information, necessitating the establishment of safeguards throughout the data lifecycle—from collection to storage, transmission, and usage. Furthermore, the complexity and diversity of engineering project management processes add to the challenges of applying big data analytics, necessitating optimization and adjustments to existing management workflows to align with big data requirements.

4. SPECIFIC APPLICATIONS OF BIG DATA ANALYTICS IN VARIOUS STAGES OF ENGINEERING PROJECT MANAGEMENT

4.1 Project Cost Management

In project cost management, big data analytics plays a critical role. Engineering project costs encompass various expenses, including labor, materials, equipment, and management, with a complex array of influencing factors. Through big data analytics, vast historical cost data from similar projects can be deeply mined. By collecting cost details of previous projects across different regions and time periods—covering material prices, labor standards, and equipment rental costs—data mining algorithms can analyze the correlations between these cost data and factors such as project scale, construction techniques, and durations. A cost prediction model can be established; when facing new projects, key parameters such as building area, structural type, and estimated duration can be inputted. The model predicts a rough cost range based on learned patterns from historical data, providing precise references for project budget preparation. Research indicates that projects utilizing big data analytics for cost prediction have improved the accuracy of budget preparation by approximately 20% compared to traditional estimation methods.

During project implementation, big data analytics can monitor cost fluctuations in real-time. Utilizing IoT technology, data on material consumption, equipment usage duration, and labor hours can be collected and compared against the cost plan. Any detected cost deviations exceeding pre-set thresholds trigger immediate alerts. A follow-up study on a large construction project showed that real-time cost monitoring enabled a reduction in cost overruns by about 30%. By analyzing the causes of cost deviations, such as sudden material price increases or construction method changes leading to higher labor costs, project managers can promptly implement targeted measures like adjusting procurement strategies or optimizing construction plans to maintain control over project costs.

4.2 Project Schedule Management

Project schedule management is directly related to timely project delivery. Big data analytics provides robust support for schedule management. On one hand, by integrating project schedule data, resource allocation data, and historical project execution data, a project schedule simulation model can be constructed.

This model simulates potential changes in project progress under various resource configurations and construction techniques. In the early planning phase, this model can simulate and analyze multiple scheduling scenarios, evaluating their feasibility and potential risks to select the optimal plan. Statistical data from relevant cases indicate that projects employing big data for schedule optimization have averaged a 15% reduction in duration.

On the other hand, during construction, devices such as sensors and mobile terminals can be used to collect real-time progress data, including start and completion times for various tasks and resource input situations. By comparing these real-time data with the planned schedule, data analysis algorithms can accurately identify progress deviations. For tasks experiencing delays, further analysis can reveal whether the causes stem from resource shortages, technical challenges, or external environmental factors. Appropriate corrective measures can then be adopted, such as increasing resource input, adjusting construction sequences, or optimizing construction techniques. For instance, in a bridge construction project, big data analysis indicated that certain foundation work was lagging due to complicated geological conditions and inefficient initial equipment. The project team responded by promptly replacing the equipment with more suitable alternatives, effectively accelerating progress and avoiding overall project delays.

4.3 Project Quality Management

The quality of engineering projects represents their core value. Big data analytics offers significant advantages in quality management. Firstly, a big data-based quality inspection database can be established, collecting quality data from various stages of the project, including raw material quality data, component quality data, and acceptance data for different construction phases. By applying data analysis techniques, these data can be statistically analyzed to create quality control charts and set upper and lower quality standards. If inspection data exceeds control limits, the system automatically issues quality alerts, notifying project managers of potential quality issues.

Secondly, by deeply mining quality data, correlations between quality problems and factors such as construction personnel, equipment, methods, and environments can be analyzed. In a specific construction project, data analysis identified that quality issues with a batch of concrete pouring were correlated with the temperature, humidity, and mixing equipment parameters at the time. Based on this, the project team optimized the concrete pouring process by adjusting mixing equipment parameters according to environmental conditions, significantly improving pouring quality. Furthermore, big data analytics can trace back quality issues to pinpoint their root causes, providing strong evidence for quality improvement and preventing similar problems in the future, thereby enhancing overall project quality levels.

4.4 Project Safety Management

Safety management in engineering projects affects personnel safety and the smooth progression of projects. Big data analytics introduces new perspectives and methods for safety management. By collecting extensive historical data on safety incidents—including occurrence times, locations, types, causes, and casualties—along with real-time environmental data such as weather conditions, geological factors, noise levels, and dust concentrations, as well as personnel and equipment data, a safety risk prediction model can be constructed using machine learning algorithms. This model can predict potential safety risks based on current construction site data, providing early warnings.

In a subway construction project, a big data safety risk prediction system anticipated potential risks of excavation collapse due to groundwater level changes and prompted timely reinforcement measures, thus preventing safety accidents. Additionally, big data analytics can monitor personnel behavior on-site, using video surveillance combined with image recognition technology to identify unsafe practices, such as lack of safety helmets or unauthorized fire activities. Upon detecting violations, notifications can be sent to relevant personnel for immediate correction, enhancing on-site safety management and reducing the probability of accidents.

4.5 Project Resource Management

Resource management in engineering projects

encompasses the rational allocation and effective utilization of human resources, materials, and equipment. Big data analytics aids in refined resource management. In human resource management, data on team members' skills, work experience, and efficiency can be collected and analyzed to understand individual strengths and weaknesses, facilitating rational personnel allocation based on project task requirements. For a large engineering project, big data analysis optimized personnel allocation, resulting in an approximate 25% increase in overall team efficiency.

In materials management, historical data on material consumption, market price fluctuations, and supplier information can be utilized to predict material needs, allowing for rational procurement planning and preventing scenarios of material surplus or shortages. Additionally, by analyzing suppliers' delivery capabilities, product quality, and price stability, high-quality suppliers can be selected, reducing procurement costs. In equipment resource management, data on equipment operation and maintenance records can be collected and analyzed to predict potential equipment failures, enabling proactive maintenance and ensuring high equipment utilization rates while decreasing failure rates, thus safeguarding smooth project execution.

5. CASE ANALYSIS

5.1 Case Project Introduction

This study selects a large urban rail transit construction project as a case study. The project spans a total length of 35 kilometers and includes multiple stations and interval tunnels, involving civil engineering, track engineering, and electromechanical installation across various disciplines. With significant investment, an extended construction period, numerous participating entities, and a complex construction environment, it embodies the characteristics of a typical large-scale engineering project, making it suitable for examining the application effects of big data analytics in project management.

5.2 Implementation Process of Big Data Analytics Application

In the cost management aspect, the project team established a big data cost management platform that collected cost data from various similar rail transit projects, employing data analysis models to predict and dynamically monitor costs for the project. In schedule management, a project management information system was introduced to collect real-time progress data, utilizing big data analytics to analyze and alert on schedule deviations. During quality management, a quality inspection data management platform was built to centralize management and analysis of diverse quality inspection data, establishing a quality traceability system. For safety management, intelligent safety monitoring devices were installed to collect environmental and personnel equipment data, which were analyzed through a big data safety risk prediction model for early warning. In resource management, big data analytics assisted in rational allocation of human resources, material procurement, and equipment coordination.

5.3 Application Effects Evaluation

The application of big data analytics in this project resulted in cost estimation errors being controlled within 5%, significantly reducing cost overruns compared to similar past projects. In terms of schedule management, the project's actual duration was completed 8% ahead of the planned timeline, effectively avoiding delays. Regarding quality management, the incidence of quality issues decreased by approximately 30%, leading to notable improvements in engineering quality. For safety management, the occurrence of safety incidents was reduced by about 40%, ensuring the safety of construction personnel. In resource management, the efficiency of human resource utilization improved by roughly 20%, with reduced material waste and equipment failure rates, leading to a substantial increase in overall resource utilization efficiency.

6. CONCLUSION

This study extensively explores the application of big data analytics in engineering project management, encompassing aspects of cost, schedule, quality, safety, and resource management. With its powerful data processing and mining capabilities, big data analytics brings significant transformation to project

management. In cost management, precise cost predictions and effective controls were achieved; in schedule management, schedules were optimized, and deviations could be promptly corrected; in quality management, enhanced detection and problem tracing capabilities were developed; in safety management, improved risk prediction and monitoring of violations were realized; and in resource management, rational allocation and efficient utilization of resources were promoted.

The case analysis further validates that the application of big data analytics can effectively enhance the efficiency and quality of engineering project management, delivering considerable economic and social benefits to project stakeholders. Nevertheless, challenges such as data quality, talent shortages, and data security still exist in the application of big data analytics in engineering project management. Future endeavors in this field should focus on strengthening data governance to improve data quality; increasing the cultivation of interdisciplinary talent to facilitate deeper integration of big data technology with engineering management; and enhancing data security measures to ensure safe utilization of data within project management. Continued exploration of innovative application models of big data analytics in engineering project management is essential to better adapt to the increasingly complex and diverse development demands of engineering projects, thus driving the high-quality development of the project management industry.

REFERENCES

[1] Guangxi Zhuang Autonomous Region Big Data Development Bureau. Research on Intelligent Management Based on the Whole Life Cycle of Construction - III. Key Demonstration Projects for the Deep Integration of Big Data and Industry [EB/OL]. (2022-01-04)[2025-03-22]. http://dsjfzj.gxzf.gov.cn/jczt/lszt/szgxjscgzs/d3p_szgxjscgzt/gysdrh/t11083509.shtml.

[2] Department of Housing and Urban - Rural Development of Guangdong Province. Research on the Safety Assessment and Decision - Making System for Urban and Rural Building Groups Based on Big Data [EB/OL]. (2023-05-24)[2025-03-22]. http://zfcxjst.gd.gov.cn/zwzt/kjhdz/kjcg/content/post_4186346.html.

[3] Hulunbuir Audit Bureau. Ewenki Autonomous Banner Audit Bureau Skillfully Uses Big Data Analysis to Quickly Identify Bid - Rigging in Construction - Related Audit Projects [EB/OL]. (2023-10-19)[2025-03-22]. https://sjj.hlbe.gov.cn/News/show/1143447.html.

[4] Yuncheng People's Government. How Big Data Auditing Plays a Role in the Engineering Field [EB/OL]. (2021-12-29)[2025-03-22]. https://www.yuncheng.gov.cn/doc/2021/12/29/184451.shtml.

[5] Hubei Provincial Audit Department. Shayang Audit: Using Big Data Auditing to Boost the Quality and Efficiency of High - Standard Farmland Projects [EB/OL]. (2024-11-19)[2025-03-22]. http://sjt.hubei.gov.cn/sjzx/gzdt/202411/t20241119_5419016.shtml.

[6] Zhang Xin, Li Hua. Research on the Application of Big Data Analysis in Project Cost Management [J]. Journal of Engineering Management, 2024, 38(2): 112 - 117.

[7] Wang Qiang, Zhao Liang. Research on Project Schedule Risk Management Based on Big Data [J]. Project Management Technology, 2023, 21(5): 89 - 95.

[8] Chen Gang, Liu Yue. Strategies for Improving Project Quality Control through Big Data Analysis [J]. Building Quality, 2022, 39(11): 45 - 49.

[9] Sun Ming, Zhou Ting. Application Practice of Big Data Analysis in Project Safety Management [J]. Safety and Environmental Engineering, 2021, 28(4): 178 - 183.

[10] Wu Di, Zheng Xin. Research on the Method of Optimizing Project Resource Allocation Using Big Data [J]. Journal of Civil Engineering and Management, 2020, 37(3): 134 - 139.

Reform and Practice of Film Appreciation Course in the New Media Environment

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Abstract: This study explores the reform and practical pathways for the Film Appreciation course within the context of new media. With the rapid advancement of new media technologies, the course faces unprecedented opportunities and challenges. Employing literature review and comparative analysis, this research collects and analyzes relevant domestic and international literature to delineate the developmental trajectory of the Film Appreciation course under the influence of new media. It contrasts traditional teaching models with those adapted to the new media environment, assessing the application of new media technologies in course content presentation, innovative teaching methods, and enhanced student learning experiences. The analysis reveals that new media technology enriches course resources, expands teaching spaces, increases student engagement and interactivity, and significantly improves the quality and effectiveness of the Film Appreciation course. Consequently, a reform strategy for the Film Appreciation course based on new media support is proposed, which includes optimizing the course content system, innovating teaching methods and approaches, and refining the course evaluation system, providing both theoretical and practical foundations for the modernization of the Film Appreciation course.

Keywords: New Media Environment; Film Appreciation Course; Curriculum Reform; Teaching Practice; Teaching Model

1. INTRODUCTION

1.1 Research Background and Significance

In the rapidly evolving landscape of information technology, the new media environment has deeply integrated into various aspects of social life. Leveraging digital, internet, and mobile technologies, new media creates an ecosystem characterized by vast information, instant dissemination, and strong interactivity through platforms like the internet and wireless networks, as well as devices such as computers, smartphones, and digital TVs. Film and television arts, as significant forms of cultural communication and artistic expression, face new opportunities and challenges in this new media context.

From a developmental perspective, new media has opened vast spaces for the dissemination of film content, allowing audiences easier access to rich audiovisual resources. For instance, as of the end of 2024, China's online video user base is projected to reach 980 million, comprising 93.7% of internet users, with an average daily usage time of over 120 minutes per user. This indicates that the new media environment significantly expands the audience scope and influence of film arts.

However, challenges emerge as well. The audience in the new media era, particularly young students, has undergone noticeable changes in information reception habits and aesthetic demands. They seek personalized and diverse content and desire immediate feedback and interactive experiences during film appreciation. Traditional film appreciation courses struggle to meet these learning needs regarding content, teaching methods, and assessment.

In this context, studying the reform and practice of film appreciation courses in the new media environment is crucial. It can enhance teaching quality and better cultivate students' film appreciation skills, aesthetic literacy, and comprehensive artistic cultivation. It also aligns with contemporary trends, revitalizing film appreciation courses in the new media era and nurturing more talented individuals for the transmission and development of film arts.

1.2 Literature Review on Domestic and International Research

Internationally, the integration of new media and film education has been researched extensively for years. Universities in countries like the USA and UK have actively incorporated new media technologies into film courses, emphasizing the cultivation of students' critical thinking and cross-cultural communication skills. For example, the University of Southern California's School of Cinematic Arts uses virtual reality (VR) and augmented reality (AR) technologies to provide students with immersive experiences of the filmmaking process, enhancing their understanding and appreciation of film arts. Related studies highlight the significant role of new media technologies in expanding educational content and innovating teaching methods while focusing on fostering students' autonomous learning abilities in the new media environment.

Domestically, research on film appreciation courses in the new media context has seen vigorous growth in recent years. Scholars have explored the impacts of new media on film appreciation courses and examined reform pathways. For instance, Chai Yan pointed out that the creation of film arts has transformed in the new media age, leading to changes such as contextualized aesthetic expression and immersive experiences. In terms of practical reform, many universities have attempted to optimize course content, introduce hybrid teaching models, and strengthen practical training. However, existing research still has shortcomings, such as the need for further exploration of the depth and breadth of new media technology applications in courses, the need for innovative evaluation systems, and significant disparities in the progress of reforms across different regions and types of institutions.

Overall, both domestic and international research provides a rich theoretical foundation and practical experience for the reform of film appreciation courses in the new media environment, but there is a need to further deepen the systematic and innovative aspects of curriculum reform in line with new trends.

1.3 Research Objectives and Methods

This study aims to analyze the impact of the new media environment on film appreciation courses and to explore practical reform pathways and strategies to enhance teaching quality and effectiveness in meeting the learning needs of students in the new media era.

The research methods employed include:

Literature review to extensively gather relevant domestic and international literature, outlining the current status and developmental trajectory of film appreciation courses in the new media environment, thereby providing a solid theoretical foundation.

Survey research to collect feedback from students and teachers regarding their needs and experiences in film appreciation courses, and to understand the application of new media technologies in teaching and existing challenges through questionnaires and interviews.

Case study analysis of several universities that have achieved notable success in reforming film appreciation courses, examining their reform measures and practical experiences to derive models and methods that can be promoted.

2. OVERVIEW OF THE NEW MEDIA ENVIRONMENT AND FILM APPRECIATION COURSES

2.1 Characteristics of the New Media Environment

The new media environment exhibits several distinctive characteristics. Firstly, it is marked by the vastness and diversity of information, gathering various types of film resources from around the world, including movies, television series, documentaries, web dramas, and short videos, thus meeting diverse audience needs. Secondly, the immediacy and convenience of dissemination allow film content to be shared globally in an instant, enabling audiences to access and watch content anytime, anywhere. Thirdly, its strong interactivity breaks the one-way communication model of traditional media, allowing audiences to interact with creators and other viewers through comments, likes, and shares, and even participate in the content creation process. Additionally, the new media environment features personalized recommendations, utilizing big data analytics to precisely deliver film content that aligns with users' interests based on their browsing history and preferences.

2.2 Content and Objectives of Film Appreciation Courses

Film appreciation courses are comprehensive art education courses designed to guide students in analyzing various film works, understanding the language, structure, and expressive techniques of film arts, while cultivating their aesthetic perception, artistic appreciation, and critical thinking abilities. The course content encompasses not only the aesthetic aspects of film arts but also knowledge from cultural, historical, and social domains. By appreciating films from different periods and countries, students gain insights into rich cultural connotations and social phenomena.

The course objectives include knowledge goals (mastering the history of film development, basic theories of film arts, and elements of film creation), ability goals (developing the ability to analyze films from thematic, narrative, character, and audiovisual language perspectives), and quality goals (enhancing comprehensive artistic literacy, fostering humanistic spirit and innovative thinking, and guiding students to establish correct aesthetic concepts and values).

3. IMPACT OF THE NEW MEDIA ENVIRONMENT ON FILM APPRECIATION COURSES

3.1 Impact on Course Content

The new media environment significantly enriches the content resources for film appreciation courses. Traditional content primarily relied on classic films, while in the new media era, a plethora of niche, avant-garde, and culturally diverse films can be widely disseminated, providing more varied materials for the course. For example, independent art films and niche documentaries have gained more exposure on new media platforms, allowing teachers to incorporate them into the classroom and broaden students' horizons.

Moreover, new media has spawned new film genres, such as web dramas, web films, and short videos, which possess unique creative styles and forms of expression, becoming essential components of course content. For instance, short videos, known for their fragmented and highly creative nature, can be used by teachers to guide students in understanding the creative techniques and dissemination patterns of this emerging film form.

Furthermore, the abundance of film information and reviews available on new media platforms facilitates the updating and expansion of course content. Teachers can keep up with industry trends and introduce the latest film news and popular topics into classroom discussions, making the course content timelier and more relevant.

3.2 Impact on Teaching Methods

New media technologies provide robust support for innovating teaching methods in film appreciation courses. The hybrid teaching model, combining online and offline elements, is gradually becoming mainstream. Instructors can utilize online platforms such as MOOCs and Rain Classroom to release course videos and learning materials, assign online tasks and tests, allowing students to schedule their online learning at their convenience. In-class, teachers can employ face-to-face explanations, group discussions, and case analyses to delve into key issues, thereby integrating the strengths of online and offline teaching.

Interactive teaching methods have become increasingly prevalent, leveraging the interactivity of new media to facilitate real-time engagement among students. For example, using bullet screen features allows students to express their thoughts and feelings while watching films, enhancing their sense of participation; conducting online polls and Q&A activities stimulates students' interest in learning.

Immersive teaching technologies such as virtual reality (VR) and augmented reality (AR) are also beginning to be integrated into film appreciation courses. These technologies enable students to experience film scenes firsthand, enhancing comprehension and engagement. For instance, when analyzing grand historical scenes in films, students can use VR equipment to feel as if they are transported to the historical setting, experiencing the atmosphere created by the film more vividly.

3.3 Impact on Student Learning Experience

The new media environment enhances students' learning experiences. On one hand, students have easier access to film resources, allowing them to choose films based on their interests and learning pace, facilitating

personalized learning. On the other hand, the interactive features of new media platforms enable real-time communication between students and teachers or peers, fostering timely feedback and guidance. This interactive learning experience encourages students to be more engaged and proactive in their studies.

Additionally, the learning resources available in the new media environment encompass a variety of multimedia forms, such as video explanations, image presentations, and animated demonstrations, making the learning process more vivid and engaging. For example, when explaining audiovisual language in film, using animations to demonstrate shot transitions and composition techniques is often more understandable than traditional text-based explanations. Moreover, new media platforms allow students to showcase their work, enabling them to express their understanding and insights through creating short video reviews or writing online critiques, thereby enhancing their overall abilities.

4. REFORM PRACTICES OF FILM APPRECIATION COURSES IN THE NEW MEDIA ENVIRONMENT

4.1 Optimization of Course Content System

In the new media environment, optimizing the content system of film appreciation courses is essential. First, classic film content must be re-evaluated and integrated. While traditional classic films have stood the test of time, their presentation and interpretation in the new media era need to evolve. For instance, when discussing "The Godfather," instructors should analyze its narrative structure and character development while also incorporating diverse interpretations from new media platforms, such as cultural metaphors and cross-media communication, to help students understand the significance of classic films in different contemporary contexts.

Secondly, it is crucial to incorporate emerging film content. Web series are particularly popular among younger audiences due to their unique narrative rhythms and relatable themes. For example, "The Bad Kids" has garnered widespread attention for its gripping storyline and reflection of social issues. Including such web series in the curriculum helps students recognize the innovative development of film arts in the new media era. Additionally, short videos, characterized by low production thresholds and rapid dissemination, are rich in creative elements. Instructors can analyze representative short videos, focusing on creativity, filming techniques, and dissemination effects to cultivate students' appreciation skills and creative thinking regarding this new form of media.

Furthermore, course content should emphasize the integration of multicultural elements. New media has transcended geographic limitations, allowing diverse film cultures from various countries to be widely disseminated. Introducing excellent international films, such as French New Wave cinema and Japanese animated films, can broaden students' global perspectives and enhance their cross-cultural understanding. By comparing films from different cultural backgrounds, students gain insights into the close relationship between film arts and culture, thereby improving their cultural literacy.

4.2 Innovation in Teaching Methods and Approaches

The hybrid teaching model, combining online and offline elements, has become a significant direction for innovating teaching methods in film appreciation courses. In online teaching, instructors can utilize high-quality platforms like China University MOOC and XueTang Online to release well-crafted course videos. These videos should not only cover fundamental knowledge but also include in-depth analyses of classic films. Additionally, discussion forums on these platforms allow students to share their viewing experiences freely, with instructors providing timely feedback and guidance. For example, when discussing "Farewell My Concubine," instructors can share relevant materials and analysis videos online, prompting students to discuss character fates and cultural meanings in the discussion area, where instructors can comment on and expand students' viewpoints.

In the classroom, various interactive teaching methods can be employed. Collaborative learning groups allow students to analyze specific films, co-write reviews, or prepare thematic presentations. For instance, while appreciating the sci-fi film "Interstellar,"

students can discuss the scientific concepts and philosophical reflections within the film, fostering teamwork and critical thinking. Role-playing is another effective strategy, where instructors create scenarios related to film works, allowing students to embody characters and experience the emotions and conflicts within the narratives. For example, in studying historical films, students can simulate dialogues between historical figures, deepening their understanding of the film's context and character motivations.

Immersive teaching technologies such as virtual reality (VR) and augmented reality (AR) are also being applied in film appreciation courses, providing students with new learning experiences. Using VR devices, students can immerse themselves in film scenes; for example, when analyzing disaster films, students can feel as if they are present in the disaster scenario, gaining a visceral understanding of the tension and emotional impact conveyed. AR technology can integrate virtual elements from films with real-world settings, enhancing student interaction. For instance, when discussing animated films, AR can bring animated characters into the physical environment, allowing students to observe them from various angles and learn about character design and production principles.

4.3 Improvement of Course Evaluation System

Establishing a diversified evaluation system is crucial for the reform of film appreciation courses in the new media environment. Evaluation should combine teacher assessments, self-evaluations, and peer evaluations. Teacher evaluations should focus not only on students' mastery of film knowledge but also on their performance in class discussions, group collaborations, and the enhancement of analytical skills and aesthetic appreciation. Self-evaluations help students reflect on their learning processes and outcomes, clarifying their strengths and weaknesses. For instance, after completing a film review, students can evaluate their writing process, viewpoint expression, and depth of understanding based on set criteria. Peer evaluations encourage communication and learning among students; through this process, students can learn from each other's perspectives and methods, broadening their thinking.

The content of evaluations should also be diverse, including not only traditional exam scores but also classroom performance, assignment completion, and practical project outcomes. Classroom performance can be assessed based on participation, quality of contributions, and teamwork abilities. Assignment completion should not only evaluate students' understanding and application of knowledge but also consider creativity and unique insights. Practical project outcomes are indicators of students' comprehensive capabilities, including their short films or film poster designs. For example, when assessing student-made short films, evaluation criteria can encompass scriptwriting, filming techniques, editing skills, and thematic expression.

Evaluation methods should also keep pace with the times and leverage new media technologies. Online learning platforms can provide data analysis features to document students' learning trajectories in real-time, such as video viewing duration, discussion participation frequency, and assignment completion times, offering objective bases for evaluation. Instructors can utilize online polls and surveys to gather student feedback and suggestions regarding the course, allowing for timely adjustments to teaching strategies. Additionally, establishing student learning portfolios to integrate various works and evaluation records throughout the course can comprehensively showcase students' learning progress, providing richer materials for comprehensive evaluations.

5. CHALLENGES AND ISSUES IN REFORMING FILM APPRECIATION COURSES IN THE NEW MEDIA ENVIRONMENT

5.1 Technical Application Challenges

The application of new media technology in film appreciation courses faces several challenges. First, there are issues regarding the availability and updating of technical equipment. The use of advanced technologies like VR and AR requires corresponding hardware support, such as VR headsets and AR glasses, which can be expensive, making it difficult for some institutions to afford large-

scale procurement. Furthermore, the rapid pace of technological advancement necessitates continuous financial investment for schools to update equipment, ensuring effective teaching. For instance, a university may purchase a batch of VR devices for instructional purposes, but within a year, due to technological upgrades, the original equipment may no longer meet educational needs, and budget constraints hinder timely updates.

Secondly, there are concerns about the stability and compatibility of technology applications. During the use of new media teaching platforms, issues like lagging or disconnections can disrupt teaching progress and detract from the student learning experience. Compatibility problems may arise between different teaching software and devices; for example, some online teaching platforms may not function correctly on certain models of phones or computers. Additionally, the application of emerging technologies in film education is still in the exploratory stage, lacking established teaching cases and operational guidelines, leaving teachers uncertain about effectively using technology to achieve educational objectives.

5.2 Need for Teacher Capability Enhancement

In the new media environment, teachers need to develop multiple competencies. On one hand, they must master the application of new media technologies. Teachers should not only be familiar with online teaching platform operations, such as course construction and management on MOOC platforms, and using interactive features on platforms like Rain Classroom, but should also be skilled in using video editing and image processing tools to create teaching resources. For instance, teachers need to edit film clips into suitable materials for classroom instruction, requiring them to possess video editing skills. However, many teachers currently have limited proficiency in new media technologies, preventing them from fully leveraging technological advantages in teaching.

On the other hand, teachers' pedagogical philosophies and methods need to be updated. In the new media era, students' learning styles and needs have changed, requiring teachers to shift from traditional knowledge transmitters to guides and facilitators of student learning. Teachers need to learn to design student-centered teaching activities that stimulate students' interest and initiative. For example, organizing small group discussions and project-based learning in class may be challenging for some teachers who are still constrained by traditional teaching mindsets. Furthermore, teachers should enhance their expertise in film studies by staying informed about new developments and trends in the film industry, so that they can incorporate the latest knowledge and ideas into their teaching.

5.3 Challenges in Student Learning Management

In the new media environment, students face new challenges in learning management. First, there is the issue of attention distraction. The vast amount of information on new media platforms can lead to students being easily distracted by irrelevant content; for instance, while watching online course videos, students may be drawn away by notifications from social media, resulting in decreased focus and learning efficiency. According to relevant surveys, over 60% of students reported experiencing external distractions during online learning that negatively affected their learning outcomes.

Secondly, there are significant differences in students' self-directed learning abilities. While the new media environment provides conveniences for self-directed learning, some students lack awareness and skills to effectively plan their study time and create study schedules. For example, when completing online course assignments, some students exhibit severe procrastination and fail to submit work on time, and instances of plagiarism are reported. Additionally, in group cooperative learning, some students may engage in "free-riding" behaviors, relying on others to complete tasks without contributing, which complicates classroom management.

6. CONCLUSION

This study thoroughly explores the reform and practice of film appreciation courses in the new media environment. Based on a clear understanding of the characteristics of the new media environment and the content and objectives of film appreciation courses, it

analyzes the impacts of the new media environment on course content, teaching methods, and student learning experiences. Through practices such as optimizing the course content system, innovating teaching methods and approaches, and improving the course evaluation system, feasible pathways are provided for enhancing the teaching quality of film appreciation courses. However, challenges remain, including technical application issues, the need for teacher capability enhancement, and student learning management difficulties. In the future, further research and investment in the application of new media technologies in film appreciation courses should be prioritized, along with efforts to enhance teachers' comprehensive competencies and strengthen student learning management. This will continue to promote the innovative development of film appreciation courses in the new media environment, better cultivating students' film appreciation skills, aesthetic literacy, and comprehensive artistic cultivation to meet the new demands of film education in contemporary society.

