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International Education Forum

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Table of Contents

1	Digital Intelligence Empowerment: Teaching Exploration of Mathematics Subject Data Course <i>Yuting Li, Hairong Lian, Fengjie Geng</i>
9	A Multimodal Critical Discourse Analysis of Lingnan Cultural Promotional Videos by Official Institutions and Influencers on Social Media <i>Lu Jiang</i>
23	Curriculum Analysis and Instructional Strategies for the Fundamentals of Astronomy in Chinese Senior High School Geography <i>Jizhao Ding, Yan Gao</i>
30	The Real Dilemmas and Breakthrough Paths of Technology Transfer in Higher Vocational Colleges <i>Xiao Zhang, Hongyan Liu, Lingzhao Deng</i>
37	Exploration of English Writing Teaching Strategies from the Perspective of Learning Science in the Context of Large-Unit Teaching <i>Dan Wu</i>
44	Inheritance and Innovation of Guangdong Han Opera: Xu Qing's Artistic Practice and Thoughts <i>Bo Dong, Ruiji Shengchuan</i>
51	A Study on the Inheritance and Innovation of Guangdong Han Opera: A Case Study of Xianhua Li as a Representative Inheritor <i>Bo Dong, Ruiji Shengchuan, Huaman Chen</i>
64	The Dilemma and Outlet of Higher Education Management Research <i>Honglei Jiao</i>
71	The Innovation, Integration, and Development Path of AI Art in the Framework of Smart Cities <i>Yu Wu</i>
77	Research on the Optimization Path of Industry- Education Integration Model in Vocational Education from the Perspective of Lifelong Learning <i>Zhe Wu</i>

Digital Intelligence Empowerment: Teaching Exploration of Mathematics Subject Data Course

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Abstract: Given the rapid development of the data science field, college personnel training is facing new challenges and opportunities. This paper focuses on the “Introduction to Data Science” course, an in-depth exploration of the teaching reform of data courses. With the optimization of curriculum settings, innovation, and reform of teaching methods and other measures, the study focuses on case design, effectively promotes the deep combination of theory and practice, and integrates machine learning algorithms and Python programming language, to effectively improve students’ comprehensive literacy. In addition, this paper also discusses the cross integration of mathematics and data science, to provide a valuable reference for the transportation of high-quality talents in the flourishing era of numerical intelligence.

Keywords: Data science; Mathematics; Digital intelligence empowerment; Teaching reform

Online publication: March 12, 2025

1. Introduction

With the rapid development of emerging technologies such as big data and artificial intelligence, human society has entered the era of digital intelligence^[1-2]. In this wave of times, data has exploded and become a key factor driving innovation and development in various fields, and its influence in the field of education has become increasingly prominent. Innovation-driven development has always been the strategic focus of China, which strives to promote the vigorous development of new economies such as new technologies, new forms of business, new industries, and new models^[3]. To occupy a dominant position in the global competition, overcome the “bottleneck” problem, and break through the core technology, the country urgently needs a large number of talents with a solid theoretical foundation and the application ability of new technology. However, the traditional training model of basic science talents has made it difficult to meet the requirements of the new era, new economic development, and new industrial revolution^[4]. Therefore, the establishment of an applied science major has become an urgent need for national strategic development. As the core carrier of training students’ application and practice ability, data majors are facing unprecedented

opportunities and challenges^[5-6].

On the one hand, data courses are developing rapidly with the advent of the age of digital intelligence. Digital resources are very rich, online platforms for students to bring a large number of learning materials so that students can access cutting-edge knowledge. Teachers can also use big data technology to analyze students' learning trajectories, such as the mastery of knowledge points, to carry out personalized teaching more accurately and effectively complete the teaching content. The emergence of a variety of data analysis software has brought great convenience to learning data courses, such as Python, R language, etc., which allows students to quickly apply what they have learned and achieve the effect of putting what they have learned into practice.

On the other hand, the teaching of data courses has also encountered many difficulties. With the acceleration of knowledge upgrading and the endless emergence of new technologies and algorithms in the field of data science, how to keep up with the pace of the time and incorporate cutting-edge achievements in time has become a thorny problem faced by teachers. At the same time, how to build a data specialty under the background of mathematics discipline has become an increasingly prominent problem. The traditional teaching mode emphasizes theory teaching, and the practice teaching link is weak, which makes it difficult to meet the strict requirements of students' practice and innovation ability in the age of digital intelligence. At a time when data security and ethical issues are increasingly attracting social attention, how to integrate relevant educational content into the curriculum and guide students to establish correct data values cannot be ignored.

Given this, it is of great significance to deeply explore the teaching strategies of data courses in the age of digital intelligence. For the data computation and application specialty under the mathematics discipline, "Introduction to Data Science" as an introductory course, its importance is self-evident. Although mathematical theory is the cornerstone of data science, how to carry out teaching for students of this major in line with their disciplinary background, so that students can not only have a solid grasp of data science knowledge but also deeply integrate mathematical expertise, is an urgent problem to be solved, which is related to whether educators can provide the society with compound talents with profound mathematical heritage and data science application ability. This paper focuses on the construction of data courses under the background of mathematics, and discusses the teaching research and practice of "Introduction to Data Science."

2. Characteristics and status quo of data courses

2.1. Features

The era of digital intelligence is a high-level stage of information technology development, and its core essence is the deep integration of digitalization and intelligence, cutting-edge technologies such as big data, artificial intelligence, and the Internet of Things enable each other to work together to drive all-round social change. Big data is like a "digital gold mine" containing endless value, with massive, diverse, high-speed, and real data continuously pouring out from every corner. Artificial intelligence is like a "digital brain" with extraordinary wisdom, and cutting-edge algorithms such as machine learning and deep learning make it have the excellent ability to simulate human intelligence, and can accurately analyze, predict, and make decisions on massive data.

As a key component of the education system in the age of digital intelligence, data courses cover the interdisciplinary knowledge fields of statistics, computer science, mathematics, etc., as shown in **Figure 1**. From the perspective of basic theory, statistics provides the cornerstone of scientific methodology for data collection, sorting, analysis, and inference, enabling students to master core skills such as data distribution law, correlation analysis, and hypoth-

esis testing, and to mine valuable information from massive data. Computer science gives students the ability to data storage, processing, algorithm design, and programming implementation. With the help of knowledge of database management systems, data structure, algorithms, programming languages, and so on, they can effectively realize the automatic operation of data and solve complex tasks. As the foundation of logical thinking and quantitative analysis, mathematics, linear algebra, calculus, probability theory, and other branches provide powerful tools for data modeling, optimization algorithms, machine learning theoretical derivation, etc., to help students build accurate mathematical models to explain data phenomena.

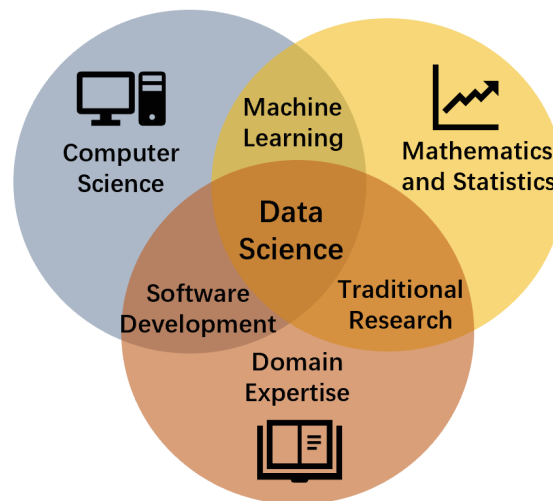


Figure 1. Data science

“Introduction to Data Science” is an important data course aimed at cultivating talents with theoretical knowledge and practical ability. On the one hand, to be able to apply the knowledge learned, students need to master the technical means of data processing, such as data acquisition, storage, processing, analysis, and visualization. At the same time, they should be proficient in data processing software SQL, Python, R language, and other tools. For structured and unstructured data, such as marketing data, social network data, image recognition, etc., students need to process and analyze. On the other hand, it is very important to cultivate students’ mathematical thinking and creative consciousness to construct data courses under the mathematics discipline. Students should have the thinking habit of using data to understand the nature of problems, discover potential rules, predict development trends, and use data to drive decision-making and solve practical problems innovatively.

2.2. Status quo

The teaching and research of data courses in foreign countries started earlier and achieved a lot. Many top universities in Europe and the United States, such as Stanford University and Massachusetts Institute of Technology, rely on strong scientific research strength and rich educational resources to build a cutting-edge and systematic data science curriculum system. These courses not only cover basic theoretical knowledge such as statistics and computer science but also closely combine with the actual needs of the industry and integrate the latest research results in hot fields such as machine learning, data mining, and artificial intelligence so that what students learn is closely connected with the needs of the market.

In contrast, although the domestic data course teaching and research started a little later, in recent years, with the vigorous rise of the big data industry, the development momentum is rapid. Among institutions of higher learning in the country, key universities such as Renmin University of China and Tsinghua University started data-related courses earlier. Subsequently, two undergraduate majors, Big Data and Data Science, were officially established in 2016 and 2022 respectively^[4]. Many universities have set up data science and big data technology, data analysis, and other related majors and courses, and actively explore the teaching model suitable for national conditions. In August 2017, experts from the Guiding Committee for the Teaching of Mathematics in higher education institutions of the Ministry of Education declared the major “Data Calculation and Application.” In March 2018, the exploration and practice of “Data Computation and Application” of mathematics applied science major, chaired by Professor Wu Shuquan of Fudan University, was approved^[4].

In the field of mathematics, the major of data computation and application, as a cutting-edge major that deeply integrates mathematical theories into data processing and application, its guiding course “Introduction to Data Science” has become more and more important. Mathematical theory, as the solid foundation of data science, provides indispensable support for data analysis, modeling, and algorithm design. However, how to carry out precise teaching based on the unique disciplinary background of students in this major, so that they can not only grasp the core knowledge system of data science but also seamlessly embed their deep mathematical expertise in data science applications, has become a key problem to be solved in the field of education. The solution to this challenge is directly related to the ability to provide a steady stream of composite high-end talents with deep mathematical literacy and excellent data science application ability for society.

3. The internal relationship between mathematics and data science

In the context of mathematics, many students who choose to major in data computation and application have a question: “Why do we need to learn mathematical theory?” Therefore, in the Introduction to Data Science course, educators should explain to students what role mathematics plays in data science, which actually provides the theoretical foundation and practical tools for understanding and processing data. For example, matrix operations in linear algebra play a key role in dimensionality reduction and image processing. Therefore, students should understand that mathematics can serve as a powerful toolbox for data scientists, enabling them to extract valuable information from complex data sets and make relatively accurate decisions based on it. Through these types of courses, students understand that a solid mathematical foundation is essential for anyone wishing to go deep into the field of data science.

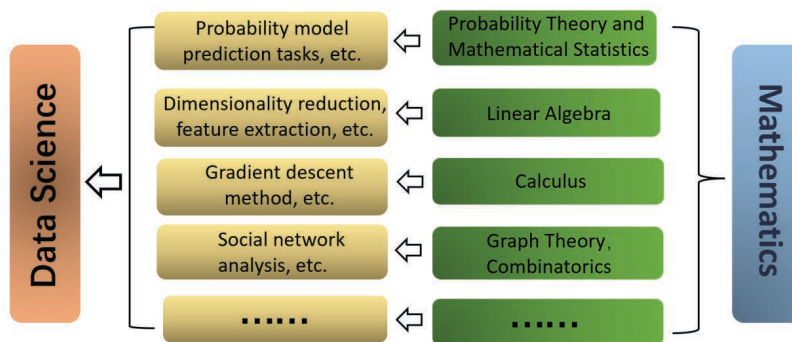


Figure 2. Connection between mathematics and data science

When using data science tools to analyze problems, students should be taught some connections between math and data science, as shown in **Figure 2**. Some examples are as follows.

Probability theory is the basis for understanding random phenomena. In data science, probability theory is used to model uncertainty and risk, such as the use of probabilistic models in machine learning algorithms to predict the likelihood of events occurring.

Linear algebra is essential for processing high-dimensional data. It involves vectors, matrices, and their operations, concepts that are widely used in data representation, feature extraction, dimensionality reduction techniques such as PCA, and many machine learning algorithms.

Calculus can be applied in the field of optimization of artificial intelligence algorithms, especially when the algorithm needs to search for the optimal value of a task. For example, the gradient descent method used in neural network training is based on calculus theory.

Graph theory, combinatorial mathematics, and other knowledge points in basic mathematics can be used to explain neural network structure, social network analysis, and graph neural networks.

Through the above analysis, educators need to let students know that data science research is based on mathematical theory, and mathematics also provides ideas and methods for data science. For data science, whether it is from theoretical research to application landing, or simple data visualization to complex artificial intelligence models, mathematics plays an indispensable role. Therefore, giving students a deep understanding and mastery of mathematics is essential to becoming a good data scientist.

4. Teaching thinking

4.1. Enhancement of mathematics and data science knowledge

For students majoring in data computation and application in mathematics, although they have a certain mathematical foundation, they still need to strengthen the mathematical knowledge closely related to data science. Explain in depth the Bayesian theory of probability theory, which has important applications in data classification, prediction, and other tasks. Strengthen the teaching of matrix decomposition and singular value decomposition in linear algebra, which is very important in data dimensionality reduction and recommendation systems. Through practical cases, such as the use of a Bayesian classifier for spam identification, students can experience the specific application of mathematical knowledge in data science.

In addition, the core body of knowledge for data science should be detailed. In terms of data mining, it explains algorithms such as association rule mining and cluster analysis, such as the Apriori algorithm for mining association rules in commodity sales data, and the K-Means clustering algorithm for classifying customer groups. In the field of machine learning, in-depth analysis of supervised learning, unsupervised learning, semi-supervised learning, and other algorithm principles, by comparing the performance of different algorithms in image recognition, speech recognition, and other tasks, so that students can understand the advantages of algorithms and suitable tasks. In the deep learning section, the structure of neural networks, backpropagation algorithms, and classical models such as convolutional neural networks and recurrent neural networks are introduced. Practical projects such as image classification and natural language processing are taken as examples to enable students to master the construction and training methods of deep learning models.

4.2. Problem-based learning

A teaching method that encourages active Learning by dealing with practical problems is called Problem-Based

learning (PBL), as shown in **Figure 3**. An important feature of the “Introduction to Data Science” course is that it is suitable for PBL teaching. Therefore, in classroom teaching, practical problems are used as examples to guide students to think and solve problems. This method encourages students to find problems, analyze problems, and find solutions by themselves in the classroom, to achieve the purpose of in-depth understanding and mastery of knowledge.

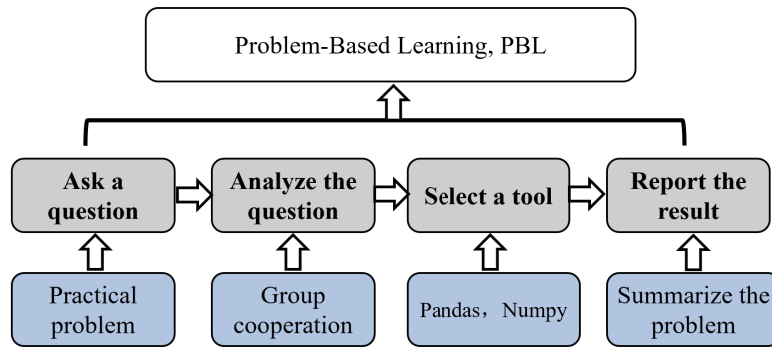


Figure 3. PBL teaching method map

The PBL teaching method is described in detail below.

Ask questions. When preparing the lesson, educators can set a problem that comes from life and integrate it with the course content to stimulate students’ interest in learning. For example, when explaining the data preprocessing method, the specific case of the “Titanic sinking” incident can be introduced to analyze the relationship between gender, age, and other factors and the survival probability of passengers. The event was made famous by the movie *Titanic*, so students are very interested in it. Given specific problems, educators can solve the problem of “gender, age and the correlation between survivors and passengers” as a guide, and teach students relevant pretreatment methods such as data filling and data missing, which will help students understand and accept the knowledge points.

Analyze the question. After the question is raised, the analysis of the problem through data science methods can be in the form of group cooperation, for example, each group is consisted of 3–5 people, so that each student can participate in the discussion. Students can be assigned different roles within the group, such as collecting information, writing programs, and visualizing data analysis. This can not only improve work efficiency but also let students experience the importance of teamwork. For example, when talking about “exploratory data analysis”, three students can be assigned to undertake professional terminology query, data collection, and data visualization. As a result, it can enhance students’ classroom participation and activity, and stimulate students’ interest in learning.

Select a tool. In the process of group work, teachers need to provide students with the necessary reference materials, tools, or platforms to help them gather information. For example, some commonly used data preprocessing libraries are Pandas, Numpy, etc., and visualization tools are Matplotlib, Seaborn, and so on. Teachers should regularly check the progress of each group and give feedback and guidance. At the same time, critical thinking is required in the evaluation process, guiding students to put forward open-ended questions and encouraging them to think about problems from different angles. After solving the problem, organize students to reflect and discuss what worked and what needs to be improved.

Report results. After the group debriefing, teachers need to find out how students feel about the PBL teaching style and what problems they encounter during the learning process. Finally, according to the results, the teaching methods are adjusted to improve the teaching design and classroom management. This can effectively implement the

PBL model in the classroom, not only improving students' interest in learning and engagement but also cultivating their teamwork and problem-solving skills.

4.3. Classroom thinking and politics in data science

For data courses, it is not only necessary to cultivate students' practical ability in teaching, but more importantly, to let them establish correct social values. The integration of ideological and political education in the course of "Introduction to Data Science" will not only help to cultivate well-developed scientific and technological talents but also promote the harmonious development of society.

As shown in **Figure 4**, the following examples give specific methods of integrating ideological and political education in the course of teaching "Introduction to Data Science."

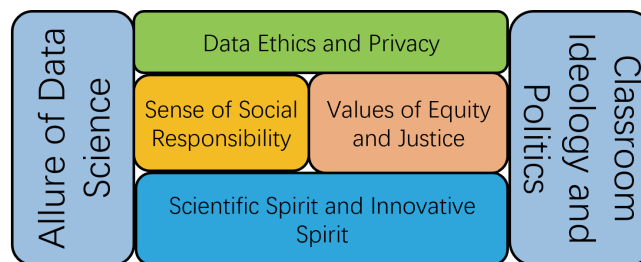


Figure 4. Classroom thinking and politics in data science

Data ethics and privacy protection. Data science cases are basically from life, so students must understand the importance of data ethics while learning knowledge. Real-world examples of data breaches and data abuse, such as the Facebook-Cambridge Analytica incident, can teach students the need for data privacy and set the bottom line for scientific research.

Enhance social responsibility. In the selection of data science projects, students can be encouraged to pay more attention to social welfare projects, such as using data science methods to deal with health care problems. By using the knowledge learned in class, students can solve social problems, enhance their sense of social responsibility, and in turn, promote students' interest in learning.

Cultivate values of fairness and justice. Using some typical cases, such as gender discrimination in recruitment algorithms, racial bias in judicial decisions, etc., can let students know that the application of data science should consider diverse population backgrounds and establish the value of fairness and justice.

Promote the spirit of science and innovation. While learning classroom knowledge well, students' innovation ability should be cultivated, and students should be inspired to explore unknown areas through basic knowledge. For example, more students are encouraged to participate in some discipline competitions to stimulate students' sense of innovation, especially emphasizing multi-disciplinary cooperation (such as sociology, psychology, physics, etc.). In this way, students' scientific spirit, innovative spirit, and teamwork ability can be better cultivated.

Through the above methods, ideological and political education can be effectively integrated into the data science classroom to cultivate compound talents with both professional knowledge and noble character.

5. Summary and outlook

To sum up, building a data-related course teaching system that meets the needs of the digital intelligence era is a key

path to cultivating talents with a deep theoretical foundation and cutting-edge technology application ability. As a typical representative of the curriculum system, Introduction to Data Science should guide students to use knowledge flexibly and solve complex problems in reality. In particular, the close connection between mathematics and data science should be explained, so that students can understand the important value of mathematical theory. In addition, the organic integration of ideological and political education elements helps cultivate high-quality scientific and technological talents with both morality and talent and meets the needs of the national science and technology strategy and talent reserve.

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Disclosure statement

The authors declare no conflict of interest.

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A Multimodal Critical Discourse Analysis of Lingnan Cultural Promotional Videos by Official Institutions and Influencers on Social Media

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Abstract: This study analyzes Lingnan cultural promotional videos published by official institutions with and without streamers, influencers with and without streamers on social media on the theme of natural scenery and cityscape, historical stories of Lingnan culture, cuisine, folklore, and spring festival customs by the method of multimodal critical discourse analysis. This study also explores the differences in the communication effect of these videos by the method of corpus linguistics. The research results reveal that official videos of natural scenery and cityscapes without streamers use third-person narration and formal lexis, while influencer videos adopt a more personal and emotional style. Official videos with streamers follow a structured, formal approach with guided hosts, while influencer videos are spontaneous and interactive. Unlike official institutions, influencers excel in storytelling about Lingnan culture. In videos of cuisine and customs, official institutions often feature public figures, while influencers engage local chefs or folk practitioners in casual Cantonese conversations. Official videos use scripted narration, while influencer videos focus on entertainment, creating an immersive, dynamic experience. This study not only contributes to the better dissemination of Lingnan culture but also provides a foundation for the construction of the “Cultural Bay Area” image, creating a harmonious and friendly cultural ecosystem and public opinion environment.