REFERENCES

[1] Chai, Y., & Yang, F. H. (2020). The Aesthetic Transformation of Film and Television Art in the New Media Era. Journal of Ocean University of China (Social Sciences Edition), (1), 144 - 151.

[2] Ministry of Education, National Development and Reform Commission, Ministry of Finance, Ministry of Culture, and State Administration of Radio and Television. (2008, June 19). Notice on Further Carrying out Film and Television Education in Primary and Secondary Schools [EB/OL]. Retrieved from http://www.moe.gov.cn/srcsite/A06/s3325/201001/t20100120_81874.html (Accessed on March 22, 2025).

[3] Zhang, Y. (2020). Exploration on the Innovation of Teaching Mode of Film and Television Appreciation Course in Colleges and Universities. Education Teaching Forum, (37), 234 - 235.

[4] Northeast Petroleum University. (2024, XX - XX). Construction of Aesthetic Education Courses in Colleges and Universities in the New Media Environment - Taking the Film Appreciation Course as an Example [EB/OL]. Retrieved from http://mp.weixin.qq.com/s?__biz=Mzk0NTM4MzkwMA==&mid=2247496814&idx=1&sn=b78fb58ad7d5ecff1bc918fd28d08bfb&scene=0 (Accessed on March 22, 2025).

[5] Wang, X. D. (2018). Research on the Teaching Practice of Film and Television Appreciation Course in Colleges and Universities under the New Media Environment. Journal of Heihe University, 9(11), 134 - 135.

[6] Li, H. (2024). Research on the Influence of New Media on Film and Television Appreciation Teaching. Media Forum, 7(2), 158 - 160.

[7] Zhao, D. (2023). Exploration on the Innovative Mode of Film and Television Appreciation Course Based on New Media. Home Drama, (24), 171 - 173.

[8] Liu, J. (2022). The Reform Path of Film and Television Appreciation Course in the New Media Era. West China Broadcasting TV, 43(15), 50 - 52.

[9] Chen, C. (2021). New Media Technology Facilitates the Practice and Development of Film and Television Appreciation Courses. Journal of News Research, 12(10), 249 - 250.

[10] Wang, L. (2020). The Teaching Reform and Practice of Film and Television Appreciation Course in the New Media Environment. Education Modernization, 7(22), 117 - 119.

Research on Innovation in Student Management in Higher Education under the Informationization Background

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Abstract: This study aims to explore innovative pathways for student management in higher education within the context of informationization, enhancing management efficiency and promoting holistic student development. Utilizing literature review methodology, the research extensively examines domestic and international academic achievements to understand the current application and development trends of information technology in student management. Through system analysis, the study identifies challenges faced by existing student management models in the information age, such as information silos and cumbersome management processes. Building on this foundation, the research delves into multiple dimensions, including management philosophy, technology application, and institutional construction, proposing innovative strategies for establishing an information-based student management system. The findings indicate that universities should adopt a student-centered information management philosophy, deeply integrate advanced technologies such as big data and artificial intelligence, streamline management processes, and refine relevant systems to achieve precise, efficient, and personalized student management, thereby providing strong support for the innovative development of student management practices in higher education.

Keywords: Informationization; Student Management in Higher Education; Innovative Strategies; Management Philosophy; Information Technology

1. INTRODUCTION

1.1 Research Background and Significance

With the rapid development of information technology, digital transformation has penetrated various sectors, particularly in higher education management. The push for informationization poses a challenge to traditional student management models, necessitating a re-evaluation. Implementing informationization not only enhances the efficiency of university administrators but also transforms the student management experience. Educators are increasingly recognizing that the application of information technology can significantly improve interaction between students and managers, thereby optimizing the learning environment and enhancing teaching quality. Therefore, researching innovations in student management under the informationization background has become a crucial task for many universities to achieve refined management and improve educational quality. The practical significance of this study is profound. By exploring how information technology meets the needs of higher education, the research aims to gradually construct a new management system in higher education that aligns with the demands of the new era. This transition not only helps universities fulfill their educational and managerial responsibilities but also lays a foundation for effectively connecting multiple functions, including cultural transmission, knowledge exchange, and social service.

1.2 Review of Domestic and International Research Status

Research on the informationization of student management in higher education began earlier abroad, especially in Europe and the United States, where the integration of information technology and educational management has reached a considerable scale. For example, many U.S. universities successfully utilize data analytics to monitor and assess student behaviors and academic performance, which

not only enhances the precision of student management but also provides a solid data foundation for academic research. Research by Black and Dunga (2019) indicates that intelligent educational management systems can significantly reduce errors in student enrollment management, accurately identify student needs, and improve teaching satisfaction.

In China, universities are also showing a positive trend in informationized student management. The Ministry of Education's "Action Plan for Educational Revitalization in the New Era (2020-2035)" explicitly states the guiding role of information technology in educational reform. Institutions like Tsinghua University and Fudan University have built smart campuses, integrating course management, academic administration, and student management to maximize resource utilization. However, despite significant progress, challenges remain, including incomplete technical systems and outdated management philosophies that need to be addressed while remaining vigilant in efforts to elevate the overall level of educational informationization across universities in the country.

1.3 Research Methods and Innovations

This study primarily employs literature analysis, case studies, and questionnaire surveys to explore optimization paths for student management in higher education under the informationization context, combining the characteristics and practical situations of Chinese universities. The innovations of this research include:

Integrating modern network technologies to provide accurate data analysis and management tools, promoting the scientific management of higher education.

Adopting a combination of vertical and horizontal dimensions to seek a broader perspective, conducting multidimensional analysis and optimization design from institutional and technological levels.

Establishing a student-centered information management mechanism that explores dynamic feedback strategies based on big data and personalized services.

2. THEORETICAL FOUNDATIONS RELATED TO INFORMATIONIZATION AND STUDENT MANAGEMENT IN HIGHER EDUCATION

2.1 Overview of Informationization Theory

Informationization refers to the integration of information that can be obtained, analyzed, disseminated, and applied through information systems, tools, and platforms across various sectors, ultimately enhancing operational efficiency and effectiveness. In higher education, informationization extends beyond merely adopting information systems; it includes the comprehensive integration of intelligent platforms, cyberspace, and physical information technology entities within the institution.

Research indicates that while China has made strides in informationization, there remains a gap when compared to international educational standards. A 2019 survey revealed that China scored 5.9 on the informationization scale, compared to the global average of 7.6, indicating insufficient educational support from funding and decision-making levels.

2.2 Theoretical Foundation of Student Management in Higher Education

Student management in higher education refers to the series of services and institutional arrangements provided by universities to facilitate students' daily lives, learning, and development. The theoretical framework for student management generally revolves around several core components: student organizations (e.g., student unions), counselor work, mental health management, and career development guidance. These areas help universities consider student factors comprehensively in their management processes, thereby promoting system optimization and rational management.

As educational reflections deepen and educational concepts evolve, student management has shifted from a singular focus on constraints and control to fostering student activities and shaping values, leading to profound changes in this field.

2.3 Impact Mechanism of Informationization on Student Management in Higher Education

The impact mechanism of student management under the context of informationization can be divided into several aspects, including information acquisition,

resource integration, decision support, and response mechanisms. Students gain timely and targeted information through information tools (e.g., mobile apps, learning platforms), which helps effectively expand academic support channels.

The emergence of object-oriented programming (OOP) and general disciplines (e.g., data science, artificial intelligence) has disrupted course design and management models, prompting schools to shift traditional educational mindsets and innovate in educational content and management practices.

3. CURRENT SITUATION ANALYSIS OF STUDENT MANAGEMENT UNDER THE INFORMATIONIZATION BACKGROUND

3.1 Current Application of Information Technology in Student Management

In recent years, many universities have placed significant emphasis on informationization to effectively address the increasing student population and diverse needs. Steps taken to build campus networks and information management systems, such as comprehensive information service platforms, electronic academic systems, and cloud classrooms, have established a multidimensional management system. According to the "Annual Report on Informationization of Chinese Universities (2022)," 96% of universities have applied management information systems to varying degrees. Many institutions utilize cloud-based information management systems to achieve information resource sharing, significantly enhancing the speed of management and communication.

A survey conducted across 50 universities revealed that 90% of institutions have adopted mobile technology, utilizing learning apps and QR codes to gather real-time feedback from students and dynamically adjust education quality. For instance, Shaanxi Normal University has entered a new phase of management by implementing a cloud platform that enhances empathy feedback and presentation capabilities across its educational framework. The efficiency characteristics observed in administrative decision-making and data analysis stem from the adaptability of users to the information platform technology.

3.2 Effectiveness and Limitations of Existing Management Models

Currently, despite the strong penetration of informationization into university student management, several limitations and shortcomings remain evident. The student self-service-oriented model often progresses based on its existing structures, contradicting the slow-moving mechanisms intended to facilitate its advancement. A 2018 survey indicated that the satisfaction rate among teachers and students regarding the current management system was below 45%.

On the other hand, the various methods arising from information management still exhibit uneven efficiency; some universities are more comprehensive and systematic, while others tend to be less coordinated, lacking horizontal integration and nationwide coverage. This leads to certain local institutions prioritizing specific processes, while traditional management models struggle to adapt to the new information landscape.

3.3 Student and Manager Perceptions and Feedback on Information Management

To address the current situation, a questionnaire survey was conducted, revealing that 82% of students believe that information management has improved communication efficiency, while 73% of managers appreciate the resource sharing and convenience brought by informationization. Notably, only 35% of respondents expressed a proactive attitude towards engaging with technology in a manner that encourages data analysis and usage for comprehensive assessment, often resorting to formal feedback. This indicates a preliminary engagement with student management psychology that has yet to achieve deep internalization and transformation, suggesting that further practical implementation of new technological services is needed to reach an effective transition.

4. CHALLENGES FACED BY STUDENT MANAGEMENT IN HIGHER EDUCATION UNDER THE INFORMATIONIZATION BACKGROUND

4.1 Issues of Information Security and Privacy Protection

With the widespread application of

information technology, universities have accumulated vast amounts of personal data on students, including enrollment records, grades, family backgrounds, and mental health statuses. The centralized management and long-term storage of this data increase the risks of information leakage, malicious tampering, and misuse. According to the 2022 Cybersecurity Report released by China's Cyberspace Administration, the proportion of data breaches in universities has been rising year by year, with as much as 40% of student information at large institutions being accessed by external malicious actors.

Privacy issues not only concern students' personal rights but also directly impact the institution's reputation and the legality of its management practices. Once a data breach occurs, it can impose psychological burdens on affected students and potentially expose the university to legal liabilities. Therefore, universities need to establish a robust information security management system and enhance their focus on cybersecurity. Industry experts recommend strengthening information security measures through cybersecurity education, data encryption techniques, and access control mechanisms.

4.2 Challenges in Adapting Technology to Management Processes

Currently, many universities face a disconnect between the introduction of technology and the actual management processes during their informationization initiatives. Ideally, the application of new technologies should integrate with traditional management processes to facilitate business process reengineering, but in practice, the anticipated outcomes often remain unfulfilled. Surveys indicate that over 60% of students find existing management systems complex and user-unfriendly, hampering user experience. Additionally, the varying skill levels of faculty and staff regarding new technologies hinder the smooth transformation of information management.

A case study conducted at Hubei University revealed that the implementation of its information management system involved over 200 operational steps differing from the original management process. Despite significant investments in human and material resources, the anticipated improvements in management efficiency were not realized. Consequently, universities must prioritize technological adaptability and provide relevant training to enhance user proficiency, ensuring that management processes align more cohesively with operational needs.

4.3 Lagging Management Philosophy and Personnel Quality

Some vague perceptions and outdated management philosophies in student management severely undermine the effectiveness of informationization. Traditional views emphasize monitoring and control over students, lacking attention and respect for student agency. In the context of informationization, this static and closed management model is ill-suited to the needs of the new era.

A nationwide educational survey indicated that approximately 58% of university faculty believe that many student management systems are still based on a "control mentality," failing to foster personalized care for students and mutual growth. Moreover, many managements personnel exhibit insufficient awareness of new technological knowledge, with overall competencies not meeting the requirements of informationized management.

5. INNOVATIVE STRATEGIES FOR STUDENT MANAGEMENT IN HIGHER EDUCATION UNDER THE INFORMATIONIZATION BACKGROUND

5.1 Innovating Management Philosophy to Establish a Student-Centered Orientation

Student management in higher education needs to transition from a "rule-based" approach to a "service-oriented" concept centered on students. To achieve this, it is essential to reassess management goals and pathways, promoting students' roles as active participants in the management process. Specific strategies can include establishing open communication mechanisms and conducting regular internal and external surveys to understand student needs and opinions. Creating a culture of feedback and acceptance will further advance a diverse participation model centered around students.

For instance, Xiamen University implemented a team mentoring system during new student

orientation in 2021, addressing significant issues in traditional management practices. This approach received widespread acclaim, with digital feedback indicating a nearly 43% increase in students' training needs. Innovations in both technology and philosophy can contribute to cultivating a positive environment and culture.

5.2 Deepening Technology Application to Build an Intelligent Management Platform

Universities with low levels of informationization urgently need to adopt intelligent management platforms to improve efficiency and reduce the workload on staff. For example, leveraging big data analytics can facilitate systematic evaluations of students' learning conditions, psychological states, and behavioral habits to achieve precise management. However, challenges persist in effectively utilizing technology.

Qingdao University of Science and Technology has established a "smart campus" management platform utilizing AI and big data technology to monitor and analyze enrollment, attendance, and psychological assessment data in real-time, significantly enhancing management transparency and efficiency. This platform also offers robust data support to teachers, ensuring that teaching methods align with student needs.

5.3 Improving Management Systems to Ensure Effective Operation of Informationized Management

As information technology gradually integrates into management practices, universities must establish and refine corresponding management systems, including standardized processes for applying information technology across various management domains, clearly defined roles and responsibilities, and a traceable feedback mechanism. This approach ensures that information serves not merely as a one-sided clue but as a comprehensive overview of management roles.

Legal and ethical guidance for information management also needs timely incorporation into institutional frameworks. Some universities have implemented a "dual responsibility system," where management is accountable for a democratic feedback mechanism throughout the process, while also granting some rights to faculty and students to adjust roles linearly, fostering cooperation and governance at a higher level. This strategy aims to address critical data flow and learning system security issues effectively.

6. CONCLUSION

The innovation of student management in higher education under the informationization context has profound significance. The challenges presented, such as information security, technological adaptability, and personnel quality, are critical factors hindering the successful implementation of informationized management. After in-depth analysis of these issues, it is evident that universities need to adjust their management philosophies, strengthen technology applications, and enhance management systems. This innovative process will undoubtedly reinforce the central role of students within the management system and promote an overall improvement in the quality of higher education.

REFERENCES

[1] Chen, C. Research on the Innovative Strategies of College Student Management in the Information Age [J]. Journal of Heilongjiang Institute of Teacher Development, 2024, 43(02): 74 - 76.

[2] Lin, L. Analysis of the Innovative Paths of College Student Management in the Era of Big Data [J]. China Journal of Multimedia & Network Teaching (First Half), 2023(07): 186 - 188.

[3] Wang, H. Research on the Innovation of College Student Management Model under the Background of Informatization [J]. Modern Vocational Education, 2023(16): 142 - 144.

[4] Li, H. The Innovative Practice of College Student Management under the Background of Internet+ [J]. China Adult Education, 2022(11): 44 - 47.

[5] Zhang, Y. Discussion on the Innovative Strategies of College Student Management Based on Informatization [J]. Industrial & Science Tribune, 2022, 21(06): 257 - 258.

[6] Zhao, Q. Challenges and Countermeasures of College Student Management in the Era of Big Data [J]. Theory and Practice of Education, 2021, 41(18): 29 - 31.

[7] Liu, Y., Zhang, X. Research on the Innovation of College Student Management under the Background of Informatization [J]. Educational Research and Innovation, 2020, 10(02): 45 - 56.
[8] Wang, L., Li, M. Exploration on the Innovation of College Student Management in the Information Age [J]. Journal of Higher Education Research, 2019, 35(03): 78 - 89.
[9] Smith, J. The Impact of Information Technology on College Student Management: Challenges and Opportunities [J]. International Journal of Educational Technology, 2021, 28(04): 123 - 135.
[10] Johnson, A. Informatization and the Innovation of College Student Management Practices [J]. Journal of Educational Leadership and Management, 2020, 15(02): 67 - 79.

Optimization of the Curriculum System for Engineering Cost Management and Its Dynamic Alignment with Industry Demand

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Abstract: This study focuses on the optimization of the curriculum system for engineering cost management and its dynamic alignment with industry demands. Given the rapid development of the engineering cost industry and the evolving requirements for professional capabilities, the curriculum must adapt to cultivate suitable talent. Utilizing literature review, survey research, and data analysis, this research examines the current status of engineering cost curricula and industry trends both domestically and internationally. Initially, a comprehensive literature review was conducted to establish a research foundation. Subsequently, surveys and interviews were carried out with industry stakeholders, educational institutions, and students to gather primary data. Statistical analysis tools were employed for in-depth data exploration. The findings reveal shortcomings in the existing curriculum, particularly in terms of practical course proportions, integration of emerging technologies, and course coherence, indicating a disconnect with industry needs. To address these issues, recommendations include optimizing course structure, introducing cutting-edge technology courses, enhancing practical teaching components, and establishing a dynamic curriculum adjustment mechanism. These measures aim to achieve dynamic alignment with industry demands and improve the quality of talent cultivation in engineering cost management, thereby continuously supplying high-quality professionals to the industry.

Keywords: Engineering Cost Management; Curriculum Optimization; Industry Demand; Dynamic Alignment; Talent Development

1. INTRODUCTION

1.1 Research Background and Significance

With the sustained growth of China's economy and steady urbanization, the construction industry remains a pillar of the national economy, maintaining robust development in infrastructure and real estate. According to the China Construction Industry Association's "2024 Statistical Analysis of Construction Industry Development," the total output value of the construction industry is projected to reach 32.65 trillion yuan in 2024, a year-on-year increase of 3.85%. As a critical component of the construction industry, engineering cost management plays a vital role in precise cost control and rational resource allocation.

Simultaneously, the engineering cost sector is undergoing profound changes. Emerging technologies such as Building Information Modeling (BIM), big data, and artificial intelligence are increasingly integrated, transforming cost management towards digitization and intelligence. For example, BIM enables information integration and sharing throughout the project lifecycle, allowing cost engineers to accurately predict costs early in the project, thereby effectively reducing changes and waste. Industry reports indicate that BIM applications can reduce project costs by 20%-30% and shorten timelines by 10%-20%. Moreover, the rise of green and prefabricated buildings imposes new skills and knowledge requirements on professionals in the field. For instance, familiarity with green building standards and the cost accounting associated with prefabricated components is essential. Currently, China's green building label projects number over 35,000, covering more than 3.8 billion square meters, indicating a growing demand for talent in green building cost management.

However, the current curriculum for engineering cost programs in higher education

has not kept pace with these industry changes. Traditional curricula focus heavily on theoretical knowledge while practical training is relatively weak, leading to insufficient preparedness for complex projects in real-world applications. Additionally, the slow update of course content fails to incorporate emerging technologies and industry trends, resulting in a disconnect between the skills of graduates and the needs of the industry. The "2024 Talent Report for the Construction Industry" by Master Human Resources Group shows that over 60% of construction companies believe recent graduates lack essential skills in new technologies and practical applications.

Therefore, researching the optimization of the engineering cost curriculum and its dynamic alignment with industry demand is of significant practical importance. By optimizing the curriculum, we can train more high-quality professionals that meet the evolving demands of the industry, enhancing the core competitiveness of construction enterprises and promoting high-quality development in the sector. From an educational perspective, this research will aid in advancing teaching reforms in higher education, improving the quality of talent cultivation in engineering cost management, and achieving deep integration between education and industry.

1.2 Review of Domestic and International Research

Internationally, developed countries such as the U.S. and Europe have initiated research on engineering cost education earlier, resulting in a relatively mature curriculum system. U.S. engineering cost education emphasizes practical skills, with many universities forming close partnerships with industry to provide students with real-world insights through internships and project-based learning. For example, Penn State University's engineering cost program includes numerous practical segments based on real industry projects, allowing students to gain significant hands-on experience under the guidance of instructors and industry mentors. In terms of curriculum content, foreign universities frequently update their programs to reflect industry trends by integrating new technologies and concepts. For instance, Cranfield University in the UK has incorporated life-cycle cost management (LCC) principles into its engineering cost courses, equipping students with skills for comprehensive cost management from project inception to deconstruction.

Domestically, research on the engineering cost curriculum is also advancing. In recent years, with the rapid development of China's construction industry and the promotion of engineering education accreditation, numerous scholars and educators have conducted extensive studies on curriculum optimization. Some researchers propose a student-centered, outcome-oriented, and continuously improving curriculum framework based on engineering education accreditation, emphasizing the cultivation of comprehensive abilities and professional qualities among students. Other studies focus on optimizing practical training by increasing the proportion of hands-on courses and building practical training bases to enhance students' operational abilities. However, domestic research still faces challenges, such as insufficient timely tracking of industry demand dynamics, limited flexibility in curriculum adjustments, and a need for further strengthening interdisciplinary course offerings.

While both domestic and international research has yielded achievements in optimizing engineering cost curricula, there remains significant room for exploration regarding how to accurately align curriculum systems with dynamic industry demand in real time.

1.3 Research Objectives and Innovations

This study aims to analyze the current state and trends of the engineering cost industry, clarifying the competency requirements for professionals. By comprehensively evaluating the existing curriculum system for engineering cost management, the research seeks to identify gaps between the curriculum and industry demand, and to propose targeted optimization strategies, developing a dynamic matching mechanism to ensure tight alignment between the curriculum and industry needs, ultimately enhancing the quality of talent cultivation.

The innovations of this study are primarily reflected in several areas:

Innovative Perspective: This research adopts a dynamic matching perspective, integrating industry demand changes throughout the curriculum optimization process, breaking the limitations of static analysis in traditional studies.

Methodological Innovation: A variety of research methods are employed, including big data analysis techniques for real-time monitoring and analysis of industry demand data, and system dynamics methods to develop a curriculum system and industry demand dynamic matching model, yielding more scientific and accurate results.

Outcome Innovation: This study proposes a set of actionable curriculum optimization strategies and a dynamic matching mechanism, providing practical plans for reforming engineering cost education in universities and promoting deep integration between education and industry development.

2. THEORETICAL FOUNDATIONS

2.1 Overview of Engineering Cost Theory

Engineering cost theory encompasses multidisciplinary knowledge, focusing on cost management throughout the construction process. It spans from investment estimation in the project decision phase, budget preparation during design, to contract price management, change control, and settlement in the construction phase, covering the entire project lifecycle. The theoretical foundation includes engineering economics, which analyzes project costs and benefits to support investment decisions. For example, net present value (NPV) and internal rate of return (IRR) are used to evaluate economic feasibility during project feasibility studies. Engineering quota principles are also crucial, establishing quantitative standards for labor, materials, and machinery necessary for producing qualified products, serving as a basis for cost estimation. For instance, budget quotas determine the budget cost of construction projects, while construction quotas guide internal cost controls. Additionally, engineering contract management theory ensures reasonable determination and effective control of costs within contract frameworks, with different contract types (e.g., fixed-price contracts, unit-price contracts, cost-plus contracts) influencing cost management in various ways.

2.2 Curriculum System Construction Theory

Curriculum construction theory provides a guiding framework for optimizing the engineering cost curriculum. Represented by Tyler's objective model, it emphasizes the clear establishment of course objectives based on social needs, disciplinary knowledge, and student characteristics, followed by selecting course content, organizing teaching activities, and evaluating the curriculum. In constructing the engineering cost curriculum, the primary goal is to cultivate professionals who meet industry demands, subsequently filtering core course contents such as engineering measurement and valuation, and engineering cost management, alongside reasonable sequencing of teaching. Bruner's structuralist curriculum theory advocates for a subject-centered approach, emphasizing the mastery of fundamental concepts, principles, and methods. For engineering cost management, this involves ensuring students grasp core knowledge structures related to cost control methods and basic principles. Constructivist learning theory posits that learning is an active process of knowledge construction, necessitating curriculum design that emphasizes practical training and student autonomy. Courses should involve project design, internships, and practical training to help students build understanding and application capabilities for engineering cost knowledge.

2.3 Industry Demand Analysis Theory

Industry demand analysis theory provides methodologies for accurately understanding the competency needs in the engineering cost sector. Common methods include surveys, where scientifically designed questionnaires are distributed to construction companies and cost consulting firms to gather information on knowledge, skills, and qualities desired in talent. Interviews with industry experts and company executives also serve as a vital means to gain insights into industry trends and expectations for talent capabilities. For example, interviews can reveal that companies increasingly require talent skilled in BIM software and digital tools due to the application of digital technologies in the industry. Trend analysis methods study

historical data and development dynamics to predict future changes in industry demand, such as analyzing growth trends in construction industry output and applications of new building technologies. This provides a basis for curriculum adjustments in response to anticipated changes in demand for engineering cost professionals.

3. CURRENT STATUS AND DEMAND ANALYSIS OF THE ENGINEERING COST INDUSTRY

3.1 Current Development Trends

Currently, China's engineering cost industry is expanding in scale and diversifying its offerings. In addition to traditional services such as project valuation and bidding agency, new services like full-process engineering consulting and project management are emerging. The annual report from the China Construction Cost Management Association indicates that in 2024, revenue from engineering cost consulting companies is expected to reach 480 billion yuan, representing a year-on-year increase of 10.5%, with full-process engineering consulting accounting for 25% of this revenue—a 5 percentage point increase from the previous year.

From a technological perspective, digital transformation is becoming an inevitable trend in industry development. The application of BIM technology in engineering cost management is expanding, enabling automatic calculation of quantities, cost analysis, and simulation through three-dimensional information modeling, greatly enhancing accuracy and efficiency in cost management. Big data technology supports data collection, analysis, and application in engineering cost management, aiding companies in cost forecasting and risk assessment. For instance, a major construction firm utilized big data analysis of past project cost data to establish a cost forecasting model, effectively controlling cost overruns in new projects. Additionally, the rapid development of green and prefabricated buildings significantly impacts the engineering cost sector. Green buildings necessitate consideration of environmental costs throughout the project lifecycle, while prefabricated buildings alter traditional construction processes and cost structures, requiring cost personnel to master new pricing rules and cost control methods.

3.2 Analysis of Talent Capability Requirements

As the industry evolves, the competency requirements for engineering cost professionals are also escalating. In terms of knowledge, professionals are expected to understand not only traditional areas such as engineering measurement and valuation, but also emerging technologies like BIM and big data applications in engineering cost, as well as cost management knowledge related to green and prefabricated buildings. For instance, cost personnel are expected to use BIM software for quantity calculations and cost analyses and to be familiar with green building evaluation standards and associated costing methods.

On the skills front, proficiency in engineering cost and office software, along with strong communication and coordination abilities, are essential. Cost professionals must liaise effectively with various project stakeholders (e.g., owners, design firms, construction units) to ensure smooth cost management processes. Furthermore, as full-process engineering consulting becomes more common, project management skills and risk assessment capabilities are increasingly vital. For example, during project implementation, professionals need to identify potential cost risks and develop appropriate mitigation strategies.

In terms of qualities, the industry expects talent to demonstrate strong professional ethics, innovation awareness, and team collaboration spirit. Given the substantial financial stakes involved in engineering cost work, maintaining ethical standards is crucial to ensure the accuracy and authenticity of cost data. In light of rapid industry developments, fostering innovation helps cost professionals explore new management methods and technology applications, while collaborative skills are essential for ensuring smooth operations throughout the project phases.

3.3 Analysis of Talent Supply-Demand Gap

Despite universities graduating large numbers of engineering cost professionals each year, significant gaps remain between graduates and industry demands. In terms of specialized knowledge, some graduates lack

understanding of new technologies and cost management associated with emerging building patterns. A survey by Master Human Resources Group indicates that about 40% of firms believe recent graduates are deficient in BIM knowledge and insufficiently knowledgeable about green building and prefabricated construction cost management.

In terms of skills, many graduates demonstrate inadequate software proficiency, with communication and project management abilities needing improvement. While graduates often learn engineering cost software in school, they struggle with real-world software applications in complex projects, impacting their work efficiency. Furthermore, in terms of teamwork and communication, some graduates find it challenging to collaborate effectively with other professionals, lacking a holistic perspective and the ability to respond to unexpected situations in project management.

Regarding professional qualities, some graduates exhibit weak ethical awareness and insufficient innovation capabilities. Instances of manipulating cost data for personal gain have been reported, and graduates often lack proactive problem-solving skills when faced with new challenges, adhering to traditional working methods. This talent-supply gap not only affects graduate employment quality but also constrains further industry development.