Keywords: Multimodal critical discourse analysis; Lingnan cultural promotional videos; Corpus linguistics; Social media

Online publication: March 12, 2025

1. Introduction

With the issuance of the “Cultural Protection, Inheritance, and Utilization Project Implementation Plan”, a nationwide wave of enthusiasm for the protection of traditional culture and cultural tourism has emerged in recent years. The plan, revised and issued by the National Development and Reform Commission and other departments, aims to thoroughly implement the president of CCP’s cultural thought, further improve the national urban and rural public

cultural service system, strengthen the overall protection and dynamic inheritance of cultural and natural heritage, promote the high-quality development of the integration of culture and tourism, and contribute to the construction of a culturally strong nation. Influencers and grassroots activists actively engage in producing and circulating promotional content on social media. As the influence of social media platforms in promoting culture becomes more widely recognized, government agencies and cultural institutions have increasingly begun to leverage these platforms to spread cultural content. They actively engage in publishing official tourism and cultural promotional videos with the aim of shaping and enhancing the image of cities. This shift to digital and social media channels allows institutions to reach broader, younger audiences, effectively disseminating regional and national cultural narratives. The dynamic interplay between official and grassroots representations not only reflects shifting power dynamics in the cultural sphere but also underscores the complex negotiation of cultural meanings in the digital age.

Lingnan culture, as a unique cultural system in southern China, encompasses a rich variety of traditional customs, artistic forms, architectural styles, and more. In recent years, with the widespread use of social media, the promotion of Lingnan culture has gradually diversified. Official institutions and internet influencers, as the main content producers, play different roles in the short video. Official institutions present the depth and historical significance of Lingnan culture through authoritative narrative strategies and systematic content frameworks, while influencers display the liveliness and modernity of Lingnan culture in a personalized and entertaining way, attracting a large number of young viewers ^[1-2]. The rise of this communication model has increased the acceptance and attention of Lingnan culture among different audiences.

With the advancement of social media technology, the promotion of Lingnan culture on social platforms has gradually broken through the single communication model, making the promotion methods of both official institutions and influencers have significant communication effects in different fields and audiences ^[3]. Although this communication model has enhanced the visibility of Lingnan culture, there are still noticeable differences in terms of multimodal presentation and communication effects, which affect the comprehensiveness and coherence of cultural communication ^[4]. Therefore, it is necessary to systematically analyze the characteristics and effect differences between the two in the process of short video communication of Lingnan culture, to enrich the research perspectives on the dissemination of Lingnan culture. The specific questions include: (1) What are the differences in the multimodal presentation of official cultural tourism videos with streamers and official cultural tourism videos without streamers, as well as official videos without streamers and influencer videos without streamers on the same theme? (2) What are the differences in the communication effects of official cultural tourism videos with streamers and influencer cultural tourism videos with streamers, official cultural tourism videos without streamers, and influencer cultural tourism videos without streamers?

To address these questions, the study will first do a literature review on the studies of cultural promotional videos on social media platforms. Then, the study will make a short introduction to the data collection and methodology. Subsequently, the study will discuss the communication and construction of Lingnan culture on social media platforms from the perspective of multimodal critical discourse analysis by contrastive analysis of official institution videos with streamers, internet celebrity videos with streamers, institution videos without streamers, and internet celebrity videos without streamers. Then, the study will analyze the communication effect of these videos. Ultimately, the study will discuss the strengths and weaknesses of official videos and influencer videos to achieve complementary advantages.

2. Literature review

Both official institutions and influencers play important roles in promoting Lingnan culture, yet their narrative strategies and communication characteristics in short video promotion exhibit significant differences. Li points out that official institutions present the profound nature of Lingnan culture through historical narratives and authoritative information, which helps enhance cultural authority and trustworthiness^[5]. However, this traditional and formal narrative approach has limitations in attracting younger audiences^[6]. For instance, official videos often emphasize the historical aspects of Lingnan culture while paying less attention to interactivity and entertainment, leading to poor engagement with young viewers^[4]. In contrast, influencers attract audiences through a diverse array of visual and narrative techniques, such as personal experiences and a relaxed storytelling style. They present Lingnan culture in a more relatable and entertaining way. While they perform better in terms of interactivity, the depth of their content is often lacking, making it difficult to fully convey the essence of Lingnan culture. For example, Mak analyzed how influencers' self-media styles increase content interactivity but simultaneously pointed out the lack of depth and authority^[7].

There are also notable differences between official institutions and influencers in terms of multimodal expression and communication effects in short videos. Qin et al. analyzed the roles of government departments and influencers in promoting Lingnan culture, emphasizing that official institutions lack interactivity, whereas influencers are better able to engage the audience, making the content more easily accepted but less profound^[3,5]. Qiu et al. studied the Chinese government's approach to promoting Lingnan culture via social media, noting that official promotion focuses on the protection of cultural heritage and its educational significance, while influencers' promotion highlights entertainment, making it well-suited to conveying the modern appeal of Lingnan culture^[1]. The question of how to effectively combine the strengths of both official institutions and influencers for the multi-layered dissemination of Lingnan culture has become an important topic^[6].

These studies provide theoretical foundations for multi-agent cultural promotion, yet there is still a lack of systematic comparative research on how these two approaches differ in multimodal presentation. There is an urgent need to explore the effective integration of official institutions and influencers in the promotion of Lingnan culture to optimize communication methods and deepen cultural dissemination. Jiang researched Lingnan cultural promotional videos produced by tourism bureau directors across Guangdong Province, but these videos only represent a small fraction of official cultural tourism videos^[8]. Official cultural tourism videos can be divided into those with streamers and those without streamers, while influencer cultural tourism videos can also be categorized into those with and without streamers. The focus of this study is to examine the differences in the multimodal presentation and communication effects between official cultural tourism videos without streamers and influencer cultural tourism videos without streamers, official cultural tourism videos with streamers, and influencer cultural tourism videos with streamers, and discuss how to fully leverage the communication strengths of both official institutions and influencers to promote the spread of Lingnan culture and enhance the image of the humanistic greater bay area.

3. Data and analytical method

This paper analyzes a total of 461 Lingnan cultural promotional videos, each receiving over 10,000 likes, published by both official institutions and influencers on social media platforms. Official institutions mainly include the Guangdong Provincial Department of Culture and Tourism, Guangdong Intangible Cultural Heritage Protection Center, Guangdong Cultural Center, and cultural and tourism bureaus of the 21 prefecture-level cities under Guangdong

Province. Influencer accounts promoting Lingnan culture are primarily identified by searching for “Lingnan culture” and “Lingnan” on TikTok, REDnote, and WeChat Channels with more than 100,000 followers, followed by browsing and screening them individually.

From the perspective of multimodal analysis of videos, the study employs the method of multimodal critical discourse analysis ^[9]. Feng’s research on emotional expression in the film served as a foundation, focusing on verbal and non-verbal semiotic resources to promote values ^[10–11]. This approach has since expanded to include language, visuals, and narrative elements to communicate environmental values and public service messages ^[12–13].

Wang and Feng’s social semiotic framework, which analyzed Xi’an’s promotional videos, has mapped verbal resources and visual depictions to construct an image of the city ^[14]. In this framework, verbal resources refer to both explicit and implicit expressions. Explicit verbal resources involve direct language and descriptive words that openly convey positive qualities or attributes. Implicit verbal resources are subtler, relying on statements of facts or events that evoke specific associations without directly stating them. Visual depictions are key in portraying the city’s beauty, culture, and lifestyle. Scenery depictions feature landmarks and historical sites, while character depictions are categorized into actional and analytical processes. Actional processes show characters engaged in cultural activities, while analytical processes focus on close-up shots of attire and physical features, reflecting the city’s blend of tradition and modernity.

Based on the above Wang and Feng’s framework of multimodal construction of attributes, Lang added an extra category of auditory embedding which includes depictions of voiceovers and signs and depiction of effects in the original visual depictions (**Figure 1**) ^[14–15]. According to Lang, the depiction of voiceovers can be further divided into background music (BGM) and sound effects (SFX), in which BGM usually refers to light music while sound effects refer to sounds by animals or objects ^[15].

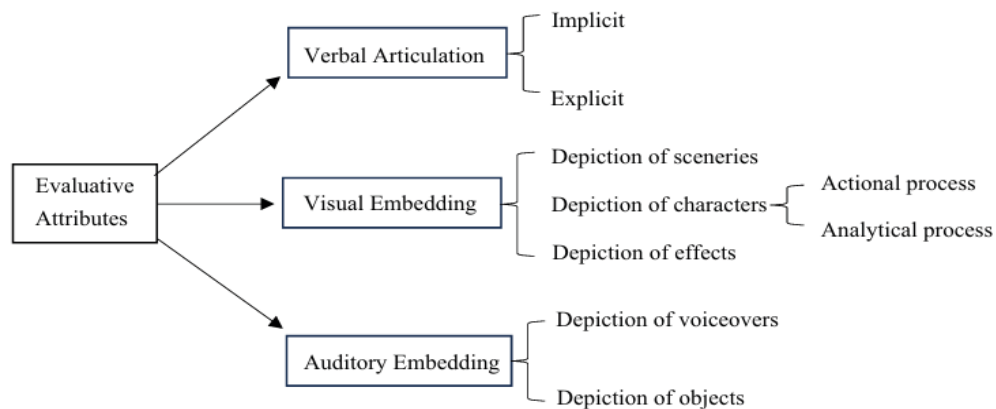


Figure 1. The multimodal construction of attributes by Lang

In the research of communication effects, the researchers adopt a corpus linguistics approach to extract the top five comments from four types of cultural tourism videos: official videos with streamers, official videos without streamers, influencer videos with streamers, and influencer videos without streamers. By comparing and analyzing keywords and high-frequency words, the study will examine the differences between the comments on official cultural tourism videos with streamers and influencer videos with streamers, as well as the differences between the comments on official cultural tourism videos without streamers and influencer videos without streamers. This analysis aims to reveal the varying communication effects and to achieve a complementary balance between the strengths of official and influencer cultural tourism videos.

This paper did both a descriptive analysis of the attributes in selected analysis videos by the method of multimodal critical discourse analysis and a quantitative analysis of comments of those videos on social media by the method of corpus linguistic analysis. To ensure the objectivity and scientificity of the data, another lecturer who majored in multimodal discourse analysis was invited to code the data independently. The result shows that the agreement reached 85% and the rest were solved through discussion.