4. ASSESSMENT OF THE CURRENT CURRICULUM SYSTEM FOR ENGINEERING COST MANAGEMENT

4.1 Analysis of Curriculum Structure and Content

Currently, most universities offering engineering cost management programs have a curriculum that includes general education courses, foundational professional courses, specialized courses, and practical training. Statistics from several domestic universities indicate that general education courses account for approximately 30%-35% of total credits, covering subjects such as English, advanced mathematics, and political theory, aimed at developing basic humanistic qualities and foundational skills. Foundational professional courses constitute around 25%-30% of credits, including subjects like engineering drawing, engineering mechanics, and civil engineering materials, which lay the groundwork for further specialized study. Specialized courses, such as engineering measurement and valuation, cost management, and contract management, make up about 20%-25% of credits. Practical courses account for approximately 15%-20%, including course design, internships, and graduation projects.

However, there are imbalances in the curriculum structure. The high proportion of general education courses reduces the time allocated for specialized courses, leading to superficial coverage of professional knowledge. Additionally, there is an excessive focus on traditional cost courses, with insufficient offerings related to emerging technologies and industry trends. For instance, courses on green building cost management and the application of BIM technology are rarely offered as core courses, mainly available as electives in a few universities, which fails to meet the changing knowledge structure required by the industry. Moreover, the connection between courses is often weak, with some content being repetitive while other knowledge segments are disconnected, hindering the systematic construction of students' knowledge.

4.2 Examination of Course Content and Teaching Methods

In terms of course content, some materials are outdated. For instance, engineering measurement and valuation courses still predominantly rely on traditional manual calculation methods, failing to adapt to the updated standards for bill of quantities pricing and market price fluctuations. Surveys indicate that over 80% of projects in cost consulting firms now utilize bill of quantities pricing models, which updates price information in real-time, yet university curricula have not kept pace with these developments. Furthermore, there is a lack of case studies involving emerging technologies such as big data and artificial intelligence in cost management, with these topics receiving minimal attention in course content.

Regarding teaching methods, most courses remain predominantly lecture-based, resulting in passive knowledge absorption by students. For example, observations in a university's engineering cost management classes reveal that approximately 70% of courses are taught

using traditional lectures, with interactive teaching methods such as case studies, project-based learning, and group discussions being underutilized. This teaching approach fails to engage students actively, hindering the development of their practical skills and innovative thinking. Additionally, there is often a significant gap between simulated projects and actual engineering scenarios in practical training, limiting students' ability to effectively tackle real-world problems.

4.3 Current Status of Practical Training

Practical training is crucial for cultivating professionals in engineering cost management, yet several issues persist. The scheduling of practical courses is often unreasonable, with some courses and internships concentrated at the end of the semester. This compressed timeline requires students to complete both theoretical learning and practical tasks simultaneously, resulting in poor practical outcomes. For example, an internship for engineering cost students was scheduled for the last four weeks of their seventh semester, making it difficult for students to gain in-depth insights into the comprehensive cost management processes within enterprises.

The establishment of practical training bases also requires improvement. While many universities have partnerships with companies, some collaborations are superficial, with limited involvement from enterprises. Some companies prioritize their operational activities over student guidance, resulting in students missing exposure to key aspects of real project work. Statistics indicate that approximately 50% of students report engaging only in basic data organization during internships, without participating in substantive cost management tasks.

Moreover, there is a deficiency in the quality of practical training faculty. Many instructors lack substantial engineering experience, which hampers their ability to provide effective guidance. For instance, less than 30% of practical instructors in one university's engineering cost management program have more than five years of engineering practice experience, leading to compromised quality in practical instruction.

5. ANALYSIS OF THE DISCONNECT BETWEEN CURRICULUM SYSTEM AND INDUSTRY DEMAND

5.1 Manifestations of Disconnect Between Curriculum and Industry Demand

From a knowledge structure perspective, emerging industry needs such as green building cost management and the application of digital cost tools are not adequately reflected in the curriculum. Graduates often require significant time to relearn these essential skills upon entering the workforce. For instance, in green building projects, cost professionals need to be familiar with certification standards and associated cost implications; however, university courses typically provide only cursory coverage of these topics, leaving graduates ill-prepared for cost-related tasks in green projects.

In terms of skill development, there exists a gap between the practical skills, communication and coordination skills, and project management skills demanded by the industry and those cultivated by the curriculum. While graduates learn the basics of engineering cost software, they struggle to proficiently apply these tools in complex project scenarios, hampering their efficiency in cost calculation and analysis. Additionally, due to a lack of systematic training in communication and coordination skills, graduates often find it challenging to effectively collaborate with other professionals, negatively impacting project progress.

At the quality level, the curriculum places insufficient emphasis on fostering students' professional ethics, innovation awareness, and teamwork spirit. Some graduates exhibit weak ethical standards, compromising the accuracy and integrity of cost data for personal gain. When faced with new industry challenges and technologies, graduates often lack the ability to propose innovative solutions and struggle to integrate into teams, missing out on collaborative advantages.

5.2 Factors Affecting Dynamic Matching

The rapid development of the industry is a significant factor contributing to the difficulty in achieving dynamic alignment between the curriculum and industry demand. As new technologies emerge and industry standards evolve, the requirements for talent are continually changing. However, university curriculum adjustments are relatively slow,

requiring lengthy approval processes for course offerings, syllabus revisions, and textbook updates, making it challenging to respond promptly to industry changes.

Moreover, a lack of deep cooperative mechanisms between universities and enterprises exacerbates the situation. Companies are not sufficiently motivated to participate in curriculum construction, and universities lack a full understanding of the actual requirements of enterprises. During course development and practical training phases, effective communication and collaboration are often absent, leading to a disconnect between the curriculum and industry needs. For example, enterprises possess valuable project case studies and the latest industry information but fail to incorporate these into university curricula effectively.

The construction of faculty teams also restricts the dynamic alignment of the curriculum with industry demand. Some instructors lack industry experience and have limited knowledge of the latest developments in the field, making it difficult to integrate real-world contexts into teaching. Furthermore, the assessment and evaluation systems for university faculty often prioritize research outputs, leading to a lack of motivation among teachers to engage in curriculum reform and optimization, thereby hindering the timely update of the curriculum.

6. STRATEGIES FOR CURRICULUM OPTIMIZATION AND ESTABLISHING DYNAMIC MATCHING MECHANISMS

6.1 Principles and Goals for Curriculum Optimization

Curriculum optimization should adhere to principles that are student-centered, industry demand-oriented, and focused on continuous improvement. A student-centered approach means that curriculum design must consider students' interests, abilities, and future career needs to stimulate their motivation and initiative in learning. An industry demand-oriented approach requires that course content closely aligns with industry trends and practical needs, ensuring that the knowledge system is regularly updated to cultivate talent that meets those needs. The principle of continuous improvement emphasizes that the curriculum should be adjusted based on feedback from teaching practices and industry changes to ensure steady enhancement in the quality of talent cultivation.

The optimization goal is to construct a curriculum system that dynamically aligns with industry demand, possesses a rational knowledge structure, and emphasizes practical competencies. By optimizing course offerings, students should acquire a solid foundation of professional knowledge and cutting-edge industry insights, proficient practical skills, effective communication and project management capabilities, as well as high standards of professional ethics and innovation, enabling them to rapidly adapt to industry developments and fulfill entrepreneurial expectations for engineering cost professionals.

6.2 Specific Strategies for Curriculum Optimization

In terms of course offerings, it is advisable to reduce the credit proportion of general education courses and increase the weight of specialized and practical courses. For instance, adjusting the credit allocation to 25%-30% for general education courses, increasing specialized course credits to 30%-35%, and elevating practical course credits to 25%-30%. New courses related to emerging technologies and industry trends, such as BIM technology in engineering cost management, green building cost management, and big data applications in cost analysis, should be added as core requirements. Concurrently, existing course content should be integrated and optimized to avoid redundancy and strengthen inter-course connections, establishing a coherent knowledge system.

In terms of pedagogical reforms, interactive teaching methods such as case studies, project-based learning, and group discussions should be promoted. For example, in engineering measurement and valuation courses, practical project case studies should be introduced extensively, allowing students to grasp measurement and valuation methods through analysis and hands-on practice. Project-based teaching could involve students working in groups to complete an entire engineering cost project, from investment estimation to final settlement, enhancing their comprehensive application and teamwork

skills. Modern educational technologies, such as online platforms and virtual simulations, should also be utilized to enrich teaching resources and expand learning opportunities.

Furthermore, practical teaching components should be strengthened, with reasonable scheduling of practical courses. Practical aspects such as design and internships should be distributed throughout the semesters, allowing students to apply theoretical knowledge in timely practical contexts. Universities should enhance their practical training bases and establish deep collaborative relationships with enterprises, with companies actively participating in defining talent cultivation plans, course development, and guiding practical training. For instance, companies could assign experienced engineers as adjunct faculty to mentor students during internships and capstone projects, providing greater access to real-world engineering projects. Additionally, efforts should be made to strengthen the practical teaching faculty by encouraging instructors to engage in industry training and regular work placements in companies to enhance their practical teaching capabilities.

6.3 Construction and Implementation of Dynamic Matching Mechanisms

A monitoring mechanism for industry demand should be established, maintaining close connections with industry associations and enterprises to regularly collect information on industry developments and talent requirements. Big data analysis techniques should be utilized for real-time monitoring and analysis of industry demand data, predicting trends in talent needs. For example, analyzing growth patterns in construction market scale and changes in the application rates of new building technologies can provide data support for curriculum adjustments.

A dynamic adjustment mechanism for the curriculum should be constructed based on the results of industry demand monitoring, allowing for timely adjustments in course offerings, content, and teaching methods. A curriculum adjustment committee composed of industry experts, company representatives, and university faculty should be established to evaluate and modify the curriculum system. Comprehensive evaluations should be conducted annually, with adjustments made according to the assessment results. For instance, if there is an increased industry demand for talent skilled in a particular emerging technology, relevant courses should be added or existing content revised promptly.

Additionally, a feedback mechanism should be established to collect information on the effectiveness of the implemented curriculum system through graduate tracking surveys and employer feedback. This will help assess graduates' performance in the workplace and measure employers' satisfaction with graduates, allowing for analysis of issues and shortcomings within the curriculum system. Regular surveys and interviews with graduates should be conducted to gather insights on challenges encountered in their work and suggestions for course improvements, facilitating timely adjustments to course content and teaching methods based on feedback.

7. CONCLUSION

This study conducts an in-depth analysis of the current state and demands of the engineering cost industry, along with a comprehensive evaluation of the existing curriculum system for engineering cost management. It identifies gaps between the curriculum and industry requirements. Based on these findings, targeted strategies for curriculum optimization and mechanisms for dynamic matching have been proposed. By optimizing course offerings, reforming teaching methods, enhancing practical training components, and establishing dynamic matching mechanisms, the alignment between the engineering cost curriculum and industry needs can be effectively improved, thereby enhancing the quality of talent cultivation.

However, this study does have certain limitations. While various methods were employed to collect data on industry demand, the comprehensiveness and accuracy of the data still require enhancement. Additionally, due to time and resource constraints, long-term tracking of the effectiveness of dynamic matching mechanisms was not feasible. Future research could further expand channels for collecting industry demand data, improve data quality, and strengthen the long-term monitoring and evaluation of dynamic matching mechanisms, continuously refining

the engineering cost curriculum to cultivate more high-quality professionals and promote sustainable and healthy development in the engineering cost industry.

REFERENCES

[1] Wang Xueqing, Hu Deming. Research on the Optimization Strategy of the Curriculum System for the Engineering Cost Major [J]. Journal of Engineering Management, 2020, 34(3): 136 - 141.

[2] Yin Yilin, Li Yang. The Practice of Curriculum Reform for the Engineering Cost Major Driven by Industry Demands: A Case Study of Tianjin University of Technology [J]. Research in Higher Engineering Education, 2021(4): 175 - 180.

[3] Feng Jingchun, Xue Song, et al. Research on the Construction of the Curriculum System for the Engineering Cost Major Based on Dynamic Matching [J]. Project Management Technology, 2022, 20(2): 125 - 130.

[4] Wu Xianguo, Chen Gang, et al. Research on the Synergistic Development of the Courses for the Engineering Cost Major and Industry Demands [J]. Education Teaching Forum, 2023(15): 145 - 148.

[5] Liu Yisheng, Wang Yuning. Research on the Optimization of Practical Teaching for the Engineering Cost Major Oriented to Industry Demands [J]. Experimental Technology and Management, 2023, 40(8): 212 - 216.

[6] He Qinghua, Li Yongkui, et al. An Empirical Analysis of the Dynamic Matching between the Curriculum System for the Engineering Cost Major and Industry Demands [J]. China University Teaching, 2024(12): 64 - 69.

[7] Ren Hong, Yan Yonggang. The Adaptive Adjustment of the Curriculum System for the Engineering Cost Major under Industry Changes [J]. Journal of Architectural Education in Institutions of Higher Learning, 2024, 33(3): 56 - 61.

[8] Zhang Lianying, Li Lihong. Research on the Innovation of the Talent Training Model for the Engineering Cost Major Based on Industry Demands [J]. Chinese Vocational and Technical Education, 2025(2): 78 - 83.

[9] Lu Ning, Wang Ting. Research on the Path of Optimizing the Curriculum System for the Engineering Cost Major and Dynamically Matching with Industry Demands [J]. Theory and Practice of Education, 2025, 45(3): 48 - 51.

[10] Cheng Hu, Chen Qun. Research on the Reform and Improvement of the Curriculum System for the Engineering Cost Major under the Guidance of Industry Demands [J]. Curriculum, Teaching Material and Method, 2025, 45(10): 108 - 113.

Research on the Intelligent Collaborative Model of Government Accounting Auditing Driven by Big Data

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Abstract: With the rapid development of information technology, the application of big data in the field of government accounting auditing has become increasingly widespread. This study aims to explore the intelligent collaborative model of government accounting auditing driven by big data, enhancing both the efficiency and quality of government accounting audits while strengthening governmental governance capabilities. By employing literature review methods, we outline relevant research findings domestically and internationally, identifying existing gaps and deficiencies in current studies. Utilizing system analysis methods, we conduct an in-depth examination of the components, operational mechanisms, and influencing factors of the intelligent collaborative model of government accounting auditing driven by big data. Throughout the research process, we analyze the application of big data technologies in accounting data collection and audit data analysis, while investigating the collaboration processes and methods between government accounting and audit departments within the intelligent collaborative model. The findings indicate that the big data-driven intelligent collaborative model for government accounting auditing effectively integrates accounting and auditing resources, enhances data processing efficiency, and improves the accuracy and timeliness of audit supervision, providing more reliable information support for government decision-making. This model is significant for promoting the modernization of government accounting auditing practices.

Keywords: Big Data; Government Accounting; Intelligent Auditing; Collaborative Model; Government Governance

1. INTRODUCTION

1.1 Research Background and Significance

In today's digital age, the rapid advancement of information technology has made big data a key driver of transformation across various sectors. As important managers and overseers of socio-economic activities, government departments face unprecedented challenges and opportunities in their accounting and auditing practices. On one hand, as government functions continue to expand, the scale of public funds grows, and economic activities become increasingly complex, traditional government accounting and auditing models reveal limitations in data processing capabilities, audit efficiency, and supervisory effectiveness. For instance, the manual handling of vast amounts of fiscal data and complex government investment project accounts is not only time-consuming but also prone to errors, making it difficult to meet the demands for efficient decision-making and precise supervision.

On the other hand, the emergence of big data technologies presents new opportunities for government accounting and auditing. Characterized by large volumes, diverse types, rapid processing speeds, and low value density, big data allows for comprehensive collection, efficient storage, and in-depth analysis of various structured and unstructured data related to government accounting and auditing. Through big data technologies, government accounting and auditing departments can access broader data sources, including financial data, operational data, and internet public opinion data, enabling a more comprehensive and accurate understanding of government economic activities. In government accounting, big data technologies facilitate automated bookkeeping and real-time financial reporting, enhancing the

timeliness and accuracy of accounting information. In auditing, big data analytics can quickly identify audit red flags and pinpoint problematic areas, significantly improving audit efficiency and quality.

From a societal perspective, there has been a growing public demand for transparency in government finance and the effectiveness of fund utilization, urging government departments to enhance the quality of accounting information disclosure and strengthen audit supervision. In this context, researching the intelligent collaborative model of government accounting auditing driven by big data holds significant practical importance. The construction and application of this model can integrate government accounting and auditing resources, break down inter-departmental data barriers, achieve data sharing and collaborative operations, thereby enhancing governance effectiveness, increasing public trust in government, and promoting stable and healthy socio-economic development.

1.2 Review of Domestic and International Research

International scholars have long recognized the impact of information technology on government accounting and auditing. In the application of big data theory to government accounting auditing, some studies focus on how big data technologies can optimize audit data analysis processes. For example, one study indicates that big data analytics tools can deeply mine complex data in government audits to uncover potential audit clues, thus enhancing audit efficiency. In the area of government accounting informatization, some developed countries have established relatively comprehensive e-government systems, enabling real-time collection and sharing of government accounting information; however, research on the collaboration between accounting and auditing remains underdeveloped.

Domestically, scholars have also made notable progress in studying the intelligent collaborative model of government accounting auditing driven by big data. Some research has outlined the development history of government accounting informatization, highlighting issues such as data security risks and low integration of information systems. In terms of auditing intelligence, domestic researchers are actively exploring the application of artificial intelligence and machine learning in auditing, developing various audit data analysis models. Regarding collaborative models, some scholars have examined pathways and methods for collaboration between government accounting and auditing from the perspectives of organizational structure and business processes. However, systematic research on the intelligent collaborative model driven by big data remains insufficient, particularly concerning how it aligns with the national context and analyzes the operational mechanisms and safeguards of this model in depth.

1.3 Research Methods and Innovations

This research primarily employs a literature review method, extensively reviewing relevant domestic and international literature to outline the current state of research on the intelligent collaborative model of government accounting auditing driven by big data, clarifying the starting point and direction for the study. Through case analysis, we examine practical cases of intelligent collaboration in government accounting auditing both domestically and internationally, summarizing successful experiences and identifying existing problems. A system analysis method is also utilized to analyze the component elements, operational mechanisms, and safeguards of this model from a systemic perspective, constructing a comprehensive research framework.

The innovation of this research lies in its systematic approach to studying the intelligent collaborative model of government accounting auditing driven by big data for the first time. It emphasizes not only the individual application of big data technologies in government accounting and auditing but also the collaborative operational mechanisms between accounting and auditing in an intelligent environment. By considering the business characteristics, technical needs, and organizational management factors of government accounting and auditing, the study proposes an innovative framework for the intelligent collaborative model, providing new ideas and methods for the innovative development of government accounting

auditing practices.

2. THEORETICAL FOUNDATIONS

2.1 Big Data Theory

Big data theory encompasses a series of technologies and methods for data collection, storage, processing, and analysis. In the data collection phase, various channels such as sensors and web crawlers can be used to capture vast amounts of structured, semi-structured, and unstructured data. For data storage, distributed storage technologies like the Hadoop Distributed File System (HDFS) facilitate efficient large-scale data storage. In the data processing and analysis phase, the MapReduce programming model enables parallel processing of massive data sets, combined with data mining algorithms such as clustering analysis and association rule mining to extract valuable information from the data. These technologies and methods provide a solid technical foundation for the intelligent collaborative model of government accounting auditing, making efficient processing and deep analysis of complex data related to government accounting and auditing feasible.

2.2 Government Accounting Theory

The purpose of government accounting is to comprehensively and systematically record and account for the financial activities of the government, providing accurate financial information for decision-making. Government accounting theory includes principles of accounting recognition, measurement of accounting elements, and more. In recent years, with the transformation of government functions and the reform of public financial systems, government accounting theory has continuously evolved and improved. The application of the accrual basis of accounting in government accounting practices has expanded, allowing government accounting information to more accurately reflect the government's asset and liability status and operational performance. Government accounting theory provides the theoretical basis for accounting data processing and information disclosure within the intelligent collaborative model of government accounting auditing, clarifying the norms for recording, measuring, and reporting accounting data to ensure the quality and reliability of accounting information.

2.3 Auditing Intelligence Theory

Auditing intelligence theory represents a theoretical framework for applying advanced technologies such as artificial intelligence, machine learning, and big data analytics in the auditing field. By utilizing intelligent algorithms to analyze audit data, auditing intelligence can automatically identify audit risks and detect audit anomalies. Machine learning algorithms can learn from historical audit data to build audit models that predict potential audit issues. This theory provides theoretical guidance for the intelligent transformation of government auditing in the context of big data, enabling auditors to leverage advanced technological tools to improve audit efficiency and quality, thereby enhancing the scientific and precise nature of audit supervision.

2.4 Collaboration Theory

Collaboration theory emphasizes the optimization of overall system functions through cooperation among subsystems. In the intelligent collaborative model of government accounting auditing, this theory manifests in the cooperation between government accounting departments and auditing departments. The accounting department provides accurate financial data, while the auditing department conducts audit work based on this data. Both parties achieve resource optimization through information sharing and process collaboration, breaking down departmental barriers. Collaboration theory serves as the theoretical foundation for constructing the operational mechanism of the intelligent collaborative model in government accounting auditing, guiding how to coordinate relationships between departments and enhance the overall effectiveness of government accounting auditing.

3. CURRENT STATUS OF THE BIG DATA-DRIVEN INTELLIGENT COLLABORATIVE MODEL OF GOVERNMENT ACCOUNTING AUDITING

3.1 Current State of Government Accounting Informatization

In recent years, significant progress has been made in the informatization of government accounting in China. Various levels of

government departments are actively promoting the upgrading and transformation of accounting information systems, achieving computerization and informatization of accounting practices. Most government departments now use financial software for bookkeeping, calculations, and reporting, thereby improving the efficiency and accuracy of accounting processes. Some regions have also established centralized management platforms for government financial data, enabling real-time monitoring and summary analysis of financial data from subordinate units. However, several issues still persist in government accounting informatization. Some government departments' accounting information systems lack effective integration with business systems, leading to low data sharing levels that prevent accounting data from accurately reflecting the full scope of business activities in a timely manner. Data security concerns are also prominent, as the electronic storage and transmission of accounting data face risks such as network attacks and data breaches.

3.2 Current Status of Auditing Intelligence Development

In terms of auditing intelligence, domestic auditing agencies are actively exploring the application of new technologies. Big data auditing has been implemented in various sectors by establishing audit data analysis platforms to integrate data from finance, taxation, and industry departments, achieving comprehensive data analysis of audit subjects. Some auditing agencies have also introduced artificial intelligence technologies, using image recognition to identify and verify audit evidence and employing natural language processing to analyze audit documents. However, the development of auditing intelligence faces challenges. The proficiency of auditors in new technologies varies significantly, with some lacking capabilities in big data analysis and the application of artificial intelligence, which limits the promotion of auditing intelligence. Additionally, the relevant laws, regulations, and standards governing auditing intelligence are not yet fully developed, affecting the normative conduct of intelligent auditing work.

3.3 Analysis of Existing Collaborative Models

Currently, several collaborative models exist between government accounting and auditing. In some regions, joint conference systems have been established to enhance communication and coordination between accounting and auditing departments, facilitating regular exchanges of work information and joint discussions on major issues. Some areas have also implemented joint project audits, where accounting departments provide financial data support for audits, while auditing departments supervise and inspect the quality of accounting information. However, existing collaborative models under the big data environment remain insufficient. Collaborative efforts often lack depth and breadth, primarily focusing on data sharing and simple business cooperation, with slow progress in intelligent collaboration. The collaborative mechanisms are not well-developed, lacking clear processes and divisions of responsibility, resulting in low efficiency and an inability to fully leverage the synergistic effects of government accounting and auditing.

4. CONSTRUCTION OF THE BIG DATA-DRIVEN INTELLIGENT COLLABORATIVE MODEL FOR GOVERNMENT ACCOUNTING AUDITING

4.1 Model Goals and Principles

The core goal of constructing this model is to fully leverage big data technologies to achieve intelligent collaboration between government accounting and auditing operations, thereby enhancing both efficiency and quality. Specifically, through intelligent means, the model aims to achieve precise collection, efficient processing, and real-time sharing of accounting data, ensuring the timeliness and accuracy of accounting information to provide robust data support for government decision-making. In terms of auditing, big data analytics will be utilized to deeply mine audit clues, accurately identify risk points, and enhance the scientific and effective nature of audit supervision. Additionally, by establishing a collaborative mechanism, the model aims to break down data barriers and business silos between accounting and auditing departments, optimizing resource allocation and improving overall government

governance effectiveness.

Key principles followed in the construction process include:

Data-Driven Principle: Big data serves as the central driving force behind the model's operation, encompassing data acquisition, integration, and analytical utilization throughout the accounting and auditing processes. Ensuring data authenticity, completeness, and timeliness is essential for providing a reliable basis for intelligent collaboration.

Collaboration and Sharing Principle: This emphasizes deep cooperation and information sharing between government accounting and auditing departments. Establishing smooth data sharing channels ensures that accounting data is promptly communicated to auditing departments and that audit results are fed back to accounting departments, promoting collaborative operations.

Security and Reliability Principle: Given the sensitivity and importance of government accounting and auditing data, the model prioritizes data security and system stability. Advanced encryption technologies, access control mechanisms, and data backup strategies will be employed to ensure the security of data during transmission, storage, and usage, preventing data breaches and tampering.

4.2 Model Components

The big data-driven intelligent collaborative model for government accounting auditing comprises several key components:

Data Resources: This foundational element includes financial data generated from government accounting, such as detailed information on fiscal revenues and expenditures, as well as asset and liability data. It also encompasses audit evidence data and problem discovery data accumulated during the auditing process. Additionally, external data sources, including relevant economic data, industry data, and internet public opinion data, collectively constitute the data foundation for the model's operation.

Technology Platform: A critical support element for achieving intelligent collaboration, this platform integrates advanced information technologies such as big data processing, artificial intelligence algorithms, and cloud computing. Big data processing technologies are used for storage, cleaning, transformation, and analysis of massive datasets. Artificial intelligence algorithms facilitate intelligent risk identification and automatic alerts for anomalies in accounting data. Cloud computing technologies provide powerful computational resources and storage capacity, ensuring efficient operation and scalability of the system.

Organizational Structure and Personnel: These elements are equally indispensable. Regarding organizational structure, adaptive adjustments to the government accounting and auditing departments are necessary, establishing dedicated collaborative workgroups or coordinating institutions responsible for managing and coordinating both parties' work, clarifying divisions of responsibilities, and promoting inter-departmental communication and collaboration. In terms of personnel, accounting and auditing staff should possess data analysis capabilities, information technology application skills, and a collaborative mindset. Through training and talent recruitment, a multidisciplinary team should be built that has expertise in both accounting and auditing as well as advanced information technologies.

4.3 Operating Mechanism Design

The operating mechanism of the model includes mechanisms for data flow, collaborative operations, and supervision feedback.

Data Flow Mechanism: This mechanism specifies the pathways and methods for data movement between government accounting and auditing departments. During routine accounting processes, the accounting department uploads real-time financial data to a shared data platform according to established data standards and formats. The auditing department can retrieve relevant accounting data from the shared platform based on audit task needs, and any audit data generated during the auditing process is also timely fed back to the platform for reference and analysis by the accounting department.

Collaborative Operations Mechanism: This mechanism standardizes the collaborative methods between accounting and auditing departments in their workflows. During the initiation phase of an audit project, both departments discuss the audit objectives and

priorities together, with the accounting department providing necessary financial data interpretations and business context. During the audit implementation process, auditors utilize big data analytics to deeply explore accounting data, promptly communicating and verifying findings with accounting personnel. The accounting department optimizes and enhances its accounting processes and methods based on audit feedback.

Supervision Feedback Mechanism: This mechanism ensures the effective operation of the model. A dedicated supervisory group is established to monitor the timeliness, accuracy, and normative aspects of data flow and collaborative operations. Feedback channels are also set up to encourage accounting and auditing personnel to promptly report issues encountered during the model's operation, facilitating continuous optimization and adjustment of the operational mechanisms.

5. APPLICATION OF BIG DATA IN INTELLIGENT COLLABORATION OF GOVERNMENT ACCOUNTING AUDITING

5.1 Accounting Data Collection and Processing

In the accounting data collection phase, big data technologies expand the channels for data acquisition. Beyond traditional financial system data entry, web scraping technologies can be employed to gather external data related to government accounting business from government department websites and industry information platforms, such as market price information and changes in policy regulations. Sensor technologies can also be used to collect real-time operational data from government public facilities and asset equipment status data, enriching the sources of accounting data. In terms of data processing, big data cleaning algorithms are utilized to denoise, deduplicate, and format the collected raw data, ensuring data quality. Distributed computing frameworks, such as Hadoop's MapReduce model, allow for parallel processing of vast amounts of accounting data, facilitating automated bookkeeping, cost accounting, and financial report generation, significantly enhancing the efficiency and accuracy of accounting data processing.

5.2 Auditing Data Analysis and Mining

Big data plays a critical role in auditing data analysis and mining. Auditors apply data mining algorithms, such as association rule mining, to analyze the relationships between fiscal revenue and expenditure data, uncovering potential irregular fund flow clues. Through clustering analysis, historical data from similar audit projects can be categorized to identify abnormal projects, accurately pinpointing audit focuses. Machine learning algorithms can be utilized to construct audit risk prediction models, estimating the risk levels of current audit projects based on historical audit data and related risk factors, thus providing a scientific basis for audit resource allocation. Additionally, text analysis techniques can be used to analyze unstructured data from audit documents and meeting minutes, extracting key information to assist in audit decision-making.

5.3 Collaborative Decision Support

The intelligent collaborative model driven by big data provides robust support for government decision-making. By integrating accounting and auditing data, it forms a comprehensive and accurate view of government economic activities. Utilizing data analysis and visualization technologies, complex data can be transformed into intuitive charts and graphics, presenting key information such as government fiscal revenue and expenditure status, fund utilization efficiency, and audit findings to decision-makers. Based on the results of big data analysis, the model provides scientific evidence for the formulation of fiscal policies, budget arrangements, and major project investment decisions. For instance, analyzing historical fiscal expenditure data alongside project performance data can offer insights for optimizing the structure of fiscal fund allocation and enhancing the efficiency of fund utilization.

6. SAFEGUARDS FOR IMPLEMENTING THE BIG DATA-DRIVEN INTELLIGENT COLLABORATIVE MODEL FOR GOVERNMENT ACCOUNTING AUDITING

6.1 Policy and Regulatory Safeguards

Governments need to establish a

comprehensive policy and regulatory framework to support the implementation of this model. On one hand, relevant policies should be introduced to encourage government departments to actively adopt big data technologies in accounting and auditing practices, increasing funding and policy support for the informatization of accounting and auditing. On the other hand, regulations regarding data security and privacy protection should be improved, clearly defining the ownership, usage rights, and protection responsibilities of government accounting and auditing data, while specifying security management requirements for data collection, storage, transmission, and usage processes to prevent data misuse and leakage. Additionally, unified data standards and technical specifications should be developed to promote interoperability and sharing of data among government departments, ensuring the smooth operation of the intelligent collaborative model.

6.2 Technical Support Guarantees

Continuous technological innovation and support are vital for the implementation of the model. Investment in the research and development of big data, artificial intelligence, cloud computing, and other related technologies should be increased, encouraging collaboration between research institutions and enterprises to drive the development and application of technology products suitable for the government accounting and auditing sector. A technical service team should be established to provide technical consulting, system maintenance, and troubleshooting services for government accounting and auditing departments. Regular upgrades and optimizations of the technical platform should be conducted to adapt to evolving business needs and technological changes, ensuring system stability and advancement.

6.3 Talent Pool Guarantees

Cultivating and attracting highly skilled interdisciplinary talent is key to implementing this model. Strengthening the construction of relevant academic programs in universities, optimizing course offerings, and training talent who possess both accounting and auditing expertise as well as data analysis and information technology skills is essential. Government departments should enhance the existing capabilities of accounting and auditing personnel in big data technology applications and collaborative work through internal training and technical exchange activities. Additionally, favorable policies should be established to attract external talents proficient in big data technology and auditing expertise to join the government accounting and auditing workforce, thereby strengthening the talent pool and providing robust support for implementing the big data-driven intelligent collaborative model for government accounting auditing.

REFERENCES

[1] Zhang Qinglong, Huang Guocheng, Wang Zhaoming. Government Audit Intelligence Driven by Big Data: Framework, Mechanism and Path[J]. Friends of Accounting, 2020(22): 133-139.

[2] Lu Junwei, Lin Xin. The Construction of Government Audit Informatization: Evolution, Challenges and Trends[J]. Auditing Research, 2019(4): 13-20.

[3] Wang Huijin, Wang Sumei. Research on the Cooperative Governance of National Audit: An Analytical Framework[J]. Journal of Auditing & Economics, 2019, 34(2): 1-10.

[4] Qi Zhendong, Wu Qinghua. Research on the Mechanism of Government Audit Promoting National Governance[J]. Auditing Research, 2018(1): 12-19.

[5] Li Zhaodong, Ye Chenyun, Liu Hongwei. The Application Prospect of Artificial Intelligence Technology in the Field of Audit[J]. Auditing Research, 2018(2): 32-38.

[6] Wang Aiguo. Intelligent Finance: Concept, Framework and Practice[J]. Financial Research, 2019(1): 68-76.

[7] Cai Chun, Li Minghui, Liu Gengxin. Theoretical Analysis and Realization Path of National Audit Promoting the Modernization of National Governance[J]. Auditing Research, 2019(1): 3-11.

[8] Zhang Longping, Chen Zuoxi, Liu Guangzhong. Research on the Development of Government Audit Informatization in China[J]. Auditing Research, 2019(3): 28-34.

[9] Liu Xiaoxia, Li Minghui. Opportunities, Challenges and Countermeasures of Government Audit in the Big Data Era[J]. Journal of Auditing & Economics, 2018, 33(1):

13-20.
[10] Hu Benyuan, Zhao Tianyan. Research on the Innovation of Government Audit in the Big Data Environment[J]. Auditing Research, 2018(4): 16-22.

A Study on the College English Teaching Model Based on Flipped Classroom

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Abstract: This study aims to investigate the college English teaching model based on the flipped classroom approach, with the goal of enhancing teaching quality and student learning outcomes. Using a literature review method, the research comprehensively examines domestic and international findings regarding the application of flipped classrooms in college English instruction, clarifying the current state and trends in this field. Through comparative analysis of traditional and flipped classroom models, the study delves into the advantages and potential challenges of the flipped classroom in college English education. The research explores effective construction of a flipped classroom model through aspects such as instructional design, resource development, and the transformation of teacher-student roles. Results indicate that the flipped classroom model effectively stimulates students' initiative, enhances their autonomous learning abilities, and improves comprehensive language skills. Under this model, students can flexibly arrange their study time and content based on personal progress and needs, leading to increased interaction and practical application during class, fostering an engaging classroom environment. This provides new insights and directions for college English teaching reform.

Keywords: Flipped Classroom; College English; Teaching Model; Autonomous Learning; Teaching Reform

1. INTRODUCTION

1.1 Research Background and Significance

In the context of accelerating globalization, the importance of English as a global lingua franca has become increasingly evident. College English education plays a crucial role in China's higher education system, tasked with cultivating students' comprehensive English proficiency to meet diverse societal needs. However, traditional college English teaching models have exposed various issues over time, such as teacher-centered instruction leading to passive learning, insufficient classroom interaction, and inadequate practical language application skills among students, hindering their ability to navigate real-life English communication scenarios.

Concurrently, rapid advancements in information technology have profoundly transformed the educational landscape. The widespread use of the internet and multimedia has made access to educational resources more convenient and efficient. The flipped classroom, an emerging teaching model, leverages modern technology to overcome the spatial and temporal limitations of traditional instruction. In this model, students engage in self-directed learning through instructional videos and online materials before class, while class time is dedicated to interactive discussions, problem-solving, and practical applications. This approach emphasizes student autonomy and fosters collaborative skills, providing new directions for reforming college English education.

Conducting in-depth research on the flipped classroom model in college English teaching holds significant practical value. From the students' perspective, it can stimulate interest, enhance autonomous learning abilities, and improve comprehensive language skills, better preparing them for future societal demands. For teachers, it promotes a shift in teaching philosophy, enhances pedagogical skills, and fosters innovation in teaching methods. From an educational development standpoint, this research offers useful insights for reforming college English instruction, contributing to the enhancement of higher education quality and cultivating high-quality talent with international perspectives and competitiveness.

1.2 Review of Domestic and International

Research

The flipped classroom concept has garnered widespread attention and in-depth study since its inception in the United States. Numerous scholars have empirically analyzed its application across various disciplines. In the realm of college English teaching, international research focuses on utilizing the flipped classroom to enhance language skills, such as listening, speaking, reading, and writing. Studies indicate that the flipped classroom effectively increases students' engagement time, promotes learning autonomy, and encourages collaborative learning. Some research also emphasizes the importance of quality instructional videos and online learning platforms in the implementation of the flipped classroom.

Domestically, research on the application of the flipped classroom in college English education has seen significant growth in recent years. Scholars have explored various aspects, including the construction of teaching models, implementation strategies, and evaluation of teaching effectiveness. Some studies have validated the positive impact of the flipped classroom on improving English learning outcomes and enhancing student interest through comparative experiments. Other research has highlighted the transformation of the teacher's role and the cultivation of student learning habits. However, challenges remain, such as the need for a more systematic and targeted approach to teaching resources and an in-depth study of applicability across different universities and disciplines, along with a lack of longitudinal research on the long-term effects of the flipped classroom.

1.3 Research Methods and Innovations

This study primarily employs a literature review method, extensively surveying relevant domestic and international literature on flipped classrooms and college English education to clarify research directions and focal points. A questionnaire survey is also utilized to gather student feedback on the flipped classroom model, assessing their learning needs and experiences. Furthermore, an experimental research method is adopted, selecting specific classes for comparative experiments to evaluate learning outcomes under traditional and flipped classroom teaching models, thereby validating the research hypotheses with empirical data.

The innovations of this research are manifested in several aspects. Firstly, it introduces a novel perspective by comprehensively considering the characteristics of college English education, students' learning needs, and trends in information technology to explore the application of the flipped classroom. Secondly, it proposes a targeted and practical flipped classroom model, encompassing comprehensive systems from instructional design to resource development and role transformation. Thirdly, it innovatively combines multiple research methods, integrating literature review, questionnaire surveys, and experimental research to enhance the scientific reliability of the findings.

2. THEORETICAL FOUNDATIONS

2.1 Overview of Flipped Classroom Theory

The flipped classroom originated in the United States, fundamentally reversing the traditional knowledge transfer and internalization processes. In traditional models, knowledge is primarily imparted by the teacher in the classroom, with internalization occurring through homework. In contrast, the flipped classroom allows students to learn through instructional videos and online materials before class, transforming classroom time into opportunities for interaction, problem-solving, and practical application. This model transcends traditional time and space constraints, granting students greater autonomy to personalize their learning pace and content. Its implementation relies on information technology, such as online learning platforms and video production software, to ensure effective dissemination of educational resources.

2.2 Compatibility of Second Language Acquisition Theory and Flipped Classroom

Second language acquisition (SLA) theory emphasizes that language learning is a gradual process achieved through extensive exposure and active participation in language practice. The flipped classroom creates a conducive environment for SLA. In this model, students engage with English through videos and texts before class, increasing their language input. Interactive classroom activities, such as group

discussions and role-playing, offer more opportunities for language output. Additionally, the personalized learning approach of the flipped classroom allows students to focus on their specific weaknesses, aligning with the SLA perspective that recognizes individual differences in language learning. This compatibility enhances students' English learning outcomes and improves their overall language proficiency.

2.3 Support of Constructivist Learning Theory for Flipped Classroom

Constructivist learning theory posits that learning involves students actively constructing knowledge through interaction with their environment, based on prior knowledge and experiences. The flipped classroom exemplifies this theory. During the independent learning phase, students assimilate new knowledge according to their existing knowledge structures, forming an initial framework. In the classroom, interactions—such as problem discussions and idea sharing—further enrich and refine students' knowledge systems. Here, the teacher transitions from being a knowledge transmitter to a facilitator, guiding students in constructing knowledge based on what they already know. This constructivist approach stimulates student initiative and fosters innovative thinking and problem-solving skills.

3. ANALYSIS OF TRADITIONAL COLLEGE ENGLISH TEACHING MODEL

3.1 Characteristics of Traditional Teaching Model

The traditional college English teaching model exhibits several distinct features. It predominantly employs lecture-based methods, with teachers occupying the central role in delivering vocabulary, grammar, and text content, while students passively listen and take notes. The forms of classroom interaction are often limited, primarily involving teacher questions and student responses, resulting in low engagement frequency. Consequently, the focus of teaching content tends to revolve around textbooks, with insufficient emphasis on cultivating practical language application skills. Assessment largely relies on final exam scores, primarily evaluating knowledge retention, while neglecting a comprehensive appraisal of students' performance and skill development throughout the learning process. While this model ensures systematic and accurate knowledge delivery, it struggles to fully engage students and hinder their ability to develop comprehensive language skills.

3.2 Challenges Faced by Traditional Teaching Model in the New Era

As society evolves, the traditional college English teaching model encounters numerous challenges. Firstly, globalization has raised expectations for students' comprehensive English skills; they must not only possess solid language knowledge but also exhibit fluent speaking abilities, strong reading comprehension, and cross-cultural communication skills—demands that traditional teaching methods fall short of meeting. Secondly, the rapid advancement of information technology has diversified knowledge acquisition channels, leading to decreasing interest in conventional lecture-based instruction; students increasingly prefer self-directed learning via online and multimedia resources. Additionally, modern educational philosophies emphasize student-centered approaches, focusing on cultivating autonomy, innovative thinking, and collaborative skills, areas where traditional models are insufficient. Finally, the diverse needs of students from different majors highlight the inadequacy of a one-size-fits-all teaching approach. Therefore, the traditional college English teaching model urgently requires reform and innovation to align with the demands of the new era.

4. CONSTRUCTION OF COLLEGE ENGLISH TEACHING MODEL BASED ON FLIPPED CLASSROOM

4.1 Objectives of Model Construction

The primary aim of constructing a college English teaching model based on the flipped classroom is to enhance the quality of English instruction across various dimensions to meet the diverse demands for English proficiency in the new era. The main objective is to strengthen students' comprehensive language skills, including listening, speaking, reading, writing, and translation, enabling them to communicate fluently in authentic contexts,

accurately interpret various English texts, and possess excellent writing and translation abilities.

Another key objective is to cultivate students' autonomous learning capabilities. In a flipped classroom environment, students are required to actively manage their study schedules and develop learning plans, utilizing abundant resources to prepare and reinforce their knowledge. This process fosters good study habits, enhances self-management skills, and lays the foundation for lifelong learning.

Additionally, the model emphasizes enhancing students' collaborative learning abilities. In class, students work together through group discussions and project collaborations to solve problems and exchange ideas, learning to listen to others, leverage team strengths, and improve communication and collaboration skills. From the teachers' perspective, the model aims to transform their roles from traditional knowledge transmitters to facilitators and promoters of student learning, enhancing teachers' capabilities in information technology and supporting their professional development.

4.2 Instructional Process Design

In this teaching model, the instructional process is divided into three phases: pre-class, in-class, and post-class.

In the pre-class phase, teachers carefully create or select instructional videos based on the syllabus and the needs of the students, covering vocabulary explanations, grammar analysis, and text introductions. Relevant learning materials, such as electronic documents and online quizzes, are uploaded to an online learning platform. Students log into this platform to independently watch the videos, complete accompanying exercises, and record questions that arise during their study. Teachers monitor student progress in real-time through the platform to prepare for classroom instruction effectively.

During the class phase, teachers first address common issues encountered by students in their pre-class learning, clarifying any misunderstandings. They then organize diverse classroom activities such as group discussions on given English topics, role-playing to simulate English communication scenarios, and debates to cultivate critical thinking and logical expression. Teachers circulate during these activities, guiding students to think deeply and correcting language errors as needed.

In the post-class phase, students complete assigned extension tasks, such as writing English essays or recording English speeches. Teachers provide feedback on students' assignments, allowing them to refine their work based on this feedback. Moreover, students are encouraged to utilize external English learning resources, such as English news websites and films, to broaden their learning channels and reinforce knowledge acquired in class.

4.3 Strategies for Developing Teaching Resources

Effective implementation of the flipped classroom model relies significantly on robust teaching resources. In video resource development, teachers should ensure high-quality instructional videos that are concise, focused, and engaging, potentially using animations and case studies to support teaching. The length of videos should be controlled, ideally within 10-15 minutes, to align with students' attention spans. For instance, complex grammar concepts could be broken down into a series of short videos, each focusing on a specific grammar point with detailed explanations and examples.

Establishing an online learning platform is also crucial. The platform should feature a user-friendly interface and support functions for uploading and downloading resources, tracking progress, and facilitating interaction. Schools may collaborate with educational technology companies to develop a custom online learning platform or utilize established learning management systems like Blackboard or Moodle. Additionally, various high-quality English learning resources, such as links to reputable teaching websites and recommended learning apps, should be integrated to provide a one-stop service for students.

Moreover, teachers should develop supplementary learning materials, such as study guides, summaries of key knowledge points, and practice question sets. Study guides should offer pathways and methods for learning, while knowledge summaries assist students in organizing key concepts, and

practice sets allow for self-assessment of learning outcomes. These materials should be continuously updated to ensure relevance and targeting based on teaching content and student needs.

4.4 Roles and Transformations of Teachers and Students

In the flipped classroom model of college English teaching, the role of the teacher undergoes significant transformation. Teachers transition from being the primary authority and knowledge providers to becoming facilitators, promoters, and organizers of learning. In the pre-class phase, teachers design instructional content meticulously, create high-quality teaching resources, and plan activities to prepare students for learning. During class, teachers focus on the learning process, guiding students in deep thinking, organizing various interactive activities, and promptly addressing students' inquiries while providing personalized learning support. After class, teachers meticulously grade assignments, giving targeted feedback that aids in student growth.

Students shift from passive learners to active participants in the learning process. They are required to take the initiative to manage their study time, watch instructional videos, complete tasks, and proactively identify problems. In class, students actively engage in interactive activities, confidently express their viewpoints, collaborate with peers to solve problems, and enhance their learning capabilities. After class, students independently complete extension tasks and actively utilize external resources to reinforce knowledge while continuously improving their comprehensive English proficiency. This transformation in the roles of teachers and students helps create a student-centered learning environment conducive to holistic development.

5. IMPLEMENTATION PROCESS OF THE COLLEGE ENGLISH TEACHING MODEL BASED ON FLIPPED CLASSROOM

5.1 Organization and Guidance of Pre-Class Learning

To ensure effective pre-class learning, teachers must focus on organizing and guiding students. In terms of releasing learning materials, teachers should upload instructional videos and resources in advance to the online learning platform, setting clear learning tasks and deadlines. For example, students may be required to complete viewing specific unit videos and related exercises within a week. Teachers can also send reminders through the platform to ensure timely completion of tasks. Additionally, teachers should provide guidance on study methods. Before watching the videos, they can encourage students to familiarize themselves with relevant knowledge, outlining learning objectives and key points. During the learning process, teachers should encourage students to take notes, recording questions and key content. For students facing difficulties, support can be offered through online tutoring or group study. Furthermore, teachers may establish discussion areas on the platform to encourage students to share insights and experiences, fostering a positive learning atmosphere.

5.2 Conducting Classroom Activities

Classroom activities are the core component of the flipped classroom model. Teachers should design these activities thoughtfully based on teaching objectives and students' pre-class learning experiences. In the question-answer segment, teachers provide detailed explanations of common issues, ensuring students comprehend the material. Throughout this explanation, teachers should encourage critical thinking and diverse viewpoints.

In group discussion activities, teachers should divide students into groups of 4-6 to ensure complementary skills within the group. After assigning a discussion topic, teachers clarify requirements and time limits, guiding students to engage in in-depth discussions. Teachers should circulate among the groups to encourage English communication and promptly correct language errors while directing the conversation. Role-playing activities can simulate relatable English scenarios, such as shopping, traveling, or interviewing, allowing students to practice real-life language use and adaptability. For debate activities, teachers may select controversial topics to train students' logical thinking and verbal skills, guiding them to follow debate rules and express viewpoints

rationally.

5.3 Post-Class Consolidation and Extension

Post-class consolidation and extension are crucial for students' mastery of knowledge and improvement of skills. Homework should be relevant and extend beyond the classroom. Targeted assignments may focus on classroom highlights and students' areas of difficulty, such as grammar exercises and content rewriting, reinforcing learned concepts. Extension assignments should cultivate students' comprehensive application skills and innovative thinking, such as creative writing projects or English planning tasks.

Teachers must provide thorough feedback on student assignments, highlighting strengths and weaknesses along with suggestions for improvement. Students should revise their work based on this feedback to enhance learning outcomes. Additionally, teachers should encourage students to utilize external English learning resources, such as reading original English literature, watching English films, or participating in English conversation clubs, broadening their learning avenues and enriching their language skills.

6. EVALUATION OF THE FLIPPED CLASSROOM COLLEGE ENGLISH TEACHING MODEL

6.1 Construction of Evaluation Index System

Establishing a scientific and reasonable evaluation index system is fundamental for accurately assessing the effectiveness of the teaching model. In terms of knowledge acquisition, evaluations can be conducted through periodic testing and final exams to assess students' understanding and retention of vocabulary, grammar, and text content. For instance, evaluations may include spelling tests, grammar fill-in-the-blanks, and reading comprehension questions to gauge students' knowledge levels.

Language skills should be assessed across five dimensions: listening, speaking, reading, writing, and translation. Listening assessments can be conducted through listening tests, evaluating students' comprehension of audio materials. Speaking evaluations may consider classroom performance, speaking tests, and participation in group activities to measure fluency, accuracy, and appropriateness. Reading assessments may involve comprehension tests and reports on reading original texts to evaluate reading speed, depth of understanding, and reading strategies. Writing evaluations can involve essay corrections assessing structure, expression, and grammatical accuracy. Translation exercises can assess students' ability to convert between Chinese and English.

Learning abilities should evaluate students' autonomous learning, collaborative learning, and problem-solving skills. Autonomous learning capacity can be assessed based on students' completion of pre-class tasks and the effectiveness of their learning plans. Collaborative learning can be evaluated according to participation in group activities and teamwork performance. Problem-solving abilities can be examined through students' approaches to resolving issues during classroom activities and assignments. Learning attitudes may be gauged by observing student participation, interest in learning, and initiatives in English studies.

6.2 Empirical Analysis of Teaching Effectiveness

To validate the effectiveness of the flipped classroom college English teaching model, a comparative experiment was conducted with certain college English classes. Two parallel classes were chosen, one serving as the experimental group utilizing the flipped classroom model, and the other as the control group adhering to traditional teaching methods. The experimental period lasted a semester, with knowledge and language skill tests administered before and after the intervention, along with a questionnaire to assess changes in students' learning abilities and attitudes.

The results indicated that students in the experimental group improved by an average of 15 points in knowledge tests, whereas the control group saw an 8-point increase. In language skills assessments, students in the experimental group outperformed their counterparts across all skills, with particularly notable improvements in speaking abilities. Additionally, questionnaire responses revealed that students in the experimental group exhibited significantly higher scores in autonomous and collaborative learning

abilities and showed increased interest and motivation in English learning. This empirical analysis strongly supports the notion that the flipped classroom model effectively enhances students' knowledge acquisition, language skills, learning abilities, and attitudes.

6.3 Feedback and Recommendations for Model Application

Collecting feedback from both teachers and students during the model application phase is crucial for the continuous improvement of the teaching approach. Teachers' feedback has primarily focused on issues related to resource development and activity organization. Some teachers reported that creating instructional videos is time-consuming and suggested that schools provide more technical support and training. Additionally, certain classroom activities were noted to require better time management.

Student feedback often revolved around the workload and suitability of learning resources. Some students felt overwhelmed by pre-class tasks and suggested streamlining the material, while others indicated that resource difficulty levels did not align with their own, requesting differentiated learning materials.

Based on this feedback, several recommendations are proposed. At the institutional level, schools should enhance technical training for teachers, establish a shared repository of teaching resources to lighten the burden of resource creation, and invest in optimizing online learning platforms to improve user experiences. At the teacher level, it is essential to refine instructional videos in terms of content and duration, design differentiated tasks based on students' actual levels, and thoughtfully plan classroom activities to enhance teaching efficiency. By continually gathering feedback and making iterative improvements, the flipped classroom model for college English instruction can better serve educational practices and enhance teaching quality.

REFERENCES

[1] Yang Guanfeng. Research on the Flipped Classroom Teaching Mode of College English Based on "Lanmo Cloud Class"[J]. Journal of Shaanxi Normal University (Philosophy and Social Sciences Edition), 2019, 48(S2): 205-208.

[2] Lv Jingnan. Research on the Application of English Poetry in the Cultural Teaching of College English[J]. Overseas English, 2019(14): 88-89.

[3] Yang Lei. The Application and Reflection of the "Flipped Classroom" Model in the Foreign Media Reading Teaching of College English[J]. English on Campus, 2019(33): 34-35.

[4] Yao Nana. Exploration and Research on the Multidimensional Interactive Teaching Mode of College English Listening and Speaking Courses[J]. English Square, 2019(8): 77-78.

[5] Zhang Yaqiu. Research and Exploration on the Flipped Classroom Model of College English Based on MOOC[J]. Journal of Shanxi Finance & Taxation College, 2018, 20(1): 42-44.

[6] Qi Yan. Research on the Effectiveness of the Flipped Classroom Teaching Mode of College English Based on Micro-lectures[J]. Journal of Hubei Correspondence University, 2019, 32(4): 165-166.

[7] Zhao Xiaojun. Research on "MOOC + Flipped Classroom" Promoting the Teaching Reform of College English[J]. Journal of Heihe University, 2018, 9(15): 137-138.

[8] Wang Jian. Research on the Task-based Flipped Classroom Teaching Mode of College English[J]. Journal of Xinjiang Education Institute, 2016, 32(9): 49-53.

[9] Li Ruifang. Research on the Flipped Classroom Teaching Mode of Higher Vocational College English Based on SPOC Platform[J]. Journal of Hubei Correspondence University, 2020, 33(10): 159-160.

[10] Song Xiukui. An Empirical Study on the Flipped Classroom Teaching Mode of College English Based on POA Theory——Taking Listening and Speaking Teaching as an Example[J]. Theory and Practice of Education, 2018, 38(36): 59-61.

Research on Adjustment and Optimization of Data Center Network Architecture in the 5G Era

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Abstract: With the rapid advancement of 5G technology, traditional data center network architectures struggle to meet the demanding requirements for high speed, low latency, and massive connectivity. This study aims to explore effective adjustment strategies and optimization methods for data center network architecture in the 5G era. Utilizing literature research, we outline the characteristics of 5G networks and the challenges faced by existing data center architectures. Through comparative analysis, we evaluate the pros and cons of various network architecture adjustment plans. Theoretical modeling and simulation techniques are employed to assess the performance of the optimized network architecture. A thorough analysis of 5G traffic characteristics leads to the development of a network topology suitable for 5G services, optimizing design across multiple dimensions, including network layering, link bandwidth allocation, and equipment selection. Results indicate that a well-adjusted and optimized data center network architecture can significantly enhance network throughput, reduce transmission latency, and improve reliability and flexibility, effectively supporting diverse 5G applications and providing a solid foundation for network development in the 5G era.

Keywords: 5G Era; Data Center Network Architecture; Network Optimization; Transmission Latency; Network Reliability.

1. INTRODUCTION

1.1 Research Background and Significance

Since the global launch of 5G commercialization in 2019, 5G technology has rapidly developed worldwide. By the end of 2024, over 200 countries and regions are expected to deploy 5G networks, with users surpassing 1.5 billion. 5G, characterized by high speed, low latency, and massive connectivity, is reshaping industry development models and accelerating digital transformation. Amid this trend, the data center, as a network's core hub, faces unprecedented challenges and opportunities.

Traditional data center network architectures were primarily designed to meet the demands of 4G and earlier communication eras. However, they exhibit deficiencies when addressing the diverse and complex needs of the 5G era. From the perspective of network performance, existing architectures struggle to meet the stringent requirements for ultra-high bandwidth and ultra-low latency of 5G networks. Additionally, they are insufficient to effectively handle the massive connection demands driven by emerging applications like IoT. Therefore, optimizing the data center network architecture is crucial to unlocking the full potential of 5G technology.

Enhancing the data center network architecture is significant for improving overall 5G network performance. It can notably increase transmission efficiency, reduce packet loss and latency, and provide users with a smoother, more stable network experience. Furthermore, it enhances network scalability and flexibility, better accommodating the burgeoning new applications and technologies, such as edge computing and vehicular networks, thus facilitating industrial upgrades and innovations.

1.2 Review of Current Research

Internationally, numerous research institutions and enterprises are engaged in the study of data center network architectures in the 5G era. Research teams in the U.S. focus on reconstructing data center network architectures using Software-Defined Networking (SDN) and Network Function

Virtualization (NFV) to achieve flexible resource allocation and management. Meanwhile, European efforts emphasize network slicing technology to allocate dedicated network resources for various 5G service scenarios, enhancing overall network performance.

In China, significant research achievements have also emerged in this domain. Universities and research institutes are conducting studies on optimizing data center network architectures, considering the realities of China's 5G deployment. For example, optimizing network topology to improve reliability and transmission efficiency, and exploring equipment selection and configuration tailored to China's 5G characteristics. However, both domestic and international research still exhibit gaps in the personalized adjustment and optimization of network architectures for different regions and scales. Moreover, there is a need for stronger efforts to translate theoretical research results into practical applications swiftly.

1.3 Research Objectives and Innovations

This study aims to analyze the new demands for data center network architecture in the 5G era, evaluate the current state of existing architectures, and propose feasible adjustment strategies and optimization methods to establish an efficient data center network architecture suitable for 5G development.