4. Multimodal critical discourse analysis of Lingnan cultural promotional videos

This research collected 328 Lingnan cultural promotional videos published by official institutions and 133 Lingnan cultural promotional videos by influencers. These videos were classified by different themes, including videos of natural scenery and cityscape, culinary videos, videos of folklore and spring festival customs, videos of historical stories of Lingnan culture. Folklore refers to oral traditions, material culture, customary lore, forms, and rituals of celebrations. Historical stories of Lingnan culture mainly include the stories of historical figures, contemporary influential figures, the development of cities in Guangdong province, and ancient buildings and architecture. Although culinary videos and videos of folklore and spring festival customs belong to different themes, their presentation styles are similar, primarily focusing on either storytelling or experiential content. Therefore, this paper will discuss these two themes together.

4.1. Contrastive analysis of videos of natural scenery and cityscape

Official institutions have published videos of natural scenery and cityscapes without streamers on social media in three main ways. The first method involves releasing individual cultural tourism promotional videos or video collections for various prefecture-level cities in Guangdong Province. Some of these videos showcase local natural landscapes and urban sceneries. For example, the video “悦享冬日，暖暖广东” (Enjoy Winter, Warm Guangdong), posted on the official account of “@广东文旅” (@Guangdong Culture and Tourism), is a video collection type that features the natural scenery, urban landscapes, cuisine, and folk customs of cities like Guangzhou, Shenzhen, and Jiangmen. The second method is to combine the natural sceneries of different prefecture-level cities in Guangdong into a single video. For example, the video titled “过年到广东看：海阔天空” (Celebrate the New Year in Guangdong: A View of the Vast Ocean) posted by “@Guangdong Culture and Tourism” includes natural sceneries from locations such as the Dapeng Peninsula and the Hong Kong-Zhuhai-Macao Bridge in Shenzhen, islands like Nan’ao Island in Shantou, and Shuangyue Bay in Huizhou. The first type of video shows natural scenery and urban landscapes, and the second type tends to use aerial and wide-angle shots, accompanied by soothing, lively, or grand music. These two types of videos have little explicit or implicit articulation. The third method focuses on specific parks, beaches, or islands in Guangdong’s prefecture-level cities, such as Nansha Wetland Park, Hailing Island, and Huizhou Beach. These videos typically use third-person narration. There are many attitudinal lexis and phrases used in explicit articulation. For example, in the video “一场夏梦，南沙湿地公园” (A Summer Dream, Nansha Wetland Park), posted by “@Guangdong Culture and Tourism”, numerous phrases express strong attitudes, such as “美成一幅画的南沙公园” (Nansha Park, as beautiful as a painting) and “绝美的拍照胜地” (a stunning place for photos). It is this explicit articulation that helps netizens appreciate the place more. Additionally, in terms of shooting perspective, a combination of aerial shots and close-ups is employed. In this video, close-up shots of lotus flowers allow viewers to better appreciate the beauty of the scene.

Compared with official videos of natural scenery and cityscapes, influencer videos without streamers have a

more personal style and emotional color. These videos often use aerial wide-angle shots, showcasing the creator's professional filming skills. The emotional tone is conveyed in two main ways: First, based on the characteristics of the city's landscape, different styles of pure instrumental music are used, such as rhythm-heavy tracks or calming melodies. For example, in the video of Guangzhou Railway Station During the Pandemic, shot by “@ 隆 . 视觉” (@Long.Visual) using aerial footage, the soothing and quiet “平安中国” (Safe China) song is played, creating a harmonious and peaceful atmosphere that expresses the understated, pragmatic nature of Guangdong people, highlighting their responsibility in easing the national burden during the pandemic. Second, videos are often narrated with radio-style voiceovers. In terms of multimodal discourse analysis, this falls under implicit articulation. This method is more relatable to the public and real life, making it easier to evoke emotional resonance. For instance, in the second most-liked video from “@Long.Visual”, a car drives on a winding modern overpass while a radio-style broadcast of Hong Kong singer Eason Chan's “Ten Years” plays in the background, showcasing the city's prosperity, busyness, and humanistic care.

Streamers in the official institutional videos are mainly professional TV hosts, influential figures from the sports or arts sectors, or local tourism bureau heads. In recent years, there has been an innovation in using celebrities to promote Lingnan culture. Although these celebrities do not appear directly in the videos, they are integrated throughout the video in the form of dynamic images, functioning as virtual hosts. For example, in the “湛江文旅” (Zhanjiang Culture and Tourism) video account, the video titled “跟着全妹一起看看咱的大美湛江” (Let's Explore the Beautiful Zhanjiang with Quan Mei) garnered 40,000 likes. Olympic diving champion Quan Hongchan does not appear in the video through live recording but is featured as a dynamic image of her dancing, seamlessly blending into the beautiful scenery of Zhanjiang. It appears as if she is personally guiding the audience through the city, with a song she once performed at a gala event playing throughout the video to enhance the communication effect.

Official videos with streamers and influencer videos with streamers employ distinct multimodal strategies in promoting Lingnan's natural scenery and cityscape. Official videos are structured and formal, with streamers serving as guided hosts following a pre-planned itinerary that highlights government-endorsed landmarks and cultural heritage sites. Their linguistic mode features scripted commentary emphasizing history and conservation, while visual elements include cinematic drone shots, panoramic views, and symmetrical framing to present a polished, authoritative portrayal of Lingnan. The aural mode reinforces professionalism, using soft instrumental music, voiceovers, and minimal ambient noise, ensuring an educational and promotional experience aligned with institutional branding.

In contrast, influencer videos with streamers are spontaneous, audience-driven, and highly interactive. Streamers frequently engage with viewers in real-time, responding to comments, altering their itinerary based on suggestions, and incorporating humor and Cantonese slang for relatability. Their visual mode relies on handheld, first-person perspectives, rapid cuts, and immersive close-ups, making the audience feel part of the experience. The aural mode integrates natural city sounds, trending music, and expressive vocal reactions, enhancing authenticity and emotional connection. While institutional streamers prioritize credibility and structured storytelling, influencer streamers create a dynamic, participatory experience that fosters deeper engagement.

4.2. Contrastive analysis of videos of historical stories of Lingnan culture

Interestingly, official institutions rarely publish videos solely about historical stories of Lingnan culture. Some historical stories are integrated into videos introducing Lingnan folklore. In the official Douyin account of the Guangdong Provincial Department of Culture and Tourism “@ 广东文旅” (@Guangdong Culture and Tourism), there are fewer videos of historical stories of Lingnan culture that have received more than 10,000 likes.

However, some Internet influencers have made significant contributions to promoting the historical stories of Lingnan culture in two ways. The first approach involves storytelling from a third-party perspective, where the streamer does not appear on camera. This method employs rhetorical questions or narrative twists to engage viewers. In terms of multimodal fusion, these videos often incorporate real historical footage, scenes from historical dramas, images from history books, and pictures of modern society. They are typically narrated with a professional broadcasting tone to enhance credibility. For example, in the video by “@广东印象” (@Guangdong Impression) introducing the “岭南秘史迁海令” (Lingnan Secret History: The Maritime Ban), the opening line states, “People generally perceive Guangdong as a place far from war and conflict. Is that really the case?” This video first presents common knowledge before subverting expectations through a rhetorical question. A small-scale corpus analysis reveals that such videos frequently use the modal particle “吗” (ma) and the keyword “历史” (history). The particle “吗” (ma) serves both as a question and a rhetorical device, with its core function being to provoke viewers’ thoughts.

The second approach features streamers narrating Lingnan historical stories in real-time, making the storytelling more engaging and relatable than the off-screen narration method. Some streamers use authentic Cantonese to recount historical events, fostering a stronger sense of cultural identity. Similar to the first approach, they employ questioning and expectation-subversion techniques to encourage viewer reflection. These videos contain explicit expressions that clearly convey the streamer’s attitude. In terms of multimodal fusion, they begin and end with real-life locations where historical events occurred, interwoven with historical footage and archival materials, creating an immersive time-travel-like experience. For example, in the video “永远怀念‘平民市长’黎子流” (Forever Remembering the “People’s Mayor” Lai Ziliu) posted by “@广东李会长” (@Guangdong Li Huizhang), the streamer appears in a formal suit and tie, first quoting one of Mayor Lai’s famous sayings to establish a connection with the audience. The video then incorporates archival footage of Mayor Li in meetings, transporting viewers back in time to experience the real impact of his governance. When discussing issues such as Guangzhou’s past traffic congestion and power shortages, the video includes grainy footage of crowded streets and vehicles, enhancing authenticity and immersion. In contrast, when introducing the development of Zhujiang New Town, it features crisp aerial shots of skyscrapers and a thriving metropolis, visually reinforcing the wisdom of the mayor’s decisions at the time.

4.3. Contrastive analysis of videos of cuisine, folklore, and spring festival customs

Cuisine, folklore, and spring festival customs are important components of Lingnan culture. Official videos with streamers often invite influential figures from the arts, sports, and business circles, either as hometown image ambassadors or through interviews where they introduce local cuisine and traditional customs. These celebrities can help attract netizens to watch the videos and generate significant publicity. For instance, the video titled “粤剧名家曾小敏登场,邀您来广东过大年,睇大戏” (Cantonese Opera Master Zeng Xiaomin Appears, Invites You to Celebrate the New Year and Watch the Grand Performance) posted by “@Guangdong Culture” received 115,000 likes. The video showcases a recording of Zeng Xiaomin’s performance, focusing on her delicate makeup and twirling dance movements, presenting the charm and elegance of Cantonese opera. An interview with Zeng Xiaomin in her everyday life adds a sense of intimacy.

Influencer videos with streamers generally involve conversations in Cantonese with chefs or folk custom inheritors, where they personally taste and evaluate the food or experience traditional activities. In terms of language, these videos often use explicit evaluative language to directly comment on the color, appearance, and taste of the dishes, as well as describe the grandeur of folk activities and the influencer’s personal experience. In terms of visual elements, food videos often focus on depicting the chef’s actions, such as flipping the wok or stir-frying. Folk customs videos

tend to focus on detailing the richness and beauty of the activities, and sometimes even include animated effects to enhance the liveliness of the video. For example, influencer “李子雄” (Li Zixiong) introduces a traditional farmhouse meal. When he walks into a farmyard with the chef, an animated image of the “海尔兄弟” (Haier Brothers) cartoon is inserted, which helps build a closer relationship between the influencer and the chef, creating a relaxed and harmonious atmosphere throughout the video. In terms of auditory elements, the videos typically feature cheerful and festive background music, while also emphasizing sounds associated with the cooking process, such as the sizzling sound when food is dropped into hot oil. One example is the influencer “顺德老baby” (Shunde Old Baby) with 659,000 followers, who, despite not showing his face, records a series of Lingnan dishes and the chef’s lifestyle. One short video introducing the famous Cantonese dish, “白切鸡” (White-Cut Chicken) in Cantonese received 14,000 likes. The video includes close-up shots of the fresh ingredients and symbolic explanations. The setting is an ordinary residential kitchen, which indicates that the dish is a common meal often made by ordinary families. It also focuses on depicting the chef’s cooking methods, such as sprinkling salt evenly over the chicken. Another highlight of this video is the depiction of texture, such as touching the soft eggs and roasted chicken, which emphasizes the freshness of the ingredients.