Innovatively, this research proposes a network architecture adjustment plan based on multi-objective optimization algorithms, considering multiple factors such as network performance, cost-effectiveness, and scalability to achieve a global optimal solution. Additionally, by incorporating artificial intelligence technologies into data center network management and optimization, real-time analysis and forecasting of network operation data will enable dynamic resource allocation and enhance intelligent management capabilities. Furthermore, the study will develop personalized network architecture adjustment and optimization plans tailored to the specific requirements and conditions of different regions, thereby enhancing the practical applicability and operability of the research outcomes.

2. NEW DEMANDS ON DATA CENTER NETWORK ARCHITECTURE IN THE 5G ERA

2.1 Analysis of 5G Network Characteristics

5G networks are characterized by three key features: high data rates, low latency, and massive machine-type communication. In terms of high data rates, 5G networks can achieve peak speeds of up to 20 Gbps, significantly surpassing 4G networks. This necessitates data centers to have higher bandwidth capabilities to ensure rapid data transmission both internally and between the data center and external networks. For instance, applications such as HD video streaming and virtual/augmented reality require substantial video data to be transmitted and processed quickly, mandating high-bandwidth data center networks.

Low latency is a core advantage of 5G, with air interface latency potentially dropping to 1 ms. This imposes stringent latency requirements on data center networks. In latency-sensitive applications such as industrial control and autonomous driving, even minor delays can result in serious consequences. Therefore, optimizing network topology and utilizing high-speed transmission links are essential to minimize data transmission latency.

Massive machine-type communication allows 5G to support up to 1 million connections per square kilometer. The explosive growth of IoT has increased demand for device connectivity, requiring data centers to have robust connection management capabilities to efficiently handle numerous device access requests and data exchanges.

2.2 Requirements of Business Application Scenarios on Data Center Networks

The 5G era has spawned diverse business application scenarios, each with unique network requirements. In smart factory settings, numerous industrial devices connect to data centers via 5G, facilitating real-time communication and collaboration between devices. This demands high reliability and low latency from the data center network to ensure continuous and accurate industrial production.

In the context of smart city initiatives, applications span intelligent transportation, security, and environmental monitoring. For example, intelligent transportation systems use 5G to connect vehicles, traffic signals, and

surveillance cameras to data centers for real-time traffic monitoring and smart regulation. This requires data center networks to possess significant data processing capabilities and high bandwidth to manage vast amounts of traffic data.

In telemedicine, 5G enables remote surgeries and consultations, necessitating extremely low latency and high reliability. Any network fluctuations could compromise the precision and safety of surgical procedures. Therefore, data center networks must ensure minimal latency and high reliability to effectively support telemedicine applications.

3. ANALYSIS OF EXISTING DATA CENTER NETWORK ARCHITECTURES

3.1 Architecture Overview

Current data center network architectures typically employ a layered design, consisting of core, aggregation, and access layers. The core layer facilitates high-speed data exchange and routing, serving as the network's central hub responsible for rapid data forwarding and distribution. The aggregation layer consolidates data from multiple access layer devices and connects to the core layer, acting as a bridge for data aggregation and distribution. The access layer manages user devices and various service endpoints.

In terms of transmission links, fiber optics are primarily used to meet bandwidth requirements. Core layers usually utilize high-performance core switches, while aggregation and access layers adopt switches of appropriate specifications based on actual needs. Network management relies on traditional management systems for configuring, monitoring, and maintaining network devices.

3.2 Challenges and Issues

With the rapid evolution of 5G services, existing data center network architectures face significant challenges across various dimensions. In terms of network performance, the high bandwidth demands of 5G make existing architectures inadequate. Research indicates that in some 5G-dense areas, the average link bandwidth utilization of existing data center networks exceeds 80%, nearing saturation and severely hindering data transmission rates.

Regarding network latency, the multi-layered structure of current architectures results in increased latency due to data passing through multiple nodes for forwarding and processing. This architecture fails to meet the low latency requirements of 5G networks, particularly for latency-sensitive applications.

In terms of service capacity, the massive connection demands from emerging applications like IoT exceed the load-bearing capacity of existing data center networks. Statistics show that in certain urban IoT pilot areas, the number of device connections a single data center must support has grown more than fivefold within a year, placing immense pressure on device management and resource allocation.

Moreover, existing data center networks exhibit shortcomings in flexibility and scalability. The traditional architecture struggles to adapt swiftly to the evolving demands of 5G services, complicating timely upgrades and adjustments. In network management, conventional systems lack real-time awareness of network state changes, hindering precise resource management and dynamic allocation.

4. DATA CENTER NETWORK ARCHITECTURE ADJUSTMENT STRATEGIES

4.1 Network Topology Adjustment

In the 5G era, traditional tree network topologies reveal limitations in handling high bandwidth and low latency demands. To enhance network performance, a flattened topology can be introduced. This structure reduces network hierarchy and shortens data transmission paths, thus lowering latency. For instance, a distributed core architecture disperses traditional centralized core functions across multiple nodes. Deploying several core switching nodes in different geographical locations enables quick processing and forwarding of data during high traffic periods, preventing congestion at a single core node. Research indicates that under equivalent load, distributed core architectures can reduce average transmission latency by approximately 30% compared to traditional tree structures.

Constructing redundant links is also crucial for improving network reliability. Establishing

backup links between critical nodes ensures automatic data switching to these alternatives in case of primary link failures. For example, adding redundant fiber links between core and aggregation layers can effectively mitigate the risk of service interruptions due to link failures, improving network availability to over 99.99%.

4.2 Network Layer Optimization Strategies

The core layer, as the high-speed switching hub, should focus on enhancing data processing and forwarding capabilities. High-performance core switches with larger backplane bandwidths and higher packet forwarding rates (e.g., several Tbps bandwidth and tens of billions of packets per second) can efficiently handle the massive data exchange demands of the 5G era. Additionally, optimizing routing algorithms using advanced dynamic routing protocols, such as enhanced OSPF, can further decrease transmission latency by adapting to real-time network conditions.

The aggregation layer must enhance its aggregation and distribution capabilities to match bandwidth differences with the core and access layers. High-density aggregation switches with flexible port configurations should be selected to connect more access layer devices and allocate port bandwidth based on business needs. Implementing caching techniques at the aggregation layer can temporarily store and buffer surges in data traffic, preventing data loss and ensuring stable transmission.

The access layer should prioritize user device accessibility and flexibility by integrating both wired and wireless access methods. For mobile 5G terminals like smartphones and tablets, advanced Wi-Fi 6 technology should be utilized for convenient wireless access. Conversely, for stability-critical devices like industrial control terminals and large servers, high-speed Ethernet cables should be used for wired connections. Additionally, the access layer should support various authentication methods to ensure network security.

5. DATA CENTER NETWORK ARCHITECTURE OPTIMIZATION METHODS

5.1 Link Bandwidth Allocation Optimization

To meet the diverse bandwidth demands of 5G services, dynamic bandwidth allocation technologies are necessary. Traditional static allocation fails to adapt to real-time traffic fluctuations, leading to resource wastage or shortages. Dynamic allocation can adjust bandwidth based on service types and real-time traffic conditions. For instance, during peak times for high-bandwidth services like HD video streaming and cloud gaming, more bandwidth can be allocated, while IoT devices with intermittent low-rate transmissions can have their bandwidth reduced accordingly, potentially increasing link bandwidth utilization by 20% - 30%.

Link aggregation is another effective method for optimizing bandwidth distribution. By bundling multiple physical links into one logical link, it increases bandwidth while providing redundancy. For example, aggregating several 1Gbps fiber links can yield total bandwidth of several Gbps or more, satisfying the high-rate requirements for 5G services. In the event of a physical link failure, data can automatically switch to another operational link, ensuring service continuity.

5.2 Device Selection and Configuration Optimization

In core layer device selection, scalability should be as critical as performance metrics. Choosing core switches with scalable slots allows for easy future upgrades with new modules or enhanced switching chips. Additionally, configuring reasonable cache sizes and queuing algorithms based on 5G traffic characteristics can optimize data storage and forwarding efficiency.

For the aggregation layer, cost-effectiveness and port flexibility are essential. Selecting aggregation switches that provide various port types (such as Ethernet and fiber) at reasonable prices can accommodate different access layer devices' connection needs. VLAN segmentation should be implemented to categorize devices by business type, enhancing network security and performance.

Access layer devices should support multiple access methods and provide robust wireless coverage. For wireless access points (APs), choosing products that support the latest wireless standards and Multi-User Multiple Input Multiple Output (MU-MIMO) technology can deliver stable, high-speed

wireless access to multiple users simultaneously. Properly adjusting AP transmission power and channels can minimize signal interference and optimize coverage, ensuring a positive user experience.

6. OPTIMIZATION EFFECT EVALUATION AND VALIDATION

6.1 Performance Evaluation Metrics

To comprehensively assess the effects of data center network architecture adjustments, a series of scientifically sound performance metrics should be established. Network throughput is a key metric reflecting the data transmission capability, crucial for supporting services like HD video and big data in the 5G era. Optimized networks should ideally achieve throughput levels in the Tbps range.

Transmission latency is another critical indicator, especially for latency-sensitive applications like industrial control and autonomous driving. The aim is to achieve sub-millisecond latencies in optimized data center networks.

Packet loss rate measures the proportion of lost data during transmission. In 5G applications, packet loss can lead to issues such as video stuttering and data errors. Thus, the optimized network should maintain a low packet loss rate, ideally below 0.1%.

Network availability reflects operational uptime and is vital for reliability assessment. For 5G data centers, a minimum availability of 99.99% is necessary to ensure service continuity.

6.2 Simulation and Real-world Testing Results Analysis

Before actual network deployment, simulation software can be used to test the optimized architecture. By modeling various service scenarios and traffic patterns, the performance of the optimized 5G network can be simulated. For example, using simulation tools like OPNET or NS-3, a model including core, aggregation, and access layers can be created, simulating scenarios like HD video streaming, IoT connectivity, and industrial data transmission.

Simulation results indicated a roughly 50% increase in network throughput, a 40-50% reduction in latency, and a packet loss rate decrease to approximately 0.05% post-optimization.

In real-world testing, pilot data centers underwent architecture adjustments and optimizations. New devices were deployed, network topology modified, and dynamic bandwidth allocation implemented. Tests conducted both within the data center and between the data center and external networks collected performance data. Results showed a roughly 40% increase in throughput, a 35% decrease in latency, and a packet loss rate maintained below 0.08%, with an availability of 99.995%. These outcomes align closely with simulation results, validating the effectiveness and feasibility of the optimization strategies.

REFERENCES

[1] Zeng Jun. Research on the key issues of the evolution of 5G bearer network from PTN to SPN [J]. Guangdong Communication Technology, 2021, 40 (6): 7-9.

[2] Zhu Huibin, Wen Liang. Strategy analysis of stepped transformation of existing network machine rooms into 5G access machine rooms [J]. Designing Techniques of Posts and Telecommunications, 2020 (10): 65-69.

[3] Li Zhengmao, et al. Network architecture and technical trends in the 5G era [J]. Journal of Communications, 2019, 40 (1): 1-10.

[4] Zhang Ping, et al. 5G network architecture and key technologies [J]. Journal of Beijing University of Posts and Telecommunications, 2018, 41 (3): 1-10.

[5] Qiao Xiuquan, et al. 5G bearer network technology and application [J]. ZTE Technology Journal, 2018, 24 (5): 1-6.

[6] Zhao Huiling, et al. Research on 5G front - haul network technology and solutions [J]. Telecommunications Science, 2018, 34 (10): 1-10.

[7] Cai Xiaoyong, Zhu Huibin, Wen Liang. Research on the optimization strategy of the location selection process for 5G access machine rooms [J]. Hubei Post and Telecommunication Technology, 2019, 35 (12): 48-50.

[8] Yang Fengyi, et al. 5G network technology and standards [M]. People's Posts and Telecommunications Publishing House, 2019.

[9] Tang Zongzhou, Zhu Xiang. Analysis of the optimization scheme for the core machine building of local operators in the post - 5G era [J]. toem Optoelectronic Communication

Forum, 2022 (11).
[10] Rui Huaping, et al. It is so simple to solve the construction problem of 5G BBU centralized machine room [J]. Vertiv Technology, 2021 (1).

The Mechanism and Pathway of Digital Economy Driving High-Quality Economic Development

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Abstract: The digital economy enhances economic efficiency by optimizing resources. Leveraging technologies such as big data analytics, artificial intelligence, and cloud computing, enterprises can more accurately predict market demand, reduce production and transaction costs, and improve resource utilization. Secondly, the digital economy promotes industrial chain upgrading and integrated development. Digital technologies accelerate the intelligent transformation of traditional industries, driving sectors like manufacturing and services toward higher value-added directions. At the same time, the digital economy provides growth opportunities for emerging industries and business models, such as the sharing economy, platform economy, and green economy. Additionally, the digital economy stimulates innovation vitality, creating more development opportunities for small and medium-sized enterprises and individual entrepreneurs, and fostering the construction of a society-wide innovation ecosystem.

Keywords: Digital Economy; High-Quality Economic Development; Mechanism and Pathway

1. UNDERSTANDING THE CONNOTATION OF THE DIGITAL ECONOMY

The digital economy is a new form of economic activity that takes data as a key factor of production, is driven by modern information technologies, relies on digital infrastructure, and achieves optimized resource allocation through the extensive flow of information. It encompasses digital industrialization (the information technology industry) and industrial digitization (the digital transformation of traditional industries), and extends to social, cultural, and governance domains. the digital economy is not only a technology-driven economic form but also a systemic transformation that profoundly alters production relations and economic structures.

First, data is the core factor of production. In the digital economy, data is the core resource, asset, and factor of production. Data collection, storage, analysis, and application directly determine production efficiency and innovation capabilities. Businesses and economies can respond more quickly to market demands through data-driven approaches, enabling precise decision-making and optimized resource allocation.

Second, technology-driven and innovation-led. the digital economy relies on developing and innovating modern information technologies, such as artificial intelligence, big data, the Internet of Things, and 5G. These technologies not only give rise to new economic formats but also profoundly transform the production methods and business models of traditional industries.

Third, decentralization and high efficiency. the digital economy breaks the spatial and temporal constraints of the traditional economy, enabling seamless resource integration and efficient flow through technological empowerment. Blockchain technology achieves distributed ledger and decentralized governance, bringing higher transparency and trust mechanisms.

Fourth, deep integration and cross-boundary collaboration. the digital economy does not exist in isolation but is deeply integrated with the real economy. It drives the digital transformation of traditional industries and fosters a cross-industry collaborative innovation system.

2. MECHANISMS BY WHICH THE DIGITAL ECONOMY DRIVES HIGH-

QUALITY ECONOMIC DEVELOPMENT

The digital economy drives high-quality economic development by enhancing technological innovation capabilities, industrial integration capabilities, and market expansion capabilities in economic growth. Therefore, it is necessary to theoretically analyze the mechanisms through which the digital economy promotes high-quality economic development, in line with the specific requirements of such development. the mechanisms by which the digital economy drives high-quality economic development include optimizing resource allocation and improving efficiency; promoting industrial structure optimization and creating new growth points; and advancing green development to achieve sustainable economic growth.

2.1 Optimizing Resource Allocation and Improving Efficiency

Optimizing resource allocation and improving efficiency are among the core mechanisms for driving high-quality economic development. Through advanced technological means, the digital economy transforms traditional resource allocation methods, enabling more precise and efficient distribution of resources, thereby significantly enhancing the overall operational efficiency of the economy. the application of big data technology makes market supply and demand information more transparent, allowing businesses and consumers to access relevant information in real time, and enabling precise decision-making and rapid responses. In the production process, enterprises use data analysis to predict market demand and consumer preferences, optimizing production plans and avoiding resource waste and inventory overstock. Through digital means, enterprises can also adjust production lines in real time, improving the flexibility and efficiency of production processes and reducing time and resource waste inherent in traditional production models.

In supply chain management, the digital economy leverages technologies such as the Internet of Things (IoT) and blockchain to break down information barriers, enabling data sharing and interconnectivity across all stages of the supply chain. This not only enhances the transparency and coordination of the supply chain but also reduces redundant links and inventory overstock, further improving the efficiency of resource allocation. Cloud-based shared platforms allow small and medium-sized enterprises to access advanced technologies and services at low costs, facilitating resource sharing and optimized allocation, thereby enhancing the competitiveness of the entire industrial chain.

The digital economy also optimizes resource allocation by fostering the rise of the platform economy. In the traditional economy, businesses often rely on physical stores and distributors to allocate goods, whereas, in the digital economy, online platforms use precise matching algorithms to quickly connect supply and demand, maximizing resource utilization. the platform economy also promotes the effective use of idle resources. Digital platforms provide technical support for the sharing economy, enabling the rapid circulation and utilization of a large number of idle resources, thereby improving resource utilization rates.

2.2 Promoting Industrial Structure Optimization and Creating New Growth Points

The digital economy accelerates the upgrading of industrial structures by driving the intelligent and informational transformation of traditional industries. In manufacturing, traditional enterprises can achieve digital management, intelligent production, and refined operations through industrial internet and smart manufacturing technologies. This not only improves production efficiency and product quality but also fosters innovation in production models, promoting the shift of manufacturing toward high-value-added and high-tech content. In agriculture, the application of IoT and precision farming technologies makes agricultural production more scientific and efficient, driving agricultural modernization and creating new growth points in the sector. the service industry has experienced rapid development through digital transformation, such as the rise of fintech, which has made financial services more inclusive and efficient, thereby promoting the upgrading of the financial sector.

The digital economy has given rise to a large number of emerging industries and business models, becoming new growth points for economic development. the sharing economy connects resource suppliers and demanders through digital platforms, improving resource utilization efficiency and fostering the emergence of new consumption models. Digital services, particularly in online education, online healthcare, and smart cities, have gradually evolved into new growth points for societal demand as technology continues to advance. These emerging industries not only create numerous job opportunities but also drive a new wave of economic growth.

2.3 Advancing Green Development and Achieving Sustainable Economic Growth

The digital economy promotes green development by enhancing resource utilization efficiency and reducing energy waste. In manufacturing, enterprises can use big data and IoT technologies to accurately predict production demands, adjust energy consumption during production processes, and optimize energy use, thereby reducing unnecessary resource waste. At the same time, digital technologies enable precision agriculture, making crop cultivation and management more scientific, which not only improves agricultural production efficiency but also reduces the use of fertilizers and pesticides, minimizing environmental pollution.

The digital economy fosters green technology innovation, promoting the development of low-carbon and environmentally friendly technologies. In the transportation sector, smart traffic systems optimize traffic flow through big data analysis, reducing congestion and carbon emissions. In the industrial sector, digital transformation enables enterprises to better monitor and reduce pollution emissions, while green technology innovation leads to the development of more environmentally friendly production processes and equipment. These technological innovations not only drive the growth of green industries but also lay the foundation for achieving sustainable economic growth.

Governments, businesses, and consumers can access environmental information and green products through digital platforms, fostering greener and more sustainable consumption patterns. Through intelligent environmental management systems, enterprises can monitor energy consumption and carbon emissions in real time during production processes, incentivizing proactive green transformation. At the same time, consumers can choose more environmentally friendly products and services through digital platforms, driving market demand toward green and low-carbon directions.

3. PATHWAYS FOR THE DIGITAL ECONOMY TO DRIVE HIGH-QUALITY ECONOMIC DEVELOPMENT

3.1 Promoting Industrial Digitization

The digital transformation of industries is first manifested in the digital upgrading of traditional industries. After undergoing industrialization, traditional sectors face issues such as low production efficiency, severe resource waste, and a homogeneous industrial structure. Digital technologies, particularly the application of big data, the Internet of Things (IoT), and cloud computing have brought revolutionary changes to traditional industries. Smart manufacturing, through automated production, robotics, and digital processes, makes production lines more flexible and efficient while reducing labor costs and error rates. the industrial internet connects equipment, production lines, and supply chains, enabling data sharing and intelligent decision-making, thereby driving the transformation of traditional manufacturing toward high-end and smart manufacturing. This not only enhances industrial competitiveness but also increases the added value of products.

FinTech, leveraging technologies such as big data, artificial intelligence (AI), and blockchain, has driven the intelligence and inclusivity of financial services. Services like online payments, digital currencies, and robo-advisors have improved efficiency and reduced the costs of the financial industry while expanding service coverage, and promoting the widespread adoption of digital finance. In the education and healthcare sectors, innovations such as online education platforms and telemedicine have broken the constraints of time and space, enabling the broader sharing of high-quality resources and

improving the accessibility and equity of services.

3.2 Strengthening Digital Infrastructure Construction

The construction of 5G networks is one of the core infrastructures for the development of the digital economy. 5G technology offers ultra-high-speed data transmission, low-latency response times, and massive connectivity, providing strong communication support for digital applications such as smart manufacturing, autonomous driving, and the IoT. 5G networks not only enhance the speed and efficiency of data transmission but also create conditions for the application of various emerging technologies. 5G can support the connection of more devices, promoting the widespread application of smart homes, smart cities, and other fields, further driving the implementation and development of the digital economy.

IoT technology is the foundation for achieving the "Internet of Everything. " By embedding smart chips in devices, sensors, and other terminals, the IoT can collect, transmit, and process massive amounts of data in real time, providing critical support for the digital transformation of industries. In manufacturing, the IoT helps enterprises achieve equipment monitoring, predictive maintenance, and remote control, improving production efficiency and reducing costs. In agriculture, energy, logistics, and other sectors, the application of the IoT helps optimize resource allocation and enhance resource utilization efficiency.

AI computing platforms, as a key enabler of the digital economy, provide powerful computing and analytical capabilities. the development of AI requires robust computing platforms to support complex data processing, machine learning, and deep learning model training. AI computing platforms accelerate the implementation and development of AI applications through parallel computing and efficient algorithm optimization, driving innovation across industries.

3.3 Advancing Digital Governance and Policy Support

The digital economy requires governments to achieve informatization and intelligent management at all levels, enhancing governance efficiency through technologies such as big data, AI, and cloud computing. A modern digital governance system demands that governments not only rely on digital platforms for efficient resource allocation but also establish scientific decision-making support systems. Through data sharing and information transparency, governments can more promptly grasp the operational status of society and the economy, improving the speed and accuracy of policy responses. the construction of smart cities is an embodiment of digital governance. By embedding IoT, sensors, and data analysis platforms into urban infrastructure, the operation and management of cities become more refined and efficient. Governments can monitor traffic flow, the usage of public service facilities, and urban environmental quality in real time, taking timely measures to improve the efficiency of public services and optimize the allocation of social resources. Additionally, digital governance can enhance government transparency, reduce corruption, and improve the credibility and efficiency of public governance.

The rapid development of the digital economy requires governments to provide targeted policy support to promote technological innovation and industrial transformation and upgrading. Governments should establish a sound policy system to support the diversified development of the digital economy and provide growth space for emerging industries. In this process, governments need to formulate industrial policies related to the application of digital technologies, including policies that encourage technological innovation, promote capital investment, and guide enterprise digital transformation. Through measures such as tax incentives, fiscal subsidies, and innovation funds, governments can incentivize enterprises to innovate in areas such as digital technology research and development, digital platform construction, and AI applications, further driving the vigorous development of the digital economy.

REFERENCES

[1] Ren, B., & He, H. (2022). Digital economy empowering high-quality development: Theoretical logic, path selection, and policy orientation. *Financial Science*, (04), 61-75.

[2] Ren, B. (2020). the logic, mechanism, and path of the digital economy leading to high-quality development. *Journal of Xi'an University of Finance and Economics*, 33(02), 5-9.

[3] Zhang, X. (2019). Research on the evolution of innovation models under the conditions of the digital economy. *Economist*, (07), 32-39.

[4] Zhang, P. (2019). the essence of the digital economy and its development logic. *Economist*, (02), 25-33.

[5] Li, C. (2017). A preliminary exploration of the connotation of the digital economy. *E-Government*, (09), 84-92.

Experimental Study on SRFP Retrofitted Timber Columns under Uniaxial Compression Load

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Abstract: In this paper, detail comparison was carried out between the mechanical properties of 25% or 50% damaged timber short columns under uniaxial compression. the ultimate bearing capacity of retrofitted columns increased up to 43.7%. the ultimate bearing capacity of partially damaged columns after retrofitting was recovered about 90%.
Keywords: Sprayed FR; Retrofitting Method; Damaged Timber Column; Glass Fiber Reinforced Polymer; Retrofitted Columns

1. INTRODUCTION

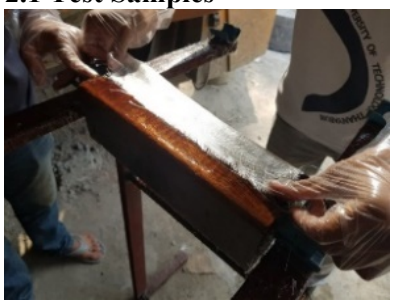
In the historical architectures, timber columns are often corroded at the root directly connected to the base because of the rain and dampness. The traditional reinforcement methods of columns include screws, steel plate with nails or screws, punched metal plates and steel glued-in rods [1, 2, 3]. In recent years, research interest focuses on strengthening timber members by using Fiber Reinforced Polymer (FRP). the more CFRP used, the better the mechanical properties the columns will have [4]. Compared with the intact column, the bearing capacity of pier column strengthened with CFRP hoops was mostly improved by 20.7% [5, 6].

In recent years, a new strengthening technique is developed and used more widely in Europe and Japan which named Sprayed Fiber-Reinforced Polymer (SFRP). the resin is mixed with short fibers such as carbon or glass at a tip of the narrow hose. the mixed materials are sprayed directly on a surface to be strengthened. This method makes seismic strengthening possible that all structure members, such as columns, beams, walls, and slabs, are monolithic since it is possible to strengthen an entire interior structure in building structures. A major advantage of this system is that the fibers are oriented in a 2D random manner in the plane of placement, which achieves a better bond with the substrate surface [7, 8]. At present, the research and application of this technology in the world are mainly concentrated in the field of concrete structure and masonry structure reinforcement [9].

The main objective of this study was to investigate whether the application of SFRP to timber columns is a feasible rehabilitation technique. the comparison experimental study on the strengthening effects of two methods was carried out and the bearing strengths of partially damaged timber columns after repair were tested and compared in detail. Some valuable conclusions were got for further research works.

2. TEST PROGRAM

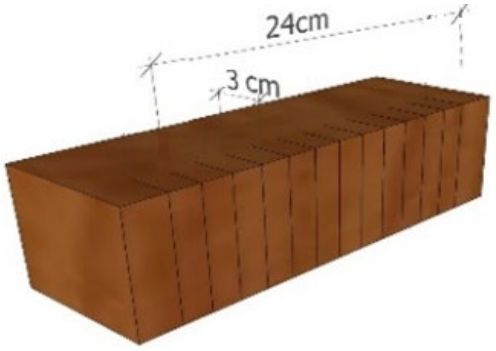
2.1 Test Samples



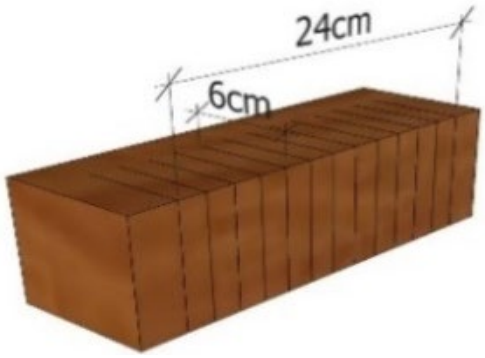
(a) pasting GFRP sheets

(b) spraying GFRP and resin

Fig. 1 Retrofitting methods



(a) 25%damaged



(b) 50% damaged

Fig. 2 Partially damaged specimens

Totally 27 timber column specimens were prepared and subjected to axial load until failure. [10]. the compressive strength perpendicular to grain od wood is 44.8 MPa, the compressive strength parallel to grain of wood is 64.03 MPa, the static bending strength is 115.5 MPa, and the tensile strength perpendicular to grain is 93.72 MPa.