Official videos without streamers and influencer videos without streamers adopt distinct multimodal approaches to promoting Lingnan’s cuisine, folklore, and Spring Festival customs. Official videos feature standard Mandarin or Cantonese with scripted narration and subtitles, explaining the cultural origins of dim sum, lion dances, or New Year rituals. The visual mode relies on cinematic shots, slow-motion cooking sequences, and symmetrical festival scenes, creating a refined, documentary-style presentation. Complementing this, the aural mode incorporates traditional Chinese music, deep-voiced narrations, and ambient sounds like temple bells or firecrackers, reinforcing ritualistic authenticity. The spatial mode is structured and balanced, ensuring a clear, formal representation of Lingnan’s traditions.

In contrast, influencer videos without streamers prioritize entertainment, engagement, and sensory appeal, making Lingnan’s customs dynamic and immersive. The linguistic mode often includes short-form text overlays, emojis, and Cantonese slang, fostering a casual, social-media-friendly tone. The visual mode employs fast cuts, extreme close-ups of sizzling dishes, and street-style festival footage, while the aural mode integrates trending background music, ASMR cooking sounds, and vibrant festival noise, enhancing emotional connection. The spatial mode is spontaneous and immersive, using POV shots, dynamic angles, and rapid montages to make the content feel lively and relatable. While institutional videos preserve cultural depth and authenticity, influencer videos maximize shareability and engagement.

5. Contrastive analysis of the communication effect of short videos

This study collects and analyzes comments under Lingnan cultural promotion videos on self-media platforms. The dataset includes comments from officially released videos with over 10,000 likes and videos posted by self-media influencers with over 100,000 followers that also exceed 10,000 likes. Through an analysis of keywords and high-frequency words, this research compares the comments from official videos without streamers and influencer videos without streamers, as well as comments from official videos with streamers and influencer videos with streamers.

The keyword statistics and comparison of comments under official videos without streamers and influencer videos without streamers reveal significant differences in audience focus and expression. First, comments on official Lingnan cultural tourism short videos without streamers (**Figure 2** and **Figure 3**) show that viewers have a strong

interest in geographical locations, cultural activities, and economic benefits. Keywords such as “珠海” (Zhuhai), “清远” (Qingyuan), “梅州” (Meizhou), “韶关” (Shaoguan) indicate audience interest in specific cities and attractions in Lingnan. Meanwhile, words like “文旅” (cultural tourism), “年例” (annual festival), and “舞狮” (lion dance) highlight the emphasis on Lingnan’s cultural events. Additionally, terms such as “互动” (interaction), “好玩” (fun), and “玩” (play) suggest a strong audience interest in participating in Lingnan cultural experiences, while “income” may reflect concerns about the tourism economy and personal financial gains.

In contrast, comments under influencer videos without streamers (**Figure 4** and **Figure 5**) focus more on traditional culture and lifestyle representation. Keywords such as “妈祖” (Mazu), “信仰” (faith), “汉服” (Hanfu), and “渔民” (fishermen) relate to traditional beliefs and cultural identity, demonstrating that influencer videos place greater emphasis on Lingnan’s cultural heritage. Furthermore, terms like “抖” (Dou) (possibly referring to Douyin, the Chinese version of TikTok) suggest that influencer videos tend to be more entertainment-driven, aiming to capture audience attention through lighthearted content. Keywords such as “胜” (win) may indicate a stronger focus on personal experiences and social interactions, while “水饺” (dumplings) implies a greater emphasis on showcasing daily life and local food culture in Lingnan.

Overall, the comments under official videos without streamers focus more on promoting Lingnan’s tourism and culture, emphasizing geographical locations, cultural events, and economic benefits. In contrast, comments under influencer videos without streamers highlight traditional culture, daily life, and entertainment content, placing greater emphasis on personal experiences and social interactions. This difference likely reflects the distinct strategies and target audiences of official institutions and internet influencers in promoting Lingnan culture—while official videos focus on cultural promotion and the tourism economy, influencer videos prioritize entertainment value and audience engagement.

10417	Keywords +
1	文旅
2	粤
3	珠海
4	清远
5	互动
6	年例
7	梅州
8	韶关
9	惠州
10	啦

Figure 2. Keywords in comments of official videos without streamers

110417	Keywords +
11	好玩
12	玩
13	收益
14	任务
15	湛江
16	别人
17	做
18	听
19	舞狮
20	鸡

Figure 3. Keywords in comments of official videos without streamers

1/990	Keywords -
1	歌队
2	妈祖
3	信仰
4	挤
5	救
6	汉服
7	渔民
8	这才
9	吉里
10	抖

Figure 4. Keywords in comments of influencer videos without streamers

11/990	Keywords -
11	明年
12	俊义
13	公孙
14	卢俊
15	发扬
16	如此
17	水游
18	水饺
19	胜
20	草原

Figure 5. Keywords in comments of influencer videos without streamers

Besides, there are some significant differences in the usage of high-frequency words between the comments under official videos without streamers and influencer videos without streamers. In the comments under official videos, high-frequency words such as “广东” (Guangdong) and “文旅” (cultural tourism) are directly related to the culture and tourism of the Lingnan region, indicating a higher focus on regional culture and tourism (**Figure 6**). Besides, the high-frequency words in the comments under official videos are more focused on expressing general opinions and feelings about Lingnan culture and tourism, with a more generic vocabulary. In the comments on influencer videos without streamers, more specific cultural elements like “潮汕” (Chaoshan), “歌舞” (song and dance), and “英歌” (Yingge) appear, reflecting that influencer videos focus more on showcasing the unique cultural features and activities of the Lingnan region (**Figure 7**). Additionally, besides common words and pronouns, influencer video comments include some vocabulary related to cultural activities, suggesting that the audience may be more interested in the cultural events and forms of expression in the Lingnan region. This difference may reflect the varying strategies and target audiences of official channels and influencers. Official channels may focus more on promoting the cultural and tourism resources of the Lingnan region, while influencers may prioritize highlighting the cultural features and activities to attract the interest and participation of their viewers.

▼ Corpus	Corpus 1	▼ Frequency	▼ Dispersion	▼ Type
Type	▼ Frequency: 01 - Freq	Dispersion: 01_CV		
的	577.000000	0.000000		
我	329.000000	0.000000		
是	263.000000	0.000000		
广东	205.000000	0.000000		
去	149.000000	0.000000		
文旅	143.000000	0.000000		
你	134.000000	0.000000		
有	131.000000	0.000000		
都	122.000000	0.000000		
在	113.000000	0.000000		
就	113.000000	0.000000		
来	94.000000	0.000000		
人	85.000000	0.000000		
不	79.000000	0.000000		
也	77.000000	0.000000		
好	76.000000	0.000000		
还	71.000000	0.000000		
我们	67.000000	0.000000		
啊	62.000000	0.000000		
想	61.000000	0.000000		

Figure 6. High-frequency words in comments of official videos without streamers

▼ Corpus	Corpus 2	▼ Frequency	▼ Dispersion	▼ Type
Type	▼ Frequency: 01 - Freq	Dispersion: 01_CV		
的	120.000000	0.000000		
是	68.000000	0.000000		
潮汕	54.000000	0.000000		
我	52.000000	0.000000		
有	30.000000	0.000000		
在	30.000000	0.000000		
就	29.000000	0.000000		
去	26.000000	0.000000		
歌舞	21.000000	0.000000		
下	21.000000	0.000000		
文化	20.000000	0.000000		
这个	19.000000	0.000000		
英	19.000000	0.000000		
想	18.000000	0.000000		
英歌	18.000000	0.000000		
还	18.000000	0.000000		
广东	17.000000	0.000000		
都	16.000000	0.000000		
我们	16.000000	0.000000		
这	16.000000	0.000000		

Figure 7. High-frequency words in comments of influencer videos without streamers

Keywords in the comments under official Lingnan cultural and tourism short videos with streamers and influencer videos with streamers also show distinct differences in audience focus and engagement. Keywords in the comments on official videos, such as “互动” (interaction), “收益” (revenue), “任务” (tasks), “加油” (keep going), “惠州” (Huizhou), and “提高” (improvement) suggest that viewers are interested in participating in interactive discussions, paying attention to economic benefits, and engaging with specific cities in the Lingnan region (**Figure 8** and **Figure 9**). These keywords also indicate that official videos may place greater emphasis on promoting the value

of culture and tourism, as well as encouraging audience participation and support. In contrast, the keywords in the comments on influencer videos, such as “岭南文化” (Lingnan culture), “谢谢” (thank you), “状元” (Zhuangyuan), “舒服” (comfortable), “清晖” (Qinghui) reflect viewers’ interest in Lingnan culture, their engagement with the influencer or individuals featured in the videos, and their preference for themes related to daily life and a comfortable environment (**Figure 10** and **Figure 11**). These keywords suggest that influencer videos focus more on showcasing personal charm and distinctive cultural features, making them more appealing to audiences.

The high-frequency keywords in the comments on official videos with streamers are primarily centered around cultural and tourism promotion, while the keywords in influencer videos with streamers’ comments emphasize personal charisma and cultural uniqueness to attract audience interest and participation. This difference may reflect the varying strategies and target audiences of official channels and influencers in promoting Lingnan culture. Official channels likely prioritize the promotion of cultural and tourism resources, whereas influencers may focus more on leveraging personal charm and cultural distinctiveness to engage audiences, thereby increasing their visibility and interaction on social media.

1/1503	Keywords +
1	互动
2	收益
3	任务
4	文旅
5	加油
6	惠州
7	提高
8	评论
9	毛毛雨
10	字数

Figure 8. Keywords in comments of official videos with streamers

11/1503	Keywords +
11	过关
12	别人
13	刷
14	全民
15	轻
16	还是
17	要够
18	重点
19	#
20	回复

Figure 9. Keywords in comments of official videos with streamers

1/1324	Keywords -
1	九月
2	顺德
3	祖庙
4	+
5	较
6	只是
7	晖园
8	清晖
9	舒服
10	👍

Figure 10. Keywords in comments of influencer videos with streamers

11/1324	Keywords -
11	kpi
12	七哥
13	北方
14	小黑
15	岭南文化
16	李子
17	状元
18	查
19	谢谢
20	顿

Figure 11. Keywords in comments of influencer videos with streamers

After analyzing the high-frequency keywords in the comments under official Lingnan cultural and tourism short videos with streamers and influencer Lingnan cultural short videos with streamers, the study found clear differences in the viewers’ focal points and modes of expression. In the comments on official videos, the high-frequency keywords (**Figure 12**) reflect that viewers tend to express personal emotions and abilities, discuss possibilities, and

engage in social interactions, while also showing a focus on specific cultural elements of the Lingnan region and placing importance on both the quantity and quality of the content. In contrast, the high-frequency keywords in the comments on influencer videos (**Figure 13**), which are more aligned with everyday conversational vocabulary, suggest that the viewers' comments focus more on casual communication and affirmation. These comments show a specific interest in the culture of the Lingnan region, potentially reflecting an interest in festivals, food culture, as well as the use of certain vocabulary to express the intensity or degree of emotions. This may suggest that influencer videos are more focused on showcasing daily life and promoting relaxed social interaction to engage a wider audience.