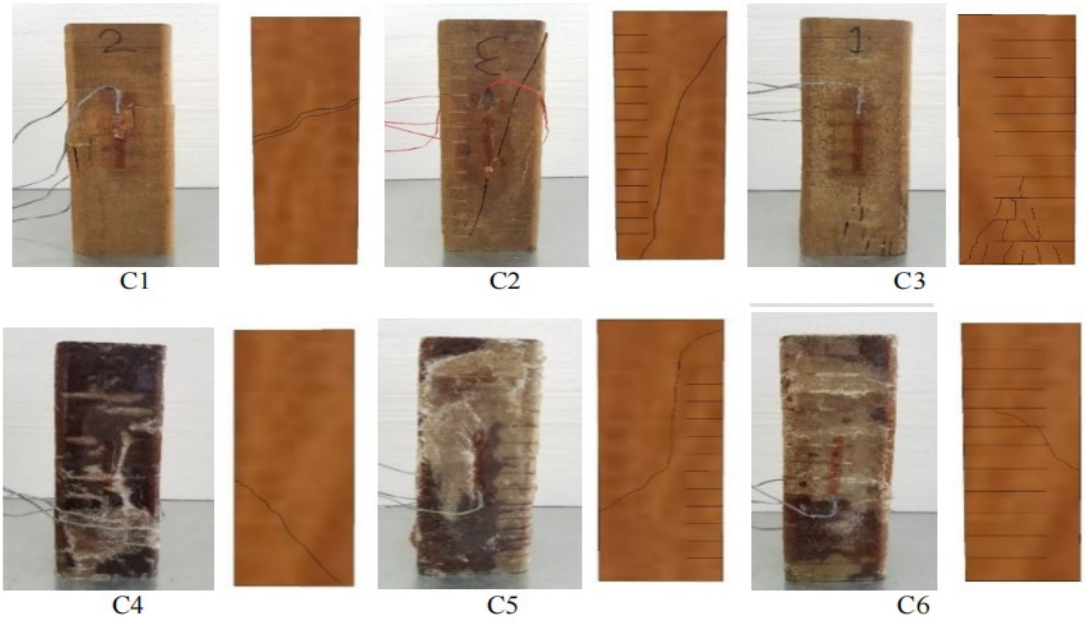
In each test procedure, specimen C1, C2 and C3 were used as comparative specimens, which were undamaged, 25% or 50% partially damaged columns without reinforcement respectively. C4, C5 and C6 are the corresponding undamaged, 25% or 50% partially damaged columns repaired and strengthened with GFRP sheets (Fig. 1. (a)). the GFRP sheets used is the type GFRP Jushi 180, with the fiber tensile strength of 1700 MPa, the fiber tensile elastic modulus of 55GPa and the elongation at break of 2.1%.

C7, C8 and C9 are the corresponding undamaged, 25% or 50% partially damaged columns repaired and strengthened with SFRP technique (Fig. 1. (b)). the spraying thickness is 3.5mm. the tensile strength, modulus of elasticity and elongation at break of SFRP were 110 MPa, 10.5 GPa and 1.2% respectively.

In order to simulate 25% partially damaged timber columns, 11 slits of 2 mm wide and 30 mm deep were cut on one side along the length of the column within 24 cm, with an interval of 2.5 cm. In order to simulate 50% partially damaged timber columns, the depth of each slit was increased to 60 mm, as shown in the Fig. 2.

2.2 Test Results Analysis

2.2. 1 Experimental Phenomenon and Failure Modes



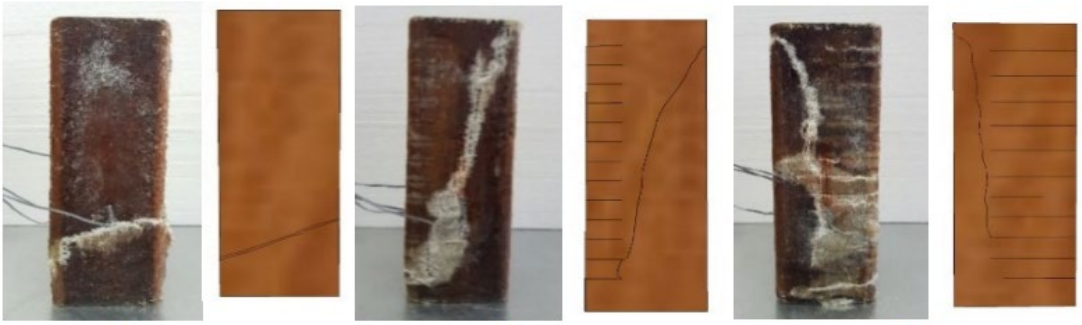


Fig. 3 Failure modes of the test specimens

In the uniaxial compression test, for specimen C1, initial crack appeared quickly and developed rapidly under loading. Finally, this crack break through the whole section, and the crack was wider (Fig. 3). For specimen C2, one inclined crack appeared on the non-damaged side soon after loading, and continued to develop through the non-damaged section, resulting in splitting failure. For specimen C3, no penetrating cracks appeared. There were some wrinkles and small cracks between the slits near the bottom part, which leaded to failure. For the specimen C4, C5 and C6, which strengthened by GFRP sheets, the cracks appeared gradually with the increase of load. As a result, the bulging appeared in many areas of the fiber sheets, mainly in the damaged narrow slits area. Until it failed, the surface of the fiber sheets did not break. For specimen C7, C8 and C9, which strengthened by SFRP, there were no obvious bulging phenomenon occurred. Before failure, the more serious bulging appeared in the main fracture area.

2.2. 2 Ultimate Bearing Capacity

The test results of the ultimate bearing capacity of specimen are shown in Table 1. For timber columns under uniaxial compressions, the load-bearing capacity increased obviously after GFRP sheets retrofitting or SFRP retrofitting. Both methods can be used for repairing and strengthening timber structures effectively. Because SFRP method has some advantages, such as easy work procedure, good workability, high strength and good durability, it is a reasonable and better substitute method of GFRP sheets retrofitting method.

It was observed that, for partially damaged columns, the improvement effect of retrofitting on the bearing capacity was much better. For 25% damaged columns under uniaxial compression, the biggest improvement in the ultimate bearing capacity after SFRP retrofitting was 43.7%. Compared with that of undamaged columns, the ultimate bearing capacity of specimen after retrofitting was recovered up to 98%. With the help of high pressure, the resin and glass fiber could be injected to the damaged cracks more deeply and more compact so that can work more closely with the column.

Table 1 Ultimate bearing capacity in the uniaxial compression test

Retrofitting method / ***Specimens***	***Un-retrofitted*** *[kN]*	***GFRP*** *[kN]*	***Improvement***	***recover***	***SFRP*** *[kN]*	***Improvement***	***recover***
undamaged	*592.55*	*695*	*17.2%*	*-*	*782.9*	*32.1%*	*-*
25%damaged	*406.51*	*522*	*28.4%*	*88.1%*	*584.3*	*43.7%*	*98.6%*
50% damaged	*226.3*	*267.2*	*18%*	*45.1%*	*270*	*19.3%*	*45.6%*

3. CONCLUSIONS

By the comparison experiment on retrofitting methods of partially damaged timber columns, the experimental phenomenal and the ultimate bearing capacity of total 54 timber column

specimens were studied in detail. Some conclusions are summarized as follows:

(1) For timber columns under either uniaxial or biaxial eccentric compressions, SFRP retrofitting method can be used for repairing and strengthening timber structures effectively. It is a reasonable and better substitute method of GFRP sheets retrofitting method.

(2) SFRP retrofitting showed the more obvious improvement in bearing capacity. Especially for partially damaged columns, the ultimate bearing capacity of specimen after retrofitting was recovered up to 98%.

(3) Possible effect factors on improvement of the bearing capacity, such as the test method, the volume ratio of spraying, type of fiber and epoxy resin, require more tests to be further studied.

(4) Because SFRP method has some advantages, such as easy work procedure, good workability, high strength and good durability.

REFERENCES

[1] Wen-Shao Chang, Con. Bui. Mat., Vol. 97 (2015), p. 14-24

[2] Song, X., R. Jiang, W. Zhang, X. Gu, and L. Luo, in: World 15 Conference on Timber Engineering. Auckland, New Zealand, (2012)

[3] Tanaka, H., H. Idota, and T. Ono. In: 9th World Conference 18 on Timber Engineering, Oregon, United States, (2006)

[4] Najm, H., J. Secaras, and P. Balaguru, J. of Mat. Civ. Eng., Vol. 19 (2) (2007), p. 198-204.

[5] Zhang W; Song X; Gu X; Tang T., J. Str. Eng. ASCE, Vol. 138 (2012), p. 90-98,

[6] Su Z Y, Doctor Thesis, Shanghai, Tongji University (2014)

[7] Toshiyuki Kanakubo, Tomoki Furuta, Keisuke Takahashi and Takeshi Nemoto, Doctor Thesis, University of Tsukuba, Japan, (2005)

[8] S. Talukdar and N. Banthia, Adv. Mat. Sci. Eng., (2010), p. 1-6

[9] E. Shaheen and N. G. Shrive, in: 10 th Canadian Masonry Symposium, Banff, Alberta, (2005)

[10] Werasak R; Meng J, Mat. Sci. For, (2019)Vol. 976, p. 173-179

Focus on Building Soul to Promote the Healthy Development of The Class

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Abstract: Cultivating what kind of people, how to cultivate them, and for whom they are cultivated are fundamental issues in education as well as the core direction for counselors in ideological and political education. How to nurture students into idealistic, responsible, hardworking, and striving young people of the new era is an eternal topic for every counselor. A survey shows that among the various needs of post-00s college students, the top three needs account for 100% of knowledge-seeking needs (100%), ideals and values (97.2%), and emotional needs (96.5%). This indicates that counselors, like ideological and political educators, play a crucial role in guiding students ideological and political education. Todays post-00s college students, due to their superior material living conditions and the widespread use of the internet, generally exhibit characteristics such as "emotional richness, " "high receptivity to new things, " "practical utilitarianism, " and "self-centeredness. " These traits directly lead to a polarized phenomenon among students when participating in class activities: some are enthusiastic about various cultural, sports, and volunteer activities but neglect their academic studies; others are fully devoted to learning, overlooking their overall development, and often feel overwhelmed by class activities. Each student is immersed in their own world, choosing what they believe will benefit their personal growth, sometimes even ignoring rules, disregarding regulations, feeling emotionally detached or extremely sensitive. None of these contribute to the comprehensive and healthy development of students. As counselors, it is essential to fully leverage the role of moral education, guiding students to find clear directions and grow robustly during this critical period of growth.

Keywords: Colleges And Universities; Class Building; Ideological and Political Education

1. WITHOUT RULES, THERE CAN BE NO SQUARE OR ROUND. —— THE RULE OF LAW IN THE CLASS IS TO PUT THE SYSTEM FIRST

Mencius in "Li Lou I" says: "Without rules, one cannot achieve order. " Establishing, adhering to, and upholding rules has been a crucial concept for the Chinese nation in governing itself and managing its people for thousands of years. In class management, setting rules is equally important; a good class system serves as a guide for students behavior. Compared to school regulations, class rules reflect the collective agreements of the class, which students are more willing to follow. Therefore, I worked with my classmates to establish various systems unique to our class, helping them understand that the school allows students to "be themselves, " as long as they do not violate the rules.

First, a "Dormitory Member Profile" system was established at the dormitory level. the establishment of this system allows for precise understanding of the overall situation of each dormitory and the personal circumstances of its members, especially their individual interests, hobbies, strengths, and special situations. Based on each students actual conditions, it guides them to participate in activities that are beneficial to their development, helping them discover their own value and find their unique highlights. This approach helps them understand the significance of participating in various activities, effectively changing the previous situation where people would shirk responsibilities by claiming they were not good at something.

Secondly, a "Dormitory Member Agreement" system has been established at the dormitory level. the establishment of this system accelerates mutual understanding among dormitory members, allowing them to express their thoughts that are hard to articulate

through writing to other members. This approach effectively prevents conflicts arising from a lack of familiarity with each others living habits and personality traits. Under these agreements, dormitory members can reasonably arrange their daily routines, making the dormitory their second home and fostering a sense of family among roommates.
Third, establish a new class committee selection system based on the class. the establishment of this system effectively strengthens the construction of student leaders in the class, changing the traditional "self-introduction+voting" model and adding a lottery defense round. Through students responses to questions, their ability to organize language, adapt on the fly, handle problems, and understand class management can be quickly assessed. Questions are set according to issues that have arisen or may arise in the future within the class, such as "In the face of dense school activities, if your classmates do not cooperate or are not proactive, how would you handle it?" or "Assuming that most of your classmates now only love studying and dislike participating in activities, or vice versa, what measures do you think should be taken by the class committee to change the current situation?" During the defense process, I also explain my views on these relevant issues to the class. This approach allows class members to anticipate potential challenges they might face in the future, encouraging them to think positively about contingency plans and providing them with some work ideas through my explanations.

2. FOCUS ON SOUL-CASTING EDUCATION —— TAKE IT AS A LESSON TO NOURISH THINGS SILENTLY

For Generation Z students, explosive online information floods their lives; they are influenced by all kinds of information every day. If mere didactic language has little impact on them, ideological and political education for this generation should focus on subtle influence. Therefore, the environment, as an implicit educational factor, is particularly crucial. Through the subtle influence of the campus environment, students can unconsciously establish correct values, thereby strengthening their ideals and beliefs, and rallying the powerful strength of the younger generation.
First, drawing lessons from history, a "Mobile Wall of Party History" has been set up in the classroom to guide students in understanding principles, enhancing faith, upholding virtue, and taking action. This allows students to establish correct worldviews, outlooks on life, and values through their knowledge of history. While pursuing personal growth, they should learn to view, dialectically understand, and rationally analyze real-world issues, discerning right from wrong and promoting truth, goodness, and beauty. At the same time, counselors can use the content of party history displayed on the boards during class meetings to educate and guide students with well-chosen quotes. the influence of vivid historical events and heroic role models surpasses all preaching.
Secondly, using role models as references, set up a "class culture wall" to make class honors "visible. " Through this approach, students enthusiasm for participating in various activities related to moral, intellectual, physical, aesthetic, and labor education is fully stimulated. This allows them to feel the sense of achievement and pride that comes from others recognition of their honor. By showcasing the added value of participating in activities, it helps students find beneficial activities for their own development, thereby increasing their enthusiasm for participation and fostering a positive class atmosphere of competition, learning, catching up, helping, and surpassing.
Third, Using civilization as a mirror, we have set up a "Civilization Bulletin Board" to constantly remind students to pay attention to their own civility and etiquette. While pursuing individuality, they should understand and abide by the rules. the "Civilization Bulletin Board" is rich in content, featuring not only essential civil norms such as the *Core Socialist Values* and the *Code of Conduct for College Students*, but also exhibition boards like "Say No to Uncivilized Behavior, " "Civil Stars of Zibo Vocational College, " and "Handwritten Civility. " Whenever students pass by, they stop to learn and remind themselves. the establishment of the "Civilization Bulletin Board" has

comprehensively enhanced the effectiveness of environmental education.

3. LOVE THOSE WHO LOVE YOU —— BE SINCERE AND EMPATHIZE WITH OTHERS

A loving heart, as one of the standards for a good teacher with four virtues, not only manifests in love for the country, society, and people but also in affection for the school, position, and students. It is shown through concern for students studies and lives, respect for their personalities and individuality, understanding of their emotions and thoughts, and trust in their words and actions. Only by showing more sincerity in student work and truly integrating into the lives of students can counselors understand them and do a good job in student affairs.

First, integrate yourself into the students world, becoming a part of class activities to earn their trust. No task in the class is solely the responsibility of the class committee or any single student; it is a joint effort between teachers and students. In this process, counselors must shift their mindset, transforming tasks that are completed just for the sake of completion or participation into marks of growth with both students and the class. In the classes I lead, I participate in their gala evenings, take them on trips to shoot short films, organize charity sales, or visit nursing homes and other venues for various public welfare practices. During field internships, I also drive to check on them. Its important for students to understand that at any time, the counselor is always with them.

Secondly, be a devoted witness to students growth, share in their joy, and become their trusted friend. A counselor is both a companion and a witness on the path of student development. For the confusion and setbacks students encounter during their growth, counselors should promptly show concern and guidance, balancing strictness with kindness. Similarly, for the achievements students make during their growth, counselors should immediately offer affirmation and encouragement, fostering empathy with the students. Only through empathy can understanding be achieved, and only with understanding can better educational guidance be provided, helping students button up the first button of their lives correctly.

President Xi Jinping emphasized: "In doing ideological and political work in universities, we must adapt to circumstances, keep pace with the times, and innovate according to trends. " However, what remains constant is the focus on "students. " Just like my class, through the joint efforts of classmates, class committee members, and teachers, a once disorganized and chaotic class has gradually developed cohesion, allowing each student to shine in their areas of expertise. Some students almost participate in volunteer activities every week, becoming one-star volunteers; others actively take part in professional competitions and achieve impressive results; still others enthusiastically engage in cultural and sports activities, making their mark at sports meets and campus cultural festivals. Each student has become optimistic, positive, and upward-looking. Many have established their life goals and found directions for their efforts through repeated participation in activities. They no longer focus solely on studying or participating in activities; the lever in their hearts seems to have surfaced.

The youth of today will be in their prime by 2035 and remain vigorous until the middle of this century, growing alongside and sharing the same destiny with the great historical process of gradually realizing the Chinese Dream. Counselors should strive to do a good job in students ideological and political education, working hard to nurture the youth of our era so that they can face the tumultuous waves without fear, advancing with determination and courage.

REFERENCES

[1] Xu Lihua. Analysis on the Path and Effectiveness of "Moral Education" in Class Management by College Counselors [J]. Science, Education and Culture Review. 2025.

[2] Yang Xuan. Research on the Grid-based Management Model of University Classes Based on MBO in the Context of Educational Informatization [J]. Science, Education, and Culture Review. 2024.

[3] Gao Yanling; Duan Yaxi. Analysis of Strategies for Class Management and Class Committee Team Building in Universities [J]. Science & Technology Trends. 2024.

A Study on the Role of Identity in the English Translation of Children's Literature

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Abstract: In the context of globalization, children's literature serves as a vital carrier of cultural exchange, and its translation is not merely a conversion of words but also a transmission and reshaping of cultural identity. Through the analysis of specific translation cases, this paper unveils how identity influences the formulation and implementation of translation strategies, as well as how the transmission and reconstruction of cultural identity are achieved in cross-cultural communication. the research finds that the core role of identity in children's literature translation lies in the profound understanding and ingenious transmission of identity elements in the original text, requiring translators to possess a high degree of cultural sensitivity and cross-cultural communication skills. Additionally, identity plays a crucial guiding role in the selection of translation strategies, necessitating translators to fully consider the cultural background, psychological characteristics, and linguistic habits of the target readers. This study provides theoretical support for the practice of children's literature translation and promotes in-depth exchanges and fusion between Chinese and Western cultures.

Keywords: Identity recognition; English Translation of Children's literature; Cultural transmission and reconstruction

1. INTRODUCTION

In the context of globalization, children's literature serves as a crucial component of cultural exchange, not only disseminating knowledge but also shaping children's identity and worldview. With increasing exchanges between China and the West, the translation of children's literature has become a cultural bridge. Translation is not merely a conversion of words but also a transmission of cultural identity. the differences in style, themes, and other aspects of Chinese and Western children's literature reflect their respective cultural characteristics. In the translation process, balancing the cultural essence of the original work with the cultural expectations of the target readers has become an urgent issue to be addressed. [1] Identity affects translation strategies and is crucial to the reception of the work and its cultural impact. This study explores the role of identity in the English translation of children's literature, analyzing cases to reveal how it influences strategy formulation and facilitates the transmission of cultural identity. It aims to provide theoretical support for translation practice, promote cultural exchange, and open up new perspectives for research on the translation of children's literature.

2. THEORETICAL BASIS

Identity theory is a complex and multidimensional concept that explores how individuals or collectives perceive and position themselves within society, as well as the formation, development, and transformation of these identities, which are influenced by social, cultural, historical, and personal factors. It emphasizes the multiplicity, fluidity, and constructiveness of identity, viewing it as a dynamic process that evolves with environmental changes and as a product of social construction. In the evolution of identity theory, American sociology emphasizes the interaction between individuals and their social environment in shaping identity, while European social psychology advocates that individual identity is established based on evaluations of social groups.

In the English translation of children's literature, identity theory plays a crucial role. Translators are tasked not merely with conveying the original content, but also with

facilitating cultural exchange and identity transmission. the translator's own identity plays a pivotal role in shaping the selection of translation strategies and textual style. Given that children's literature caters to readers in the midst of identity formation, translations must account for factors such as the age, gender, and cultural background of child readers. Suitable language styles, cultural nuances, and expressions should be chosen to foster their sense of identity and cultural recognition. Furthermore, translators must strike a delicate balance between preserving the cultural essence of the original text and ensuring its acceptability within the target culture. This involves screening, adjusting, and reconstructing cultural elements, a process for which identity theory offers invaluable guidance.

3. THE ROLE OF IDENTITY IN THE ENGLISH TRANSLATION OF CHILDREN'S LITERATURE

3.1 The core role of identity in the translation of children's literature

Identity plays a crucial role in the translation of children's literature. Children's literature is not merely a tool for entertainment and education; it also carries the important task of helping children construct their self-identity. During the translation process, translators need to deeply understand the identity elements in the original text and skillfully convey them to readers of the target language, especially when the work touches on sensitive topics such as race, gender, and culture.

Taking "Genesis Begins Again", a children's literary work by African-American author Alicia D. Williams, as an example, the book tells the story of a 13-year-old African-American girl named Genesis who overcomes prejudice and contempt due to her dark skin color, appearance, and racial identity. Genesis undergoes a transformation from self-hatred to self-acceptance and eventually reconciles with herself. This work revolves around the protagonist's identity crisis and showcases the process of her identity recognition and reconstruction, with the theme of "identity" being the focus throughout the book.

When translating this work, translators need to pay special attention to handling translation issues related to the black identity. For instance, the original text may contain expressions specific to a certain cultural background that may not be common or may have different meanings in the target language culture. Translators should use strategies such as amplification, explanatory translation, positive-negative translation, implicit-explicit translation, and annotation to ensure that the translation is smooth, accurate, and complete, fully revealing to the readers of the target language the internalized racial discrimination within the black community and the process of character identity recognition and construction. In this way, when reading the translation, child readers of the target language can not only understand the storyline but also deeply appreciate the protagonist's struggles and growth in terms of identity recognition, thereby generating positive reflections and influences on their own identity recognition.

3.2 The guiding role of identity in translation strategies

Identity plays a significant guiding role in the selection of translation strategies in children's literature translation. Translators need to fully understand the cultural background, psychological characteristics, and language habits of the target readers to ensure that the translation faithfully conveys the meaning of the original text while being understood and accepted by the target readers.

Taking "Le Petit Prince", a classic children's literary work by French author Antoine de Saint-Exupéry, as an example, when translating this work into different languages, translators need to fully consider the identity of the target readers. For instance, when dealing with symbolic elements in the work, such as planets, roses, and foxes, translators need to ensure that their presentation in the translation aligns with the cultural background and psychological characteristics of the target readers.

Another example is "The Miraculous Journey of Edward Tulane", a beloved children's book by American author Kate DiCamillo. In this book, the protagonist Edward is a porcelain rabbit who undergoes a series of adventures and transformations. When translating this work, translators need to handle descriptions involving sensitive topics such as race, gender, and culture with caution. For example, if the

original text describes interactions between Edward and characters from different cultural backgrounds, translators need to ensure that these descriptions do not lead to misunderstandings or prejudices in the translation.

Furthermore, translators also need to be cautious when dealing with descriptions involving gender roles. Taking "Charlie and the Chocolate Factory", a work by British author Roald Dahl, as an example, the story depicts five children visiting a magical chocolate factory. Some of the children exhibit typical gender characteristics or roles, such as the greedy Augustus Gloop and the mischievous Veruca Salt. When translating these descriptions, translators need to avoid reinforcing gender stereotypes and instead encourage children to explore and try out different interests and activities.

3.3 The dynamic nature of identity in the translation process

Identity in the translation process is not static but rather a dynamically evolving concept. This is particularly evident in children's literature translation, as children's identities continue to develop as they grow and their environments change. Taking the example of British author J. K. Rowling's "Harry Potter and the Philosopher's Stone", the translation process of this work fully demonstrates the dynamic nature of identity.

At the initial stage of translation, the translator may primarily focus on accurately conveying the magical world, character traits, and plot of the original text. However, as the translation progresses, the translator may gradually realize that the target readers (Chinese children) have different understandings and acceptances of concepts such as magic and wizards compared to British children. Therefore, the translator needs to continuously adjust translation strategies and methods to align with the identity of the target readers.

For instance, during the translation process, the translator may discover that the term "Philosopher's Stone" has specific connotations and associations in Chinese that do not fully align with the intention in the original text. In Chinese culture", philosopher's stone" may be more closely associated with ancient alchemy, immortality, and other concepts, rather than the mysterious substance in the original text that can create unlimited gold and grant life. As a result, the translator ultimately chooses to translate it as "magic stone" to better align with Chinese children's perceptions and expectations of the magical world.

Furthermore, the translator needs to continuously pay attention to feedback and reactions from the target readers. For example, during the translation of the "Harry Potter" series, the translator may receive feedback from young readers and parents pointing out that certain words or expressions in Chinese are not appropriate or prone to misunderstanding. In such cases, the translator needs to promptly adjust the translation based on this feedback to ensure that it better aligns with the identity of the target readers.

3.4 The bridging role of identity in cross-cultural communication

In cross-cultural communication, identity undoubtedly plays a pivotal role as a bridge, connecting people from diverse cultural backgrounds and fostering mutual understanding and respect among cultures. Taking the classic children's literature work "Charlotte's Web" by American author E. B. White as an example, this book showcases the unique landscape of American rural life and profound life philosophies through the friendship story between a spider named Charlotte and a pig named Wilbur. the translation process of this work fully embodies the bridging role of identity.

As the medium of cultural exchange, translators, when translating "Charlotte's Web", need to deeply understand and respect the differences in identity between Anglo-American culture and the target culture (such as Chinese culture). For instance, the farm life in American countryside, the friendship among animals, and Charlotte's selfless help to Wilbur, these identity elements have deep cultural roots in American culture. Through meticulous translation, translators convert these elements into expressions that are easy to understand and accept in the Chinese context, enabling Chinese readers to transcend cultural barriers and appreciate the universal values of friendship, courage, and sacrifice conveyed in the work.

Meanwhile, translators also pay attention to incorporating identity elements of Chinese

readers into the translation. When describing farm life, interactions among animals, and character traits, translators may adopt a language style that is closer to the cultural background and aesthetic habits of Chinese readers, making the translation more intimate and natural, and easier to elicit readers' resonance and reflection.

4. CONCLUSION

In summary, identity plays a crucial role in the English translation of children's literature. It not only guides the selection and implementation of translation strategies but also serves as the key to the transmission and reconstruction of cultural identity in cross-cultural communication. Through in-depth analysis of translation cases, it is found that the core function of identity lies in deeply understanding and skillfully conveying the identity elements of the original text, which requires translators to possess a high degree of cultural sensitivity and cross-cultural communication abilities. Meanwhile, the dynamic changes in identity necessitate translators to adjust their translation strategies to accommodate the development of readers' identities. As a bridge for cultural exchange, identity promotes mutual understanding and respect among cultures. Translators need to deeply understand and respect the differences in identity between the original text and the target culture, achieving cultural exchange and integration. This study provides theoretical support for the translation of children's literature and promotes in-depth exchanges between Chinese and Western cultures. In the future, it is expected that more scholars will pay attention to and enrich the theoretical system of children's literature translation, driving innovation and development in the field. At the same time, it is hoped that translators will continue to explore and bring more excellent works to young readers.

ACKNOWLEDGEMENTS

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REFERENCES

[1] Li Wenna, Zhu Jianping. Research on Children's Literature Translation: Current Status and Reflections [J]. Foreign Languages and Their Teaching, 2021(4):11.

[2] Xu Lei. Translator's Cultural Choices and Identity: A Case Study of Lin Yutang [J]. Foreign Languages and Translation, 2023, 30(2):50-54.

[3] Yan Lisha, Xia Ling. the Intertwining of Language and Identity: Cultural Translation and Identity Construction in Chinese American Literary Works [C]// Innovative Research on Foreign Language Education and Translation Development (16). 2024.

[4] Shi Fuyu. On the Connection between Nabokov's Literary Translation and Literary Creation [J]. Russian Literature and Art, 2024(1):83-92.

[5] Yang Jingmin, Zhou Ziyu. On Identity in Rudyard Kipling's Children's Novels: A Case Study of Kim and the Jungle Book [J]. Telli Research, 2021, 000(001): P. 66-74.

Research on the Construction of a Ladder-shaped Education Path for Innovation and Entrepreneurship Education in Higher Vocational Colleges

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Abstract: Higher vocational colleges' innovation and entrepreneurship education faces issues like fragmented courses and resource shortages. A "ladder - shaped education path" is proposed. It has three levels based on students' growth stages. Through counselors' efforts and school - enterprise cooperation, resources are integrated for practical platforms and educational integration. This model effectively improves students' innovation ability, offering a reference for talent cultivation optimization in such colleges.

Keywords: Higher vocational colleges; Innovation and entrepreneurship education; Ladder-shaped education path; Counselors

1. RESEARCH BACKGROUND AND SIGNIFICANCE

In the current context of accelerating economic globalization and industrial transformation, innovation and entrepreneurship have become the core forces driving social development. The Implementation Opinions of the General Office of the State Council on Deepening the Innovation and Entrepreneurship Education Reform in Higher Education Institutions clearly states that higher education institutions need to integrate innovation and entrepreneurship education into the whole process of talent cultivation [1]. As a key place for cultivating high-quality technical and skilled talents, the results of innovation and entrepreneurship education in higher vocational colleges are not only related to students' career development but also affect regional economic and industrial upgrading. Research shows that students with innovation and entrepreneurship capabilities have a 37% increase in employment competitiveness and are more likely to achieve sustainable career development. As the role that has the closest daily contact with students, counselors can customize personalized training programs for students by constructing a ladder-shaped education path, helping students improve their innovation and entrepreneurship literacy, perfecting the talent cultivation system of higher vocational colleges, and enhancing the adaptability of talents to social needs.

2. CONCEPT DEFINITION

2.1 Innovation and Entrepreneurship Education in Higher Vocational Colleges

According to the Action Plan for the Innovative Development of Higher Vocational Education, innovation and entrepreneurship education in higher vocational colleges needs to highlight the practical orientation of "learning by doing and innovating while learning" [2]. Its connotation should include three core capabilities: innovative thinking cultivation, entrepreneurial opportunity identification, and resource integration [3]. Combining the characteristics of higher vocational education that focuses on practical skills, through curriculum teaching, practical activities, and project incubation, students can master the knowledge and skills of innovation and entrepreneurship and possess the comprehensive literacy to innovate and start businesses in different industries.

2.2 Ladder-shaped Education Path

The ladder-shaped education path is a step-by-step education model. According to the characteristics of students' development stages of innovation and entrepreneurship literacy,

education links from shallow to deep are designed. From knowledge popularization, skill cultivation to achievement transformation, each stage is closely connected, forming a systematic model for improving students' innovation and entrepreneurship capabilities. Drawing on Bloom's Taxonomy of Educational Objectives, a three-stage ability development model of "cognition - application - creation" is constructed [4]. This path emphasizes designing teaching objectives and practical activities in stages according to students' cognitive development laws [5]. Counselors assume the responsibilities of guidance, supervision, and support at each stage and accompany students throughout the process.

3. ANALYSIS OF THE CURRENT SITUATION OF INNOVATION AND ENTREPRENEURSHIP EDUCATION IN HIGHER VOCATIONAL COLLEGES

3.1 Development Achievements

3.1.1 Increased Attention to Education Driven by Policies

A series of encouraging policies have been introduced by the state and local governments. Higher vocational colleges have actively responded by establishing special management departments, optimizing curriculum settings, and strengthening the cultivation and introduction of teaching staff. According to a survey by the Ministry of Education in 2021, 93% of higher vocational colleges have offered compulsory innovation and entrepreneurship courses [6]. However, the quality of these courses varies widely, and only 28% of the colleges have established a systematic curriculum system [7]. Counselors interpret policies and share cases through theme class meetings, and invite industry experts and entrepreneurs to interpret market dynamics and analyze industry trends for students, guiding students to keep up with the pulse of the times, clarify their personal development directions, establish correct concepts, and enhance students' intuitive understanding of innovation and entrepreneurship.

3.1.2 Development of Practical Platforms and Competition Activities

Many higher vocational colleges have built in-school practical platforms and organized various competitions. In particular, the "Internet +" College Students' Innovation and Entrepreneurship Competition not only provides students with a stage to show themselves and challenge themselves but also a precious opportunity for them to test their projects, accumulate experience, and broaden their horizons. Students need to comprehensively apply the knowledge they have learned, combine with market demand, put forward innovative and feasible project plans, and accept strict evaluation from judges, investors, and industry experts. Before the activity, counselors actively publicize the competition information, encourage students to form teams to participate according to their interests and expertise, and stimulate their enthusiasm for innovation and entrepreneurship. During the activity, they act as coordinators, pay attention to the progress of the project, guide students to further determine the project direction by combining their majors with market demand, and timely coordinate the communication between teachers and students to help solve the problems and difficulties encountered in the project. After the activity, they organize experience exchange meetings, allowing students to share their gains and insights during the competition process, learn from each other, and make progress together.

3.2 Existing Problems

3.2.1 Imperfect Education System

The curriculum setting lacks systematicness, the content is outdated, and there are few cases of emerging industries involved, which cannot meet students' needs for new knowledge. Teaching mainly relies on traditional lectures, and students passively accept knowledge, making it difficult to cultivate their practical and innovative abilities. The evaluation system focuses on theoretical assessment, and there is insufficient evaluation of practical achievements and innovative thinking. Counselors find in their work that students have little interest in such courses, and their homework is mostly mechanical copying, lacking analysis of cases.

3.2.2 Shortage of Resources

In terms of teaching staff, there is a lack of teachers with entrepreneurial practical experience, who are difficult to give suggestions in line with the actual market situation. Insufficient funds limit the

development of practical projects and the update of platform facilities. The cooperation with enterprises and industry associations is not close, and it is difficult to obtain industry information and practical projects. When counselors recommend internship enterprises for students, they often find it difficult to meet students' needs due to the shortage of resources.

3.2.3 Insufficient Integration with Professional Education

There is a disconnection between innovation and entrepreneurship education and professional education. Innovation and entrepreneurship courses are not combined with professional characteristics, and professional teaching also rarely permeates the concept of innovation and entrepreneurship. Taking the big data technology major as an example, students find it difficult to apply their professional knowledge to project innovation in innovation and entrepreneurship courses, and they also do not know how to carry out innovation and entrepreneurship activities in professional learning.

4. DESIGN PRINCIPLES AND FRAMEWORK OF THE LADDER-SHAPED EDUCATION PATH

4.1 Design Principles

4.1.1 Hierarchical Progression Principle

According to students' learning stages and ability differences, education content that progresses step by step is designed. In the first year of university, basic knowledge is popularized through basic courses and lectures to stimulate students' interest. In the second year of university, practical courses are carried out, and students are organized to participate in small projects to improve their skills. In the third year of university, project incubation is carried out to cultivate students' comprehensive abilities such as market development. Counselors carry out work according to different grades: guiding freshmen in the first year to visit achievement exhibitions, paying attention to the project performance of students in the second year, and assisting graduating students in the third year to dock resources.

4.1.2 Personalization Principle

Respect students' personalities and interests, and provide diverse course and project choices. Counselors understand students' interests and plans through heart-to-heart talks, investigations, counseling, etc., and recommend relevant courses and projects in a targeted manner. They also invite alumni to share their experiences. For students with technical expertise, they guide them to participate in professional technical projects and contact teachers for guidance, and assist in formulating personalized training plans.

4.1.3 Collaborative Integration Principle

Emphasize the collaboration among schools, enterprises, and society. Schools provide teaching resources, enterprises provide practical projects and experience, and society gives financial and policy support. Counselors serve as a communication bridge, contacting enterprise experts for lectures, organizing students' internships, and integrating social resources. In terms of the integration of professional education and innovation and entrepreneurship education, they cooperate with professional teachers and incorporate innovation and entrepreneurship project assignments into professional courses.

4.2 Overall Framework

4.2.1 Basic Layer: Popularize Innovation and Entrepreneurship Knowledge and Awareness

Offer basic courses for all students, covering core knowledge such as entrepreneurial project selection and business model design, and incorporate cutting-edge content such as innovative thinking training, aiming to cultivate students' innovative thinking, entrepreneurial spirit, and practical operation ability. Regularly hold lectures and forums, and invite entrepreneurs, investors, and other industry elites from different industries and fields to share their entrepreneurial experiences, market insights, and industry trends. Counselors organize theme class meetings to discuss classic entrepreneurial cases so that students can draw experience and lessons. They also set up suggestion boxes to collect students' feedback on courses and activities to continuously optimize teaching content and activity forms.

4.2.2 Improvement Layer: Cultivate Innovation and Entrepreneurship Skills and Abilities

Offer advanced practical courses for students with the intention, and organize in-school project training. Counselors assist in selecting

students to participate in projects. In order to better track the project progress and evaluate students' performance, a project reporting meeting and project tracking file system are established. Regularly organize project reporting meetings, allowing students to have the opportunity to display their project achievements and progress, and at the same time, receive comments and suggestions from judges, tutors, and classmates, providing a basis for personalized guidance.

4.2.3 Expansion Layer: Promote the Incubation and Landing of Innovation and Entrepreneurship Projects

Select excellent project teams and provide resource support. Counselors assist students in communicating with school departments to strive for policy resources and guide students to pay attention to the market. They can help students apply for scientific research funds, organize roadshows, conduct market research regularly, and establish a project achievement feedback mechanism. By establishing a quality monitoring closed loop of "curriculum learning - project practice - achievement evaluation - feedback optimization", counselors, together with professional teachers, carry out cultivation effectiveness diagnosis every semester and use Kirkpatrick's four-level evaluation model for effectiveness evaluation.

5. IMPLEMENTATION STRATEGIES OF THE LADDER-SHAPED EDUCATION PATH

5.1 Hierarchical Curriculum Setting

Design general education courses Fundamentals of Innovation and Entrepreneurship for all students to stimulate their interest; design advanced courses such as Innovative Methods and Practices for students with interest to improve their professional skills; design practical courses Entrepreneurial Project Management and Operation for project teams to cultivate their comprehensive abilities. Counselors guide students in course selection, pay attention to their learning situations, and feedback to teachers. They establish assistance groups to promote common progress.

5.2 Curriculum Content Integration

Pay attention to integrating real cases, industry dynamics, and cutting-edge technical knowledge into the curriculum system to enhance students' practical abilities and market acumen. Counselors actively collect industry information and closely share it with teachers to ensure that the curriculum content keeps up with the times. Regularly organize information sharing sessions, invite enterprise experts to enter the classroom, share industry trends, successful experiences, and challenges they face, and they can also participate in curriculum design. According to market demand and industry development, adjust teaching content and methods to make the curriculum closer to reality and enhance its practicality and pertinence.

5.3 Construction of In-school Practical Platforms and Cooperation with Out-of-school Practical Bases

Increase investment in the innovation and entrepreneurship incubation center and the maker space in the school. Learn from the "D.school" model of Stanford University and establish an interdisciplinary maker space [8], and continuously improve its infrastructure. Establish a scientific project settlement mechanism, which is assisted by counselors in management, monitors the project progress, and regularly organizes team exchanges to promote the growth and development of ideas and projects. Cooperate with enterprises and industry associations outside the school to jointly build out-of-school internship bases, provide students with rich internship opportunities, and invite enterprise experts to provide professional guidance. Counselors are responsible for communication and coordination to ensure the effectiveness and quality of students' internships.

6. CONCLUSION

To address problems in higher vocational colleges' innovation and entrepreneurship education, a counselor - led ladder - shaped education path with a "three - step" approach is designed. Counselors play dual roles. Practice shows it boosts students' innovation and confidence, integrating knowledge with market needs. In future, content should be adjusted flexibly, and cooperation with enterprises can form a practical education model to meet industry demands.

REFERENCES

[1] General Office of the State Council. Implementation Opinions on Deepening the

Innovation and Entrepreneurship Education Reform in Higher Education Institutions [Z]. 2015.
[2] Ministry of Education. Action Plan for the Innovative Development of Higher Vocational Education (2015-2018) [Z]. 2015.
[3] Huang Zhaoxin, et al. Research on the Integration Mechanism of Innovation and Entrepreneurship Education and Professional Education in Higher Vocational Education [J]. Educational Research, 2020(6): 45-52.
[4] Bloom B S. Taxonomy of Educational Objectives [M]. New York: Longman, 1956.
[5] Piaget J. The Psychology of the Child [M]. Basic Books, 1972.
[6] Ministry of Education. Investigation Report on Innovation and Entrepreneurship Education in National Higher Vocational Colleges [R]. 2021.
[7] Li Hua. Dilemmas and Breakthroughs of the Curriculum System of Innovation and Entrepreneurship Education in Higher Vocational Colleges [J]. Chinese Vocational and Technical Education, 2022(15): 32-37.
[8] Kelly T. Creative Confidence: Unleashing the Creative Potential Within Us All [M]. Crown Business, 2016.

The Rise and Prospects of China's Digital Economy

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Abstract: China has rapidly ascended to a leadership position in the global digital economy, driven by its vast population, advanced technological infrastructure, and supportive government policies. This paper examines the rapid expansion of China's digital economy, with a focus on key sectors such as e-commerce, digital payments, and innovations in artificial intelligence (AI) and 5G technology. It also explores the role of government strategies in fostering this growth and the digital transformation of traditional industries. Despite challenges such as data privacy and cybersecurity, China's commitment to innovation and technology positions it for continued leadership in the global digital economy.

Keywords: Digital Economy; E-Commerce; Artificial Intelligence; 5G

1. INTRODUCTION

In recent years, China has solidified its status as a global leader in the digital economy, capitalizing on its vast population, robust technological infrastructure, and proactive government policies to spur innovation and growth. the digital economy, which encompasses internet-based businesses, e-commerce, fintech, and digital ser-vices, has become a cornerstone of China's economic strategy, transformed traditional industries and created new avenues for development [1-3] .

As China’s digital economy has grown, its impact on global markets has increased. By fostering technological entrepreneurship, China has developed a vibrant ecosystem where both startups and established companies thrive [4] . This has led to the rise of global digital giants, reshaping domestic consumption and influencing global innovation trends. the supportive policy environment, combined with the agility of Chinese tech firms, has been key to China's leadership in the global digital economy [5] .

This paper explores the dynamic growth of China's digital economy, analyzing the key sectors driving this expansion, the role of government policies in facilitating development, and the broader implications for the global digital landscape. It also addresses challenges such as data privacy, cybersecurity, and the rural-urban digital divide that China must navigate to sustain its leadership position.

2. GROWTH, INNOVATION, AND TECHNOLOGICAL ADVANCEMENT

2.1. Unparalleled Growth and Scale

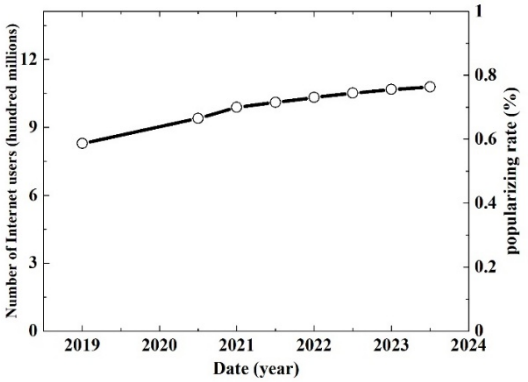

Figure 1. Number of internet users in China from 2019 to 2023

China's digital economy has experienced unparalleled growth, with the country now boasting the world's largest internet user base. As shown in Figure 1, the number of internet users in China has experienced a clear upward trend. As of 2023, over a billion Chinese citizens are connected to the internet, contributing to a dynamic and expansive digital marketplace [6] . E-commerce giants like Alibaba and JD. com have revolutionized retail, offering consumers unprecedented access to goods and services. the convenience of online shopping, coupled with efficient logistics networks, has led to an e-commerce

boom, positioning China as the world's largest e-commerce market.

The digital payments sector, led by platforms such as Alipay and WeChat Pay, has also seen exponential growth. These platforms have not only facilitated seamless transactions but have also driven financial inclusion by extending banking services to previously unbanked populations. Consequently, digital payments have become ubiquitous in China, with cash transactions becoming increasingly rare in urban areas [7] .

2.2. Innovation and Technological Advancement

Innovation lies at the heart of China's digital economy. the government has heavily invested in research and development, supporting the growth of high-tech industries. China is at the forefront of cutting-edge technologies such as artificial intelligence (AI), big data, and 5G [8] . Companies like Huawei and Baidu are leading the charge in AI research, developing applications ranging from smart cities to autonomous vehicles [9] .

Additionally, China is rapidly advancing in 5G technology, with significant investments in infrastructure and deployment. the widespread adoption of 5G is expected to further bolster the digital economy by enabling faster internet speeds, lower latency, and new applications across various sectors, including healthcare, education, and manufacturing.

3. GROWTH, INNOVATION, AND TECHNOLOGICAL ADVANCEMENT

3.1. Strategic Government Support

The Chinese government has played a pivotal role in the growth of the digital economy through strategic policies and initiatives. the "Internet Plus" strategy, introduced in 2015, aims to integrate the internet with traditional industries, enhancing productivity and fostering innovation. Additionally, the "Made in China 2025" plan focuses on upgrading the country's manufacturing capabilities through digital technologies, promoting smart manufacturing and industrial automation [10] .

The government's commitment to digital infrastructure is evident in its large-scale investments in broadband networks and data centers. These investments have established a solid foundation for the digital economy, ensuring that businesses and consumers have access to high-speed internet and reliable digital services.

3.2. Strategic Government Support

The impact of the digital economy extends beyond the tech sector, as traditional industries undergo significant digital transformation. For instance, agriculture is benefiting from precision farming technologies, which leverage AI and big data to optimize crop yields and reduce waste. In manufacturing, the adoption of smart manufacturing technologies is enhancing efficiency and reducing costs, making Chinese products more competitive on the global stage [11] .

The digital economy has introduced new opportunities and challenges to the tourism industry. It has fostered the development of smart tourism, enhancing the intelligence and convenience of tourism services through the application of technologies such as the Internet, big data, and cloud computing. For instance, online travel plat-forms enable tourists to easily book tickets, hotels, and transportation, offering a seamless, one-stop service. Additionally, the development of smart scenic spots using technologies like 5G networks and VR/AR provides tourists with a richer, more immersive experience. Tourism companies are also creating new products and services through digital means, such as cloud tourism, cloud performances, and virtual exhibitions. These innovations drive the advancement of tourism products and services, providing fresh impetus for the high-quality development of the tourism industry [12] .

4. FUTURE CHALLENGES AND PROSPECTS

Despite its impressive achievements, China's digital economy faces several challenges. Data privacy and cybersecurity remain significant concerns as rapid digitization increases the risk of data breaches and cyber-attacks. While the government has implemented stringent data protection laws, ensuring compliance and safeguarding user data continues to be an ongoing challenge. Additionally, the digital divide between urban and rural areas persists, with rural regions lagging in terms of internet penetration and digital literacy. Bridging this gap is crucial to

ensuring that the benefits of the digital economy are equitably distributed across the country.

Looking ahead, the prospects for China's digital economy remain bright. the country's commitment to innovation, technological progress and talent development, supported by proactive government policies, sets the stage for sustained growth. Emerging technologies such as blockchain, quantum computing, and the Internet of Things are expected to drive the next wave of digital transformation, creating new opportunities and addressing existing challenges.

China's digital economy is a testament to the transformative power of technology and innovation. By harnessing the potential of digital technologies, China has built a dynamic and resilient economy that is well-positioned for future growth. As the digital landscape continues to evolve, China is poised to maintain its leadership role, shaping the future of the global digital economy and setting new benchmarks for technological advancement. the journey of China's digital economy serves as an inspiring example of how strategic vision, technological innovation, and proactive policies can create a thriving digital ecosystem. With continued investment in technology and a focus on inclusive growth, China's digital economy is set to achieve even greater heights, benefiting not only the country but also the global economy.

REFERENCES

[1] Hu, M.; Hu, X.; Cheng, L., Exploring digital economy: a sociosemiotic perspective. *Int. J. Legal Discourse* **2021,** 6, (2), 181-202.

[2] Jiang, H.; Murmann, J. P., the rise of china's digital economy: An overview. *Manage. Organ. Rev.* **2022,** 18, (4), 790-802.

[3] Jiao, S.; Sun, Q., Digital economic development and its impact on econimic growth in China: Research based on the prespective of sustainability. *Sustainability* **2021,** 13, (18), 10245.

[4] Zhou, Q., Does the digital economy promote the consumption structure upgrading of urban residents? Evidence from Chinese cities. *Struct. Change Econ. D.* **2024,** 69, (2), 543-551.

[5] Cai, H.; Wang, Z.; Ji, Y.; Xu, L., Digitalization and innovation: How does the digital economy drive technology transfer in China? *Econ. Model.* **2024,** 136, (8), 106758.

[6] Li, H.; Zhang, Y.; Li, Y., the impact of the digital economy on the total factor productivity of manufacturing firms: Empirical evidence from China. *Technol. Forecast. Soc.* **2024,** 207, 123604.

[7] Johri, A.; Asif, M.; Tarkar, P.; Khan, W.; Rahisha; Wasiq, M., Digital financial inclusion in micro enterprises: understanding the determinants and impact on ease of doing business from World Bank survey. *Humanit. Soc. Sci. Commun.* **2024,** 11, (1), 361.

[8] Chen, B.; Chen, H.; Cheng, Q.; Li, Y., the development of china's digital economy and its implications for China-ASEAN cooperation. *East Asian Policy* **2023**.

[9] Li, J.; Chen, L.; Chen, Y.; He, J., Digital economy, technological innovation, and green economic efficiency—empirical evidence from 277 cities in China. *Managerial and Decision Economics* **2022,** 43, (3), 616-629.

[10] Xie, W.; Zheng, D.; Li, Z.; Wang, Y.; Wang, L., Digital technology and manufacturing industrial change: Evidence from the Chinese manufacturing industry. *Computer. Ind. Eng.* **2024,** 187, 109825.

[11] Li, Q.; Zhao, S., the impact of digital economy development on industrial restructuring: Evidence from China. *Sustainability* **2023,** 15, (14), 10847.

[12] Wu, H.; Zhong, R.; Guo, P.; Guo, Y.; Hao, Y., the role of the digital economy in tourism: mechanism, causality and geospatial spillover. *Emp. Econ.* **2024,** 66, (6), 2355-2395.

Research on the Path of Integrating Ideological and Political Education into the Teaching of Network Information Security Majors in Vocational Colleges in the Era of Digital Intelligence

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Abstract: In the era of digital intelligence, the network information security major in vocational colleges faces the important task of cultivating high-quality and high skilled talents. This article analyzes the current situation of teaching in the field of network information security, including issues related to curriculum design, teaching methods, and student quality, and emphasizes the importance of integrating ideological and political education into teaching. By optimizing curriculum design, innovating teaching methods, utilizing digital technology, and strengthening the construction of teaching staff, this article proposes a specific path for integrating ideological and political education into the teaching of network information security majors in the era of digital intelligence. the aim is to enhance students' professional skills and ideological and political qualities, and provide guarantees for cultivating high-quality talents with comprehensive development.

Keywords: Era of Digital Intelligence, Course Ideology And Politics, Vocational Colleges, Network Information Security

1. THE TEACHING STATUS OF NETWORK INFORMATION SECURITY MAJOR IN VOCATIONAL COLLEGES

At present, the information security industry has been promoted to a strategic core area for safeguarding national security and is in a golden period of rapid growth. There is an urgent demand for network security professionals with high quality and high skills in society. the information security major in higher vocational colleges shoulders the responsibility of cultivating such high-end skilled talents. However, the current teaching situation still needs to be optimized, especially in the integration of ideological and political education in the curriculum, where there is significant room for improvement. By analyzing the teaching plans, curriculum standards, lesson plans, teaching presentations, student assignments, and final exams of multiple universities, and focusing on the ideological and political content of the courses, some problems were identified.

1.1 Curriculum design and teaching content

The curriculum of network information security majors in vocational colleges usually includes multiple aspects such as basic theoretical knowledge, professional skills, and practical operations. In terms of basic theoretical knowledge, it mainly covers computer network fundamentals, operating system principles, database applications, etc; In terms of professional skills, it involves web security technology, firewall configuration, intrusion detection and defense, etc; In terms of practical operation, students need to apply theoretical knowledge to solve practical problems through experimental courses, practical training projects, and other means.

However, there are still some issues with the teaching content of network information security majors in current vocational colleges. On the one hand, some course content is too outdated to keep up with the development pace of the digital age. For example, some traditional methods of cyber attacks have been

eliminated, but still occupy a certain proportion in the curriculum; On the other hand, some course content is too theoretical and lacks close integration with practical applications. This leads to students having difficulty flexibly applying theoretical knowledge in practical operations.

1.2 Teaching methods and means

In terms of teaching methods, vocational colleges' network information security majors usually adopt teaching methods, discussion methods, case analysis methods, etc. These teaching methods can help students master knowledge and skills to a certain extent, but there are also some shortcomings. For example, the teaching method often relies too much on teachers' explanations and lacks students' active participation; the discussion rules may not be effective due to low student participation; Although case analysis can improve students' practical abilities, there are often difficulties in selecting and updating cases.

In terms of teaching methods, vocational colleges' network information security majors have gradually introduced modern teaching methods such as multimedia teaching and online teaching. These teaching methods can enrich teaching content and improve teaching effectiveness. However, due to the particularity of the network information security profession, some experiments and practical operations require specific hardware and software environments. For example, courses on firewall technology applications require the introduction of expensive professional equipment or simulation systems, which poses certain challenges to the updating and upgrading of teaching methods.

1.3 Student quality and cultivation effect

Students majoring in network information security in vocational colleges usually possess a certain level of computer foundation and logical thinking ability. However, due to differences in student backgrounds and individual differences, there are also certain differences in their learning and practical abilities. There is little or no integration of ideological and political elements that fit the current classroom context in instructional design. This is specifically reflected in the fact that some students have low cultural literacy, teachers have insufficient understanding of their own sense of mission, and there is a lack of quality education in students' comprehensive development, moral education, and the cultivation of legal concepts.

In terms of training effectiveness, the teaching of network information security majors in vocational colleges has achieved certain results, but due to deficiencies in curriculum design, teaching methods, and teaching tools, students' comprehensive quality and practical ability still need to be improved. Especially in the era of digital intelligence, network security threats are becoming increasingly complex and changing, and students need to possess stronger innovative thinking and problem-solving abilities to adapt to the needs of future market enterprises.

2. THE IMPORTANCE OF INTEGRATING IDEOLOGICAL AND POLITICAL EDUCATION INTO THE TEACHING OF NETWORK INFORMATION SECURITY MAJOR

2.1 Cultivate high-quality talents with comprehensive development

In the era of artificial intelligence, integrating ideological and political education into the teaching of network information security majors in vocational colleges can help cultivate high-quality talents with comprehensive development. Course ideological and political education can not only enhance students' ideological and political qualities, but also cultivate their moral qualities, professional ethics, team consciousness, and sense of social responsibility. These qualities are particularly important for professionals in network information security, as they will undertake the important mission of maintaining national security and social stability.

2.2 Enhance the pertinence and effectiveness of professional teaching

The integration of ideological and political education into the curriculum can enhance the pertinence and effectiveness of teaching in the field of network information security in vocational colleges. By combining ideological and political elements with professional knowledge, teachers can better guide students to understand the importance and urgency of network information security, stimulate their learning interest and motivation, such as

integrating relevant knowledge of network security laws into teaching, and making students strictly abide by the legal bottom line. At the same time, ideological and political education courses can also help students establish correct values and career perspectives, making them more determined and confident in their future careers.

2.3 Enhance the governance capability and level of cyberspace

Integrating ideological and political education into the teaching of network information security majors in vocational colleges can also help enhance the ability and level of cyberspace governance. With the advent of the digital age, cyberspace has become an important area of national and social governance. the integration of ideological and political education into curriculum can help students understand the importance of ethical and sustainable technology applications. By integrating ideological and political education into vocational education, students can cultivate their awareness of network security and law, improve their network literacy and governance ability, and contribute to building a safe, healthy, and harmonious cyberspace.

3. CURRICULUM DESIGN STRATEGIES FOR NETWORK INFORMATION SECURITY IN THE ERA OF DIGITAL INTELLIGENCE

3.1 Optimize curriculum design and integrate ideological and political elements

Update course content to keep up with the pace of the times. In response to the problem of outdated course content in network information security majors in vocational colleges, we should update the course content in a timely manner and keep up with the development pace of the digital age. For example, the latest network attack methods, defense technologies, and laws and regulations can be introduced to enable students to timely understand and master the latest knowledge and skills. At the same time, students' practical experience and response abilities can be enhanced by combining the latest domestic and international cybersecurity incidents and cases. While updating course content, we also need to strengthen the integration of ideological and political elements. For example, when explaining the methods of cyber attacks, students can be guided to think about the social reasons and moral issues behind them; Emphasize the importance and binding force of laws when explaining cybersecurity laws and regulations; When explaining network ethics and morality, let students find a balance between technological innovation and ethical principles. By integrating these ideological and political elements, students' comprehensive quality and ideological and political literacy can be enhanced. In order to broaden students' knowledge horizons and ways of thinking, we can add interdisciplinary courses. For example, courses related to law, ethics, psychology, etc. can be offered, combined with social engineering in the field of network security, to enable students to understand and think about network information security issues from multiple perspectives. These interdisciplinary courses not only enhance students' comprehensive qualities and innovative abilities, but also provide more possibilities for their future career development.

3.2 Innovative teaching methods to enhance teaching effectiveness

Introducing project-based learning to enhance students' practical abilities. Project based learning is a student-centered teaching method that enhances students' practical and innovative abilities by involving them in the planning, implementation, and evaluation of actual projects. In the teaching of network information security majors in vocational colleges, we can introduce project-based learning to allow students to conduct research and exploration around a specific network security issue. Through this method, students can gain a deeper understanding of the essence and solutions of cybersecurity issues, while cultivating their teamwork and communication skills.

In addition, the combination of theory and practice is the key to the design of network information security courses. In the teaching of network information security majors in vocational colleges, we can use case teaching to enhance students' practical experience. For example, some typical domestic and foreign network attacks or data information leaks can be selected for analysis and discussion, allowing students to understand the causes,

impacts, and preventive measures of these events. Simulation environments can be used for security testing and vulnerability assessment, enhancing students' practical abilities in the field of network security. Through this approach, students can gain a more intuitive understanding of the essence and solutions of network security issues.