▼ Corpus	Corpus 1	▼ Frequency	▼ Dispersion	▼ Type
Type	▼ Frequency: 01-Freq	Dispersion: 01_CV		
真的	25.000000	0.000000		
来	25.000000	0.000000		
才能	25.000000	0.000000		
不	24.000000	0.000000		
大家	23.000000	0.000000		
就	23.000000	0.000000		
怎么	22.000000	0.000000		
评论	21.000000	0.000000		
毛毛雨	20.000000	0.000000		
好	20.000000	0.000000		
这	20.000000	0.000000		
吧	19.000000	0.000000		
字数	19.000000	0.000000		
看	19.000000	0.000000		
确实	19.000000	0.000000		
嘿	19.000000	0.000000		
下	19.000000	0.000000		
知道	18.000000	0.000000		
我们	18.000000	0.000000		
别人	16.000000	0.000000		

Figure 12. High-frequency words in comments of official videos with streamers

▼ Corpus	Corpus 2	▼ Frequency	▼ Dispersion	▼ Type
Type	▼ Frequency: 01-Freq	Dispersion: 01_CV		
的	169.000000	0.000000		
是	87.000000	0.000000		
我	82.000000	0.000000		
你	42.000000	0.000000		
有	39.000000	0.000000		
就	32.000000	0.000000		
人	29.000000	0.000000		
好	27.000000	0.000000		
都	26.000000	0.000000		
去	26.000000	0.000000		
也	23.000000	0.000000		
真的	22.000000	0.000000		
广东	22.000000	0.000000		
很	22.000000	0.000000		
吃	21.000000	0.000000		
个	20.000000	0.000000		
在	20.000000	0.000000		
九月	19.000000	0.000000		
广州	19.000000	0.000000		
来	17.000000	0.000000		

Figure 13. High-frequency words in comments of influencer videos with streamers

6. Discussion and conclusion

Influencers have distinct advantages over official institutions in promoting Lingnan culture. Their ability to engage directly with a broad, diverse audience, particularly younger generations, allows them to present Lingnan culture authentically through dynamic and personal content. Unlike official institutions, which may struggle with bureaucratic limitations and less personal communication, internet celebrities build trust and foster engagement by presenting cultural elements in real-time via livestreams ^[13]. They also expand the reach of Lingnan culture globally, breaking geographic barriers and promoting cross-cultural exchange ^[16]. Additionally, influencers' innovation in content creation, such as immersive travel experiences and cultural showcases, resonates more effectively than traditional institutional promotions, particularly in the context of digital entertainment. This grassroots approach not only attracts attention but also drives cultural tourism and global recognition of Lingnan heritage.

Compared with self-media influencers, official institutions also have several advantages in promoting Lingnan culture, primarily due to their credibility, resources, and long-term policy capabilities. Agencies benefit from institu-

tional authority, which ensures the authenticity of their cultural narratives. Additionally, governments can implement comprehensive, long-term cultural policies that impact sectors such as education, tourism, and urban planning, fostering sustainable cultural programs. Governments also have the resources to organize large-scale cultural initiatives, such as festivals and urban development projects. Furthermore, governments control the narrative around Lingnan culture, ensuring a cohesive and consistent message that aligns with city and national branding.

Government institutions are adapting to the growing impact of influencers in promoting Lingnan culture by incorporating digital strategies and collaboration. They increasingly use social media to reach broader audiences. To respond to the dynamic and engaging content that influencers produce, many local cultural and tourism bureau directors also participate in promoting Lingnan culture, sparking a nationwide trend of “internet-famous directors”^[8]. Some government agencies have also launched short videos featuring “post-2000s civil servants” to promote local cultural highlights, attracting a large number of netizens. Additionally, institutions are innovating with more interactive and visually appealing content to resonate with younger demographics and align with modern trends^[17]. Collaborative efforts between government institutions and influencers further enhance cultural promotion, blending official narratives with the engaging personal touch of self-media^[18]. This evolution reflects a shift from traditional cultural promotion to a hybrid model leveraging both institutional authority and the relatability of influencers. In conclusion, while influencers are effective in reaching targeted groups, government agencies’ credibility, resources, and strategic vision make them more effective at shaping a lasting, broad cultural image of Lingnan culture.

This research can be used to guide the government and other official institutions to adjust their discourse system and modal expression, to publicize Lingnan culture in a way that is more interactive, close to the people, and in line with the characteristics of the self-media platform, build a humanistic bay image and create a good atmosphere of public opinion.

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Curriculum Analysis and Instructional Strategies for the Fundamentals of Astronomy in Chinese Senior High School Geography

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Abstract: The Fundamentals of Astronomy module in high school Geography Elective 1 is closely linked to Compulsory 1: Fundamentals of Earth Science and Selective Compulsory 1: Fundamentals of Physical Geography. It covers three fundamental levels—the Earth-Moon system, the Solar System, and the Galaxy-Universe—with a focus on astronomical observation methods and conceptual understanding. This paper analyzes the module’s structure, its interdisciplinary connections, and its role in fostering scientific literacy. The cosmology conveyed in this module consists of three key aspects: the scientific foundation of cosmology, the spatiotemporal perspective, and the harmony between humanity and nature. The paper further emphasizes three educational objectives: guiding students to respect nature and others, rejecting superstition in favor of scientific reasoning, and developing a reflective and positive outlook on life. By integrating astronomical concepts into geography education, the module enhances students’ comprehension of cosmic phenomena while promoting critical thinking and broader scientific awareness.

Keywords: High school geography; Elective 1; Fundamentals of astronomy; Curriculum standards; Curriculum analysis; Teaching strategy

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1. Introduction

The Geography Curriculum Standards for Ordinary High Schools (2017 Edition, revised in 2020) specify that Elective Module 1, Fundamentals of Astronomy, comprises four key thematic areas: celestial observation, the Earth-Moon system and the solar system, the Sun and stellar phenomena, and the Milky Way and the broader universe. Given the vast scope of astronomical science, it is neither practical nor necessary for secondary school geography instruction to comprehensively address every aspect of the discipline. Moreover, the primary objective of the module is not to train

students as professional astronomers but to develop a foundational understanding of astronomical concepts. Consequently, a precise interpretation of the curriculum requirements for Fundamentals of Astronomy is essential in translating core subject competencies and curriculum standards into effective classroom instruction.

2. Core elements of the fundamentals of the astronomy curriculum

The curriculum standards for Elective Module 1 outline ten content standards, categorized based on fundamental conceptual levels, core subject matter, essential competencies, and foundational methodologies (**Table 1**). This classification enables a structured analysis of the core components within the Fundamentals of Astronomy module.

Table 1. Core components of the Fundamentals of Astronomy curriculum

Conceptual Scale	Core Content (Action Verbs in Bold)	Cognitive Level	Instructional Approach
Earth-Moon System	Utilize charts, software, and data to describe the composition and motion characteristics of the Earth-Moon system.	J	Familiarize with modern astronomical instruments (L)
	Observe and describe lunar phases, eclipses, solar eclipses, and tidal phenomena, explaining their causes using diagrams and data.	J	
Solar System	Summarize the discovery and formation of the solar system.	J	
	Use solar system models and data to illustrate its structure and planetary characteristics.	J	
	Map the solar atmosphere's structure and analyze solar activity and its effects on Earth.	C J	
Galaxy	Describe the general properties of stars and explain stellar evolution using diagrams and data.	J	
	Identify major constellations using star maps and the celestial sphere, recognizing the seasonal star patterns and their geographic significance.	L	
	Observe and illustrate the Milky Way's structure and analyze its formation using diagrams and observational data.	J	
Universe	Explain the key principles of the Big Bang theory and describe the fundamental components of the universe.	J	

Note: L = Basic comprehension level, J = Conceptual understanding level, C = Independent application level

2.1. Integration with earth science and physical geography

The curriculum standards for Compulsory Module 1 require students to “utilize data to describe the cosmic environment of Earth and explain the influence of the Sun on Earth.” In contrast, Elective Module 1 builds upon this foundation by expecting students to “illustrate the layered structure of the solar atmosphere and analyze solar activities and their impacts on Earth.” Both modules emphasize the Sun’s influence on Earth, demonstrating a structured, spiral progression in curriculum design.

Similarly, Selective Compulsory Module 1 focuses on “explaining the geographic significance of Earth’s motion through case studies,” while Elective Module 1 extends this understanding by requiring students to “summarize the composition and kinematic characteristics of the Earth-Moon system using charts, software, and other tools,” and to “observe, describe, and interpret phenomena such as lunar phases, eclipses, and tides using graphical data” (**Table 1**).

These curriculum requirements underscore the strong interdisciplinary connections between Elective Module 1 (Fundamentals of Astronomy), Compulsory Module 1 (Fundamentals of Earth Science), and Selective Compulsory Module 1 (Fundamentals of Physical Geography). Within this framework, the elective module serves as an advanced extension of foundational knowledge, reinforcing key concepts across these disciplines.

2.2. Three fundamental hierarchies: Earth-moon system, solar system, and galaxy-universe

Astronomy, as a scientific discipline, explores celestial objects and the broader universe, which can be systematically organized into three hierarchical scales: planetary, stellar, and galactic ^[1]. To ensure pedagogical coherence, the curriculum structures its content into three primary levels:

Earth-moon system: Covers lunar phenomena, tidal mechanisms, and orbital dynamics.

Solar system: Examines the Sun's structure, planetary motion, and interplanetary interactions.

Galaxy and universe: Focuses on stellar evolution, galactic structures, and cosmological principles.

Although the Fundamentals of Astronomy module presents a concise selection of topics, its scope aligns with key domains in contemporary astronomical research. Upon completing the module, students are expected to develop a comprehensive cognitive framework for understanding astronomy, acquiring fundamental knowledge and conceptual mastery across these hierarchical levels (**Table 1**).

2.3. Understanding as the primary learning objective

The geography curriculum distinguishes between result-oriented objectives—focused on knowledge and skill acquisition—and experiential objectives, which emphasize attitudes and values. These distinctions are reflected in the behavioral verbs used within the curriculum standards ^[2]. Analyzing the Fundamentals of Astronomy module reveals the following patterns:

Result-oriented knowledge objectives constitute the majority, with an emphasis on conceptual understanding, as indicated by verbs such as “explain” and “analyze” (denoted as J in **Table 1**).

Basic comprehension (L) and independent skill application (C) are each represented by a single content standard.