3.3 Utilizing digital technology to enhance teaching methods

Firstly, a virtual simulation experiment platform can be constructed to improve the efficiency of student experiments. the virtual simulation experimental platform can simulate real network security scenarios and attack methods, allowing students to practice and explore in a virtual environment. In the teaching of network information security majors in vocational colleges, equipment updates rapidly. We can build a virtual simulation experiment platform to allow students to conduct simulation experiments and attack defense drills in the laboratory. This method can improve students' experimental efficiency and practical ability, while reducing experimental costs and risks.

Secondly, utilizing online teaching resources to promote the sharing of learning resources. Promoting resource sharing means breaking down information silos and building an open and collaborative learning environment. In the teaching of network information security, this can be achieved through building online resources, establishing school enterprise cooperation platforms, sharing laboratory resources, and conducting online courses and lectures. For example, inviting industry experts to campus to share the latest security threats and protection strategies, or collaborating with enterprises to involve students in real security projects, can not only enhance students' practical abilities, but also enable them to deeply understand the importance of information security to the country and society in practice, thus planting the seeds of maintaining network security in their hearts.

In addition, artificial intelligence can be introduced to assist teaching and improve teaching efficiency. Artificial intelligence assisted teaching is a new teaching model that utilizes artificial intelligence technology to assist teaching. For example, intelligent teaching systems can be used to monitor students' learning progress and mastery; Intelligent evaluation systems can be used to assess students' learning outcomes and innovation abilities; Intelligent recommendation systems can be used to provide personalized learning resources and suggestions for students, improving teaching efficiency and quality.

3.4 Strengthen the construction of the teaching staff and enhance teaching ability

Teachers are the core force in teaching network information security majors in vocational colleges. Their professional competence and teaching ability directly affect the quality and effectiveness of teaching. Therefore, we should strengthen the construction of the teaching staff and improve their professional competence and teaching ability. For example, teachers can be organized to participate in network information security training and attack and defense exercises to update their knowledge and broaden their horizons; Encourage teachers to actively participate in curriculum reform and textbook construction; Establish a teacher evaluation system to motivate teachers to continuously improve and enhance themselves. In addition to professional competence and teaching ability, the ideological and political education of teachers and the construction of their professional ethics and style are also very important. They should have firm political beliefs and good moral qualities, and be able to lead by example and influence students through words and deeds. Therefore, we should strengthen ideological and political education and the construction of teacher ethics and style, improve the ideological and political quality and professional ethics of teachers. For example, teachers can be organized to participate in various ideological and political education activities to enhance their political awareness and sense of responsibility; A teacher ethics and professional conduct evaluation system can be established to regulate teachers' behavior and professional ethics.

4. CONCLUSION

The era of digital intelligence has brought new opportunities and challenges to the teaching of

network information security majors in vocational colleges. Integrating ideological and political education into professional teaching is not only an important way to improve teaching quality and effectiveness, but also an important guarantee for cultivating high-quality talents with comprehensive development. By optimizing curriculum design, innovating teaching methods, utilizing digital technology, and strengthening faculty development, we can effectively integrate ideological and political education into the teaching of network information security majors in vocational colleges, making greater contributions to the comprehensive development of students and the stability and prosperity of society.

REFERENCES

[1] Zhang Yanxin. Research on Cross-cultural Teaching Strategies of Higher Vocational English under the Background of "One Belt and One Road" [J]. Journal of Beijing Vocational College of Labor Security, 2019, 13(04):59-63.

[2] Han Lifang. Thinking on the Optimization of Business English Teaching in Higher Vocational Colleges Based on the Talent Demand of "The Belt and Road" [J]. Journal of China Multimedia and Network Teaching (mid-day), 2020(05):154-156.

[3] Pang Xiaohong. Research on the Cultivation Strategies of Intercultural Communicative Competence in Higher Vocational English Teaching under the Background of "One Belt and One Road" [J]. Journal of China Multimedia and Network Teaching (mid-day), 2020(11):187-189.

To Explore the Role of Promoting Mandarin in Enhancing the Core Quality and Competitiveness of Vocational College Students

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Abstract: This paper mainly explores the significance of promoting Mandarin in enhancing the professional core competence and competitiveness of vocational college students. the article first analyzes the current situation of Mandarin proficiency among vocational college students, pointing out problems such as significant influence from dialects, lack of systematic Mandarin course settings, and insufficient internal motivation for learning. Second, it elaborates on the important significance of promoting Mandarin in cultivating the professional core competence of vocational college students, including improving communication and expression skills, enhancing employment security capabilities, and promoting cultural inheritance and innovation. Finally, the article proposes the main approaches to promoting Mandarin, such as establishing a school-wide promotion network, utilizing campus publicity media, organizing practical activities through school clubs, leveraging the exemplary role of teachers, conducting volunteer service activities, and making use of social media platforms. Through the implementation of these measures, the Mandarin proficiency of vocational college students can be effectively improved.
Keywords: Mandarin; Vocational college students; Core quality

1. INTRODUCTION

As the common language of the Chinese nation, Mandarin is the common language of the big family of the Chinese nation. In today's increasingly globalized world, Mandarin is not only an important carrier of Chinese national culture, but also a bridge of communication and cooperation in modern society. For vocational college students, to learn and use Mandarin well is not only to master a kind of communication and expression skills, but also an important embodiment of improving the core quality of the career and enhancing the ability of sustainable development. This paper will carry out a detailed analysis from three aspects: the current situation of Mandarin level of vocational college students, the significance of Mandarin promotion to the cultivation of vocational core quality of vocational college students and the main ways of promoting Mandarin.

2. CURRENT SITUATION OF MANDARIN LEVEL OF HIGHER VOCATIONAL STUDENTS

2.1 Students come from a wide area and have significant influence on dialects

Vocational college students come from all over the country, and their different dialect backgrounds lead to significant differences in Mandarin pronunciation and intonation, and they have obvious dialect characteristics in Mandarin oral expression [1]. On the other hand, many students have a low level of Mandarin due to the uneven level of Mandarin teachers or the lack of standard Mandarin demonstration and imitation training when they go to school in their hometown.

2.2 The Mandarin curriculum is not systematic

Mandarin courses in higher vocational colleges are often not systematic, and the curriculum is not scientific enough. In some schools, Mandarin courses are not included in the formal curriculum schedule, but when the

Mandarin test time is approaching, the relevant skills of Mandarin test are trained through community activities, "second class" and other ways. Students lack enough time and practical opportunities for systematic learning and training. This kind of "cramming" teaching method is difficult to effectively improve students' Mandarin level.

2.3 Lack of intrinsic motivation for students to learn

Some vocational college students lack enough attention and interest in learning Mandarin, thinking that Mandarin is not a professional course and do not need to spend too much energy to learn. This concept leads to their lack of initiative and enthusiasm in Mandarin learning, and the learning effect is not good. At the same time, due to the lack of practical application scenarios, students find it difficult to link Mandarin learning with their future career development and lack internal motivation to learn.

3. THE SIGNIFICANCE OF MANDARIN POPULARIZATION ON THE CULTIVATION OF VOCATIONAL CORE QUALITY OF VOCATIONAL STUDENTS

3.1 Improve communication and expression ability

Mandarin is the universal language of modern society and an important tool for effective communication between people. A good level of Mandarin can help students overcome the dialect barrier and better express their thoughts and opinions, which is conducive to making friends and learning, expanding their life circle and friends circle, and improving the efficiency and quality of communication.

3.2 Improve the ability of employment security

Mandarin is an important part of professional quality. In the current employment environment, many enterprises regard "Mandarin standard" as one of the recruitment conditions. Good Mandarin level can enhance personal image and enhance workplace competitiveness. For vocational college students, mastering standard Mandarin can help them better adapt to the market demand and changes in their future career development.

3.3 Promote cultural inheritance and innovation

As the common language of the Chinese nation, Mandarin carries rich cultural and historical connotations. Popularizing Mandarin will help carry forward the fine traditional Chinese culture and strengthen the sense of national identity and cohesion. At the same time, Mandarin is also an important support for the innovation and development of modern society. By learning and using Mandarin, students are better able to absorb new knowledge, ideas and concepts, providing strong support for future innovation and development.

4. THE MAIN WAYS TO PROMOTE MANDARIN

4.1 Establish a Mandarin promotion network covering the whole school

The promotion of Mandarin is a long-term task, which requires all departments of the school to work together and form a synergy. Higher vocational colleges should establish a Mandarin promotion network covering the whole school, clarify the responsibilities and tasks of each department, and ensure the smooth development of Mandarin promotion [2]. For example, a language Work committee with an office and full-time staff can be set up to be responsible for the organization, coordination and supervision of the Mandarin promotion work in the university. At the same time, special funds can be set up for the purchase of related hardware, software and equipment to provide a strong guarantee for the promotion of Mandarin.

4.2 Make full use of campus media and platforms

Vocational colleges should make full use of campus publicity media and platforms, such as posters, banners, radio broadcasts, websites and so on, regularly hang slogans on campus to learn Mandarin, broadcast Mandarin broadcasts and videos, set up Mandarin learning columns and Wechat public accounts to publicize the importance and necessity of Mandarin. Through publicity radiation, students' awareness of speaking Mandarin should be enhanced, and their interest and enthusiasm in learning Mandarin should be enhanced.

4.3 Carry out Mandarin practice activities by relying on school associations and campus culture and art festivals

Vocational colleges can rely on school associations and campus culture and art festivals to carry out a variety of Mandarin practice activities, such as classic reading, host competitions, debate competitions and so on. These activities can provide students with practical opportunities and display platforms, and stimulate their enthusiasm for learning and creativity. At the same time, Mandarin language corners can be set up to provide opportunities for students to practice and communicate with each other to help them improve their Mandarin proficiency.

4.4 Give full play to the exemplary and leading role of teachers

Teachers play an important role in demonstrating and leading the promotion of Mandarin. Higher vocational colleges should strengthen the construction of teachers and improve their Mandarin level and teaching ability. For example, teachers can be organized for Mandarin training and assessment to ensure that their Mandarin pronunciation is accurate and their intonation is natural. At the same time, teachers should be encouraged to use Mandarin for teaching and communication in daily teaching to set a good example for students.

4.5 Volunteer services and social practice in Mandarin should be carried out

Higher vocational colleges may organize students to carry out volunteer Mandarin service promotion activities in communities or towns, and provide Mandarin training for the elderly or migrant workers. These activities can not only help students apply what they have learned in practice, but also improve their sense of social responsibility and dedication.

4.6 Use social media platforms to promote Mandarin

In the digital age, social media platforms have become an important channel to promote Mandarin. Vocational colleges can use social media platforms to share Mandarin learning resources, publish Mandarin learning trends and results, and expand the influence and coverage of Mandarin promotion [3]. They can establish a Wechat group or QQ group for Mandarin learning, inviting students and teachers to join and share learning resources and exchange learning experiences. At the same time, Mandarin learning articles and video tutorials can be published on Wechat public accounts or Weibo platforms to provide students with convenient learning channels and resource support.

5. CONCLUSION

Popularizing Mandarin is one of the important ways to improve the core quality of vocational college students. In view of the current situation of Mandarin proficiency of higher vocational students, higher vocational colleges should take various measures to promote Mandarin, including establishing a Mandarin promotion network covering the whole school, making full use of campus media and platforms, and carrying out Mandarin practice activities relying on school associations and campus culture and art festivals. Through the implementation of multiple ways, it can effectively improve the Mandarin level of vocational students, enhance their professional core quality and sustainable development ability, and lay a solid foundation for future career development.

REFERENCES

[1] Liu Lanming, Ren Baokui. the establishment and practice of the training system of vocational students' basic quality [J]. Chinese Vocational and Technical Education, 2015(11):51-54.

[2] Zhang Lan. Promote Mandarin to improve vocational core quality of vocational students [J]. Journal of Liaoning Higher Vocational, 2021, 23(10):89-92.

[3] Lu Kaifei, Lei Kai, Ma Tianxin. Study on the model construction and path of vocational core quality training for students in higher vocational colleges [J]. Journal of Beijing Institute of Economic and Management, 2020(2):77-82

Exploration of Talent Training Models for Financial Technology and Application Majors in the Context of Digital Finance

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Abstract: In recent years, digital finance and financial technology have emerged as pivotal engines driving the evolution of the modern financial industry. With technology at their core, they have rapidly permeated every facet of financial services. Digital finance represents a novel financial service ecosystem constructed on the backbone of emerging technologies such as big data, artificial intelligence, blockchain, and cloud computing. Financial technology, on the other hand, embodies a practical approach to refining financial products and services through technological innovation. the swift advancement of both domains imposes fresh demands on higher vocational education, particularly on the curricular content, talent cultivation paradigms, and educational objectives of finance-related disciplines.

Keywords: Digital Finance; Financial Technology Application Major; Talent Cultivation Model

1. THE IMPORTANCE OF HIGHER VOCATIONAL EDUCATION IN THE CULTIVATION OF FINANCIAL TECHNOLOGY TALENTS

Digital finance and financial technology are driving the digital transformation of the traditional financial industry. Big data technology provides financial institutions with precise customer analysis and risk prediction capabilities, artificial intelligence enables automated operations such as smart investment advisory and risk control model optimization, and blockchain technology offers innovative solutions in areas like payment clearing and digital currencies. This deep integration of technologies has transformed the operational methods of traditional financial services while raising the financial industry's demands for the comprehensive qualities and practical abilities of vocational graduates. Higher vocational education needs to strengthen students' knowledge reserves in financial technology-related fields to meet industry requirements.

1.1 Serving Regional Economic Development and Meeting the Needs of the Financial Technology Industry

Higher vocational education focuses on serving local economic development as its core objective, with talent cultivation closely aligned with regional industrial demands. the development of financial technology exhibits significant regional characteristics, such as the rapid growth of internet finance in economically developed areas and the pilot promotion of blockchain technology in certain cities. Vocational colleges can design financial technology-related majors and courses based on regional economic characteristics, cultivating localized financial technology talents who are "employable and retainable, " thereby supporting the digital transformation of regional economies.

1.2 Emphasizing Practical Ability Training to Align with Financial Technology Job Requirements

The financial technology sector places high demands on practical skills, including data analysis, programming, and system operation and maintenance. the core advantage of higher vocational education lies in its emphasis on practical teaching. Through on-campus laboratories, virtual simulation training platforms, and off-campus training bases, students' practical operational abilities are enhanced. For example, students can use financial technology experimental platforms to simulate participation in big data risk control and smart investment advisory product design, quickly mastering practical skills and

achieving seamless alignment with industry job requirements.

1.3 Cultivating Interdisciplinary Talents to Bridge Industry Skill Gaps

The financial technology field requires interdisciplinary skills from practitioners, combining financial knowledge with technical backgrounds such as programming, data processing, and information security awareness. However, the discipline-specific training model of traditional higher education struggles to meet this demand. Higher vocational education, with its flexible curriculum design, can optimize course systems by introducing financial technology-related courses such as blockchain principles, artificial intelligence applications, and big data analysis into finance programs, cultivating interdisciplinary financial technology talents to bridge industry skill gaps.

1.4 Promoting Industry-Education Integration and Encouraging School-Enterprise Collaborative Innovation

Higher vocational education maintains close ties with enterprises, with industry-education integration being a key feature of its talent cultivation model. the financial technology sector is characterized by rapid technological updates and strong practical industry demands, making it difficult for schools alone to meet the teaching needs of cutting-edge technologies. Through deep collaboration with financial technology enterprises, vocational colleges can achieve resource sharing and complementary advantages. School-enterprise cooperation not only helps students better grasp the latest technologies but also enhances their adaptability to actual job roles.

2. ANALYSIS OF THE CURRENT STATUS OF TALENT TRAINING IN FINANCE MAJORS AT HIGHER VOCATIONAL INSTITUTIONS

2.1 Insufficient Curriculum System Design

The curriculum design for finance majors in higher vocational institutions generally emphasizes traditional financial theories, such as monetary banking, international finance, and financial management, with limited inclusion of financial technology-related courses. Cutting-edge topics like big data analysis, blockchain technology, and artificial intelligence applications in finance have not been effectively integrated into the existing curriculum, resulting in a mismatch between course content and industry needs.

The financial technology field emphasizes practical application, but the course design in some vocational institutions is predominantly theoretical, with limited practical teaching hours. Students lack hands-on experience in financial technology, and training content often relies on simple case studies or simulations, lacking real-world financial technology application scenarios. As a result, students cannot deeply understand the role and value of technology in actual business operations. In terms of teaching tools, outdated platforms are often used in training courses, failing to reflect the application of mainstream technologies, which hinders the improvement of students' practical skills and professional competitiveness.

2.2 Insufficient Practical Teaching Resources

Practical teaching is a crucial component of financial technology education, aiming to integrate theoretical knowledge with practical applications, cultivating students' operational skills, problem-solving abilities, and innovative thinking. However, the scarcity of practical teaching resources makes it difficult for curriculum design to meet both industry demands and student development needs.

Under limited resource support, practical courses are often simplified or relegated to supplementary teaching content, making it challenging for students to acquire comprehensive practical skills. This phenomenon leads to a curriculum that overemphasizes theoretical knowledge while neglecting the financial technology industry's strong demand for practical operational abilities. Due to the lack of sufficient practical teaching content, students struggle to truly understand and master the application of core technologies such as blockchain, big data analysis, and artificial intelligence. Many institutions' training facilities are outdated and cannot support the simulation of modern financial technology application scenarios. These resource constraints directly affect the depth and breadth of course content, preventing the curriculum from encompassing the core technologies and real business

scenarios of the financial technology field. As a result, students' practical experiences remain superficial, lacking a genuine understanding of the industry's complexities.

2.3 Insufficient Depth in School-Enterprise Collaboration

School-enterprise collaboration serves as a vital bridge connecting education and industry, providing students with learning and growth opportunities close to real industry environments through the deep integration of enterprise resources and academic teaching. However, the current school-enterprise collaboration model lacks depth and substance, significantly constraining the quality of curriculum design and the comprehensive development of students' abilities.

School-enterprise collaboration often remains superficial, lacking substantive involvement in teaching and projects. Many collaborations between institutions and enterprises are limited to signing agreements or organizing short-term activities, without delving into the core aspects of curriculum development, practical teaching, and student training. Although enterprises nominally participate in collaborations, their actual influence on curriculum design is limited. This shallow cooperation results in a significant gap between course content and industry needs, failing to fully reflect the cutting-edge technologies and real business scenarios in the financial technology field. Consequently, the skills students acquire during their studies often do not align with job requirements.

The lack of stable and close collaboration mechanisms between schools and enterprises hinders the sustained deepening of partnerships. Due to resource and channel limitations, some institutions struggle to establish long-term collaborations with leading industry enterprises, while small and medium-sized enterprises, constrained by their technical levels and resource capacities, offer relatively limited support to higher vocational education. In such cases, the projects and practical opportunities provided by enterprises are often fragmented, making it difficult for students to gain systematic industry experience and practical training through school-enterprise collaboration. This further restricts their comprehensive understanding of actual work in the financial technology field.

3. INNOVATING TALENT TRAINING MODELS IN THE CONTEXT OF DIGITAL FINANCE

3.1 Cultivating Interdisciplinary Talents

The demand for interdisciplinary talents in digital finance necessitates a talent training objective that focuses on the comprehensive cultivation of cross-disciplinary knowledge and skills. the financial technology field is essentially the intersection of finance and technology, requiring students to possess both a solid theoretical foundation in finance and strong information technology capabilities. This dual-capability training enables students to understand the logic of financial operations and enhance business efficiency or innovate financial products through technological means in their future careers.

Practical ability is one of the core competencies for talents in the digital finance field. Therefore, the talent training objective should emphasize cultivating students' practical operational skills to enable them to quickly adapt to industry job requirements. In curriculum design, introducing real business scenarios, allows students to experience and master the skills required for their roles during their studies. Additionally, the cultivation of practical abilities goes beyond skill training; it also involves developing students' comprehensive abilities to identify, analyze, and solve practical problems.

Data-driven decision-making is a core feature of the digital finance era. Therefore, the training objective should also focus on enhancing students' data analysis and decision-making capabilities. As data becomes a critical resource in the financial industry, students must be able to extract valuable insights from massive datasets and make informed decisions based on this information. At the same time, students need to develop a strong awareness of data security and legal compliance to ensure that innovative practices align with industry regulations and standards.

3.2 Optimizing the Curriculum System

Optimizing the curriculum system first requires highlighting the characteristics of interdisciplinary integration. In the era of

digital finance, the boundaries between finance and technology are increasingly blurred. the curriculum system should shift from single-discipline knowledge delivery to multidisciplinary integration. Finance theory courses need to incorporate information technology and data science content, such as embedding data modeling and analysis practices in risk management courses or adding explanations of blockchain and encryption technologies in payment and settlement courses. the curriculum content must also emphasize cutting-edge relevance and dynamic adjustments to keep pace with the rapid development of industry technologies. Against the backdrop of continuous innovations in big data, artificial intelligence, and blockchain, course content must be regularly updated. A dynamic curriculum update mechanism should be established to adjust course content based on the latest trends in industry development and technology applications.

The optimization of the evaluation system is also a crucial component of curriculum system reform. In traditional courses, evaluations are often exam-based, failing to comprehensively reflect students' practical abilities. In the optimized curriculum system, greater emphasis should be placed on students' performance in practical scenarios and the improvement of their comprehensive abilities. Multidimensional assessments, such as project presentations, teamwork evaluations, and practical operation performance, should be used to measure learning outcomes. Furthermore, evaluation standards can be jointly developed with enterprises to ensure that the results not only reflect students' academic achievements but also their adaptability to industry requirements.

3.3 School-Enterprise Collaboration and Industry-Education Integration

The core of school-enterprise collaboration and industry-education integration lies in establishing long-term, stable, and in-depth cooperative relationships, enabling enterprises to become key participants in education while allowing schools to enhance the industry relevance of their courses through integration. In school-enterprise collaboration, enterprises not only provide practical venues and equipment but also actively participate in curriculum design, teaching implementation, and student evaluation. Through this dual-participation model, course content can better align with industry needs. In financial technology courses, enterprises can provide real-world cases, such as the development process of digital payment platforms or the application scenarios of smart investment advisory systems, helping students understand real industry challenges and solutions during their studies.

To further deepen industry-education integration, it is necessary to break away from traditional school-enterprise collaboration models and shift from formal partnerships to content-based deep integration. Enterprises should not only support talent cultivation but also become primary participants in teaching content design. By jointly developing training plans, enterprises can embed their technical standards, industry norms, and business requirements directly into the curriculum system, ensuring that teaching content keeps pace with industry development.

4. CONCLUSION

The financial technology and application major, as a critical field adapting to the demands of the digital era, bears the responsibility of cultivating high-quality, interdisciplinary, and innovative talents for the industry. This paper has thoroughly analyzed the characteristics and shortcomings of the existing training models, delving into the limitations in curriculum design, practical teaching resources, and school-enterprise collaboration. It has also explored specific pathways for optimizing the curriculum system and deepening industry-education integration in the context of digital finance. By constructing a curriculum system that integrates theory and practice, emphasizes interdisciplinary integration, and allows for dynamic adjustments, students' comprehensive abilities and professional competitiveness can be effectively enhanced.

Higher vocational colleges and universities should take school-enterprise cooperation as a driving force, promote the deep integration of industry and education, ensure that enterprise demand is directly embedded in the whole teaching process, and provide students with a real practice environment and cutting-edge

technical support. Only through the continuous optimisation of the talent training model can we provide strong talent support for the digital transformation of the economy and society. This is not only the mission of education, but also the inevitable requirements of social progress.

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References

[1] Zeng, Y. (2024). Research on the Reform and Pathways of Talent Training Models for Financial Technology Application Majors in the Context of Digital Finance. *Modern Vocational Education*, (01), 109-112.

[2] Jia, J. Y., & Yu, M. Z. (2021). Practical Exploration of Financial Technology Major Construction and Talent Cultivation. *Scientific Decision-Making*, (12), 145-150.

[3] Ye, N. (2021). Strategies and Recommendations for Financial Technology Talent Cultivation in China. *Financial Technology Times*, (02), 39-46.

[4] Shi, K. P. (2021). Exploration of Talent Training Models for Applied Universities in the Context of Financial Technology. *Exhibition Economy*, (08), 92-94.

On the Quality Cultivation of Grassroots Teaching Administrators in Higher Education Institutions

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Abstract: The quality cultivation of grassroots teaching administrators in higher education institutions is a critical issue. With the popularization and increasing complexity of higher education, the competency requirements for grassroots teaching administrators are also rising. Teaching administrators must accurately position their roles, transform their philosophies, develop innovative thinking, and actively explore new educational models and methods to improve teaching quality.

Keywords: Higher Education Institutions; Grassroots Teaching; Administrators; Quality Cultivation

1. INTRODUCTION

Grassroots teaching administrators should possess sufficient professional knowledge, including a deep understanding of educational philosophies, teaching methods, and curriculum design. Additionally, they must master basic theories and methods of educational management to better plan and organize teaching activities. Efficient organizational and coordination skills are essential to ensure the smooth operation of teaching activities. They need to allocate faculty and resources appropriately, address potential issues, and maintain effective communication with all stakeholders.

2. THE ORIGIN AND CONNOTATION OF COMPETENCY

The term "competency" originated from physiological concepts and later expanded into fields such as psychology and education, becoming a key descriptor of individual physical and mental development levels. American scholar John Flanagan first proposed the "Critical Incident Technique" in 1945 to study the performance of U.S. Air Force pilots. In 1958, Professor McClelland mentioned in his book *Talent and Society: New Perspectives in the Identification of Talent* the correlation between individuals with specific personality traits and their work orientation and performance, though he used the term "talent" at the time. In 1959, American psychology professor Robert White formally introduced the term "competence." In 1973, Professor McClelland from Harvard University proposed "competency," establishing the "Competency Model" as a new research and practical framework [1].

Competency forms the physiological and psychological foundation of human development, encompassing both physical traits and psychological characteristics such as intelligence, emotions, and personality. These traits significantly influence individual behavior and performance. Professor Peng Jianfeng posits: "Competency is a collection of personality traits that drive outstanding job performance. It reflects an individual's knowledge, skills, personality, and intrinsic motivation, expressed in diverse ways." Professor Wang Zhongming emphasizes: "Competency refers to knowledge, skills, abilities, values, personality, and motivations that lead to high managerial performance." It highlights adaptability and problem-solving capabilities in specific environments. Competency includes not only knowledge and skills but also attitudes, values, and emotional expressions. These elements collectively enable individuals to demonstrate strong adaptability in society. Competency standards vary across social, cultural, and historical contexts. For instance, some cultures prioritize independence and self-actualization, while others emphasize group harmony. Competency development is a long-term process. Through education, training, experience, and reflection, individuals can continuously enhance their competencies to meet societal demands. Self-awareness, self-evaluation, and self-development play vital roles in this process.

3. ENHANCING THE COMPETENCIES OF GRASSROOTS TEACHING ADMINISTRATORS

3.1 Accurate Positioning of One's Role

Accurate role positioning is crucial for grassroots teaching administrators to fulfill their responsibilities effectively. They must thoroughly understand and implement educational policies and regulations issued by the Ministry of Education, align with institutional goals, and ensure the smooth execution of teaching activities. As educational reforms advance, the demands on teaching management in higher education institutions

continue to grow. Administrators must persistently acquire new knowledge and skills, stay updated on reform trends, and improve their professional competencies to adapt to evolving requirements. Continuous learning and self-development are essential to remain responsive to dynamic educational environments. Administrators should also clarify their roles as service providers, coordinators, and responsible learners, enhancing their comprehensive qualities to support effective teaching management.

3.2 Transformation of Teaching Management Philosophies

Grassroots teaching administrators must shift their management philosophies to align with educational reforms. Transitioning from a "teacher-centered" to a "student-centered" approach is imperative. Traditional management emphasized instructors' teaching over students' learning, whereas modern education prioritizes students' needs and development. Shifting from "scale-oriented management" to "quality-oriented management" is equally critical. Past practices focused on quantitative metrics (e.g., student enrollment, course numbers) but neglected teaching quality. Contemporary management should emphasize learning outcomes and proactive problem-solving. In summary, administrators must continuously update their philosophies to contribute to educational quality.

3.3 Innovation in Teaching Management Models

Teaching management is central to institutional administration, directly impacting teaching quality and talent cultivation [2]. Grassroots administrators must possess managerial capabilities in planning, coordination, motivation, and decision-making. Historically, uniform management models overlooked student individuality. Modern approaches should emphasize personalized management tailored to students' characteristics and developmental needs. Administrators must also understand educational mechanisms and theoretical foundations to better manage, coordinate, and implement educational tasks. Reforming talent cultivation models is key to deepening educational system reforms. Innovations in training mechanisms, curriculum design, and instructional methods necessitate a shift from flat to dynamic, multidimensional management models.

REFERENCES

[1] Cao Xiping. (2019). A Study on the Composition of Competency Elements for Distance Education Administrators in Hunan. China Management Informatization, 22(09), 116-117.

[2] Fan Xiaodan & Ling Xiurong. (2008). A Brief Discussion on the Work and Innovation of University Academic Affairs Staff. Journal of Guangxi University (Philosophy and Social Science Edition), (5), 184-185.