Experiential objectives, such as “appreciate” and “reflect,” receive minimal emphasis, indicating a pedagogical focus on cognitive mastery rather than affective engagement.

This structure underscores the curriculum's prioritization of systematic knowledge acquisition, aligning with astronomy's inherently analytical nature.

2.4. Emphasis on fundamental astronomical observation methods

Observation is the cornerstone of astronomical research, with modern methodologies relying on optical, radio, and space-based technologies. The Fundamentals of Astronomy module integrates these observational methods through:

Content Standard 2, which requires students to “understand modern astronomical instruments.”

Methodological Integration, which emphasizes the use of star charts, simulation software, and data visualization tools across multiple standards (e.g., analyzing eclipses and modeling celestial motion).

Despite the absence of newly developed textbooks aligned with the revised 2020 curriculum, the unique demands of astronomy instruction—particularly its reliance on indirect observation and technological mediation—

will inevitably shape future educational resources. Effectively conveying astronomical methodologies and research practices is essential for translating curriculum objectives into tangible student competencies, reinforcing geographic inquiry skills, and fostering scientific literacy.

3. The concept of cosmic worldview in fundamentals of astronomy

The Fundamentals of Astronomy module seeks to cultivate a scientifically grounded cosmic worldview among students. Xiao Naiyuan and Xuan Huan can categorized ancient Chinese cosmological thought into four dimensions: the origin of the universe, the structure of heaven and Earth, theories of terrestrial motion, and the cyclical processes of cosmic destruction and regeneration ^[3]. While interpretations of the cosmic worldview vary across historical and cultural contexts, this study synthesizes perspectives from historical scholarship, geographic disciplinary principles, and pedagogical frameworks to define the cosmic worldview through three key dimensions.

3.1. The evolution of the cosmic worldview in fundamentals of astronomy

Ancient Chinese cosmology, deeply rooted in celestial observations and intuitive reasoning, proposed the “Heaven-Round-Earth-Square” model (Tianyuan Difang), depicting the heavens as a domed canopy and the Earth as a flat chessboard. Over time, this conceptualization evolved into more sophisticated frameworks, including the Huntian theory, which described a celestial sphere, and the Xuanye theory, which introduced the concept of an infinite and empty cosmos ^[4].

In contrast, Western cosmological traditions initially centered around geocentrism, formulated by Aristotle and later refined by Ptolemy, positioned Earth at the center of the universe. The transition to heliocentrism, initiated by Copernicus and further advanced by Bruno’s hypothesis of an infinite universe and Galileo’s telescopic observations, marked a fundamental shift in humanity’s understanding of celestial mechanics. However, both geocentric and heliocentric models were products of their time, shaped by the prevailing knowledge and technological limitations, while the continuous pursuit of understanding cosmic motion and evolution remained a central theme in cosmology.

Modern advancements in mathematics, physics, telescope technology, and space exploration have further refined humanity’s comprehension of the universe, reinforcing a materially deterministic perspective. As Kant famously asserted, “Give me matter, and I will construct a universe”, highlighting the fundamental role of material interactions in cosmic origins ^[5]. Although early cosmological models—such as the flat-earth theory—are now scientifically obsolete, they represent critical milestones in the epistemological evolution of human understanding.

While contemporary students readily accept the Earth’s sphericity and orbital motion, many remain unaware of the intellectual struggles and historical transitions that led to these established scientific truths. Therefore, geography education should contextualize the evolving human perceptions of cosmic structure, motion, and origins. By integrating this intellectual heritage into the curriculum, students can develop a broader scientific perspective, enhance their understanding of astronomical concepts, and construct a historically grounded cosmic worldview.

3.2. The spatiotemporal worldview: “Space encompasses all directions, time spans past and future”

The etymological roots of the term cosmos (Yuzhou) reflect its dual nature, where Yu signifies spatial extension in all directions, while Zhou denotes the continuity of time from past to future. From the perspective of relativistic physics, the cosmic worldview can be understood through the interplay of matter and spacetime, with Newtonian and Einsteinian paradigms holding significant historical and scientific importance.

The Newtonian framework, which aligns with everyday human experience, postulates absolute time (uniform, unidirectional) and absolute space (flat, infinite, and independent). However, Olbers' paradox—which challenges the expectation of a uniformly bright night sky under Newtonian cosmology—exposed limitations in this model. Kant and other scholars later critiqued these inconsistencies, laying the foundation for a new understanding of spacetime. This ultimately led to Einstein's theories of special and general relativity, which demonstrated that space and time are interwoven and influenced by motion and gravity.

One key implication of Einsteinian relativity is the concept of curved spacetime, modeled mathematically through Riemannian geometry. In this framework, the angles of a triangle do not necessarily sum to 180° , and the shortest path between two points is not a straight line but a geodesic (e.g., the great-circle routes used in aviation and maritime navigation).

Modern relativistic spacetime concepts provide deeper insight into astronomical phenomena and have direct applications in geography education:

Seasonal Constellations: The visibility of constellations varies across latitudes and seasons due to Earth's axial tilt and orbital motion. This aligns with the curriculum's requirement for students to "identify major constellations in seasonal night skies."

Diurnal and Annual Cycles: The occurrence of time zones, the alternation of day and night, and great-circle navigation reflect fundamental principles of spacetime and geographic positioning.

By integrating these spatiotemporal concepts into geography instruction, students develop a more holistic understanding of natural patterns, bridging abstract scientific theory with empirical observation and real-world applications.

3.3. Emphasizing the harmony between humanity and the natural world

The cosmological worldview underscores the intrinsic harmony between humanity and the natural environment, rooted in the principle of the unity of heaven and man (Tian Ren He Yi). This concept, central to traditional Chinese philosophy, reflects a longstanding cultural emphasis on humanity's interconnectedness with the cosmos, integrating astronomical understanding with human existence ^[6].

Some scientists caution against transmitting signals into deep space without a thorough understanding of extra-terrestrial civilizations, warning that premature contact with unknown species could pose significant risks. From the perspective of the unity of heaven and man, humanity must carefully navigate its relationship with both the universe (here referring to "heaven") and the natural environment (here referring to "earth"). Striving for harmony between these realms is essential in ensuring responsible engagement with both space exploration and environmental stewardship.

The ancient principle of cosmic harmony is reflected not only in philosophical traditions but also in historical architecture and daily life. Examples include:

The Forbidden City (China): Designed in alignment with celestial movements.

The Pyramids of Egypt: Constructed based on precise astronomical orientation.

Machu Picchu (Peru): Strategically positioned according to celestial events.

These structures illustrate how early civilizations integrated astronomical knowledge into practical applications, demonstrating a profound awareness of celestial influences.

Under the modern interpretation of cosmic unity, humanity must also recognize its role within a global and cosmic community. Humans are not only an intelligent species on Earth but also part of a broader cosmic existence. The

astronomer Carl Sagan asserted, “The future fate of humankind depends on how well we understand the universe”^[7]. As humanity progresses in space exploration, fostering a sense of shared destiny and global cooperation becomes increasingly vital.

Advancing human understanding of the universe requires a multidimensional approach, respecting natural laws while promoting collaboration. By reinforcing the principles of cosmic responsibility and scientific curiosity, education in astronomy enables students to develop a holistic perspective that bridges science, philosophy, and ethical considerations.

4. Integrating geography core literacy through fundamentals of astronomy

The principle of the unity of nature and humanity aligns with the concept of harmony between humans and the Earth in geography. This relationship can be examined through the four core competencies of geography: human-Earth coordination, comprehensive thinking, regional cognition, and geographical practice.

The concepts of spatial-temporal perception and comprehensive thinking in astronomy correspond directly to geographical reasoning. Similarly, the cosmic spatial perspective forms a crucial component of regional geographical cognition, while various astronomical observation methods play an integral role in geographical practice. Given these connections, basic astronomy serves as an effective framework for fostering core geographic literacy, integrating spatial awareness, scientific inquiry, and environmental understanding into geography education.

4.1. Cultivating reverence for nature and compassion for others

A foundational understanding of astronomy should instill in students a sense of reverence for the universe and the Earth, fostering both intellectual curiosity and ethical awareness. By integrating astronomy with humanistic perspectives, students can develop a scientific worldview that encourages rational thinking and critical inquiry.

Observing the vastness of the cosmos allows individuals to comprehend their place within nature, promoting intellectual humility and expanding their perception beyond their immediate surroundings. Recognizing that humanity represents only a small fragment of the universe underscores both the ephemeral nature of human life and the importance of broader existential reflection. In the context of modern education—where core literacy serves as the guiding principle—astronomy education should extend beyond factual knowledge, fostering emotional engagement, ethical considerations, and a deep appreciation for the interconnectedness of life.

4.2. Encouraging scientific inquiry and rejecting superstition

A solid foundation in astronomy plays a crucial role in dispelling superstition, challenging dogma, and fostering scientific literacy. Throughout history, astronomy has been closely linked to science, politics, religion, and culture. Concepts such as “celestial phenomena,” “Son of Heaven,” “will of heaven,” and “heavenly power” were deeply embedded in ancient Chinese governance, where astronomical observation often aligned with political authority.

During the Renaissance, astronomy became central to the intellectual struggle between science and religious orthodoxy. The revolutionary ideas of Copernicus, Bruno, and Galileo directly challenged long-standing beliefs, leading to persecution and conflict as their discoveries undermined existing theological and political structures. Understanding this historical context enables students to appreciate the transformative power of scientific inquiry, reinforcing the value of empirical evidence, logical reasoning, and intellectual independence in advancing human knowledge.

4.3. Fostering a positive outlook on life

The study of astronomy is closely tied to personal reflection and emotional development. Wen Jiabao once stated that “a nation that has individuals who look up at the stars has hope.” His words express a deep admiration for the universe and highlight how cosmic exploration fosters inspiration, curiosity, and a profound sense of wonder.

In Looking Up at the Stars, he reflects:

“I look up at the sky—it is so vast and deep.”

“I look up at the sky—it is so solemn and sacred.”

“The awe of justice fills me with love and reverence.”^[9].

These reflections illustrate the transformative potential of astronomy education in shaping students’ perspectives on life. By incorporating astronomical exploration into geography education, students can be encouraged to develop a hopeful and inquisitive mindset, cultivating a lifestyle that embraces intellectual curiosity, scientific discovery, and a sense of connection to the cosmos.

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The Real Dilemmas and Breakthrough Paths of Technology Transfer in Higher Vocational Colleges

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Abstract: Scientific and technological innovation and achievement transformation have become the key elements to enhance national comprehensive strength. This paper focuses on the characteristics, realistic dilemmas, and breakthrough paths of Chinese higher vocational colleges in the process of transformation of scientific and technological achievements. It is found that higher vocational colleges have the characteristics of regional economic development, focusing on applied technology, diversified scientific research teams, and rapid development of scientific research forces. However, in terms of the transformation of scientific and technological achievements, there are still problems such as insufficient transformation strength, poor compatibility between achievements and market demand, insufficient financial support, and poor transformation channels. To solve these problems, this paper proposes strategies such as increasing scientific research investment, deepening school-enterprise collaboration, broadening fundraising channels, and strengthening the construction of professional institutions, to improve the transformation ability of scientific and technological achievements in higher vocational colleges and better serve the national and regional economic development.

Keywords: Higher vocational colleges; Transformation of scientific and technological achievements; School-enterprise cooperation; Promotion strategy

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1. Introduction

In today's international competition, scientific and technological innovation capability has become an important index to measure a country's core competitiveness. China is vigorously promoting the strategy of innovation-driven development. The effective transformation of scientific and technological achievements is a necessary link to ensure the implementation of scientific and technological innovation and promote economic development^[1]. From the perspective of the development trajectory of the world's leading economies, universities are not only pioneers of technological innovation and important bases for personnel training but also important promoters of transforming scientific and

technological achievements into productive forces. At present, some developed countries have established a mature and efficient system for the transformation of scientific and technological achievements in universities through various means such as legislative guarantees and the construction of intermediary institutions. However, the transformation system of scientific and technological achievements in Chinese universities is still in the stage of development, with a limited number of full-time transformation institutions and different levels, and the overall transformation efficiency needs to be improved ^[2]. Therefore, it is urgent to strengthen the transformation ability of scientific and technological achievements in Chinese universities.

Higher vocational education is an important part of China's higher education, which is of great significance for supporting the national strategy, integrating into local development, and promoting industrial upgrading. Higher vocational colleges have the characteristics of being regional, applied, and serving small, medium, and micro enterprises, thus forming the advantages of applied research and technology transformation ^[2]. However, in reality, the contribution of most higher vocational colleges in promoting the transformation of scientific and technological achievements into productive forces is still insufficient, and the expected goal of serving enterprises and regional industrial transformation and upgrading has not been reached. Based on this background, on the basis of combing the characteristics of scientific research in higher vocational colleges, this study analyzed the challenges existing in the transformation of scientific and technological achievements and proposed corresponding breakthrough paths, to improve the energy efficiency of the transformation of scientific and technological achievements in higher vocational colleges and make better contributions to national and regional development ^[3].

2. Characteristics of scientific research work in higher vocational colleges

2.1. Close to the local industry

The core mission of higher vocational colleges is to serve the regional economy, especially the small, medium, and micro enterprises in the region. Their scientific research work closely focuses on the technical needs of the local leading and characteristic industries and focuses on solving the practical problems of industrial upgrading and enterprise production. Through close cooperation with enterprises, such as jointly researching and developing new products and optimizing production processes, they provide technical support for enterprises and promote local economic development ^[4].

2.2. Focus on application technology

Different from undergraduate colleges, which focus on basic theoretical research, vocational colleges focus on the research and development of applied technology. Oriented by solving practical production problems, scientific research results pay more attention to practicability and economic benefits. Such as research and development of new equipment and new technology, can be directly applied to enterprise production and quickly transformed into productive forces ^[5]. These results come in various forms, covering patents, technical reports, etc., which can quickly meet the needs of enterprises for new technologies, shorten the technology update cycle, and enhance the competitiveness of enterprises.

2.3. Diversified scientific research team

Most teachers in higher vocational colleges are "double-qualified" teachers, who have both solid theoretical knowledge and rich practical experience ^[5]. They are good at guiding students to participate in practical links such as internships, practical training, or innovation and entrepreneurship competitions. Through these practical activities, students

can apply the professional knowledge they have learned to solve practical problems, to improve their practical and innovative ability. In addition, higher vocational colleges cooperate closely with enterprises, often inviting the technical backbone of enterprises to participate in the school's scientific research projects, and the two sides jointly carry out technology research and development and product innovation work, which not only promotes the transformation and industrialization of scientific research results but also forms a complementary scientific research cooperation mode.

2.4. The scientific research strength is developing rapidly, but there is still room for improvement

Compared with the research-oriented undergraduate colleges, the scientific research strength of vocational colleges is relatively weak, but in recent years, the development momentum has been strong, which is reflected in the improvement of the introduction of teachers' qualifications, the addition of full-time researchers and the formation of scientific research teams, the increase in the number of scientific research results, and the increasingly rich innovation content. Overall, however, there is still much room for improvement in terms of scientific research quality, academic influence, and internationalization level ^[6].

3. There are challenges in the transformation of scientific and technological achievements in higher vocational colleges

In the whole process of the transformation of scientific and technological achievements, the output of scientific and technological achievements is the foundation, the evaluation and screening of achievements is the basis, the implementation and promotion of transformation is the key, and industrialization and marketization are the goals ^[7]. The object of transformation of scientific and technological achievements is the scientific and technological achievements themselves, covering new technologies, new processes, new materials, and so on. Participants include exporters of scientific and technological achievements, such as research institutes and schools; Importers, such as enterprises; And service providers that help transform scientific and technological achievements, such as governments, financial institutions, and third-party service organizations. Combined with the process and main body of the transformation of scientific and technological achievements, the current transformation of scientific and technological achievements in higher vocational colleges is faced with the following problems.

3.1. The transformation of scientific and technological achievements is not good

Higher vocational colleges have a short history of running schools, and their overall development started late. They mainly focus on professional construction and personnel training, and their scientific and technological research and development are relatively weak. The specific performance is as follows: First, higher vocational colleges mainly focus on teaching, less investment in scientific research, relatively high teachers, heavy teaching tasks, teachers do not have enough time and energy to invest in science and technology research and development. Second, the teachers' scientific research mentality is more conservative, satisfied with the declaration of topics, published papers, and patent applications, there is a psychological fear of scientific and technological achievements transformation. Third, higher vocational colleges lack leading scientific research talents and high-level scientific research platforms, and it is difficult to form tight research and development teams, resulting in the scarcity of high-level achievements and insufficient reserves of transformable scientific and technological achievements ^[9]. Therefore, the lack of overall technology research and development ability has become a major shortcoming limiting the scientific and technological

service ability of higher vocational colleges.

3.2. The scientific and technological achievements do not fit the market demand well

On the one hand, as a supplier of scientific and technological achievements, vocational colleges lack a direct incentive mechanism for in-depth docking with enterprises, which will lead to the lack of market orientation in technology research and development, and most of the achievements stay in the laboratory stage, with low compatibility with the needs of enterprises. At the same time, the number of pilot platforms in China is small, and it is difficult for enterprises to undertake the achievements of colleges and universities. On the other hand, as the demand side of scientific and technological achievements, enterprises are often more willing to cooperate with undergraduate institutions with strong scientific research strength when they need the support of scientific and technological achievements. At present, the school-enterprise cooperation between vocational colleges and enterprises is mostly at the superficial level, and the common forms include carrying out short-term project cooperation and accepting students' short-term internships and training, but the cooperation framework based on long-term and systematic planning is lacking. In this kind of short-term cooperation, enterprises cannot fully understand the research director of the school, and the school cannot gain insight into the actual needs of enterprises.

3.3. Insufficient financial support

The research and development funds of higher vocational colleges mainly rely on financial allocation, and the sources and channels are limited. Compared with European and American countries, China's social capital is less involved in scientific research, especially the enterprise capital is insufficient to support technical research and development in higher vocational colleges. In addition, new technologies and products need to go through the pilot stage from the laboratory to the market, which requires a lot of capital investment and repeated trials. However, small, medium, and micro enterprises are unwilling to bear the cost of pilot tests, and vocational colleges themselves lack pilot test conditions, resulting in the transformation of some results cannot complete the test link, and the technical feasibility and rationality of the demonstration are limited ^[10]. The transformation of scientific and technological achievements has the characteristics of high risk and high growth and needs the support of professional venture capital institutions. However, at present, it mainly relies on government funds and lacks scientific and technological financial tools.

3.4. The channels for the transformation of scientific and technological achievements are not smooth

There are many obstacles to the transformation of scientific and technological achievements in higher vocational colleges. First of all, most colleges lack departments or full-time personnel who are specifically responsible for the transformation of scientific and technological achievements, and the related responsibilities are often taken into account by the scientific research management department. However, the transformation of scientific and technological achievements is a highly professional and complex work, and it is difficult for the scientific research management department to fully meet its professional and comprehensive needs, which limits the possibility of effective transformation of scientific and technological achievements. Secondly, the information communication channels between vocational colleges and enterprises are not smooth, and it is difficult to promote the achievements of schools and transfer the needs of enterprises. Finally, as intermediaries tend to prefer to cooperate with well-known institutions with deep scientific research backgrounds and rich achievements, vocational colleges are at a disadvantage in obtaining market information and seeking intermediary services ^[11].

4. Strategies for improving the transformation ability of scientific and technological achievements in higher vocational colleges

4.1. Increase the investment in scientific research resources and strengthen the construction of scientific research teams

Higher vocational colleges need to increase investment in scientific research in an all-round way, covering key areas such as capital, advanced equipment, and allocation of human resources. Create a campus atmosphere that attaches importance to scientific research, establish incentive mechanisms, such as setting up special research funds, implementing a reward system, and taking scientific research contributions into consideration in the evaluation of professional titles, to fully mobilize the enthusiasm of teachers. Encourage teachers to cooperate with enterprises to carry out research projects with high application value, and form a stable research and development direction. At the same time, the university actively introduces leading scientific research talents, builds high-level research platforms, sets up close-knit research teams, carries out systematic and organized research work, and comprehensively improves the overall scientific research strength of the university^[12]. At the same time, the university has strengthened the training and encouragement of teachers in scientific research, changed their conservative ideas, and encouraged them to boldly explore the path of transforming scientific and technological achievements.

4.2. Strengthen market orientation and optimize school-enterprise cooperation mode

Higher vocational colleges should establish market-oriented research and development concepts, take the initiative to deeply investigate enterprises, accurately grasp the actual technical needs of enterprises, and flexibly adjust the direction of scientific research accordingly. Actively jointly declare scientific research projects with enterprises, jointly carry out technical research, to ensure that the research and development results can directly solve the practical problems of enterprises, and enhance the market adaptability of scientific and technological achievements. Strengthening the construction of pilot platforms can solve the problem of an insufficient number of pilot platforms by co-building with enterprises and winning government support. In addition, explore the establishment of a long-term and stable school-enterprise cooperation mechanism, and encourage enterprises to participate in the establishment and implementation of scientific research projects in higher vocational colleges. Resources sharing and technology docking should be realized through the joint construction of industrial colleges and the establishment of joint laboratories or research and development centers^[13].

4.3. Expand diversified financing channels and strengthen financial support

The government should play a leading role in jointly building pilot bases with enterprises and private capital, lowering the threshold for SMEs to participate, and improving the efficiency of translating results. Based on relying on financial allocations, the government should actively seek the injection of social funds, such as venture capital and angel funds, to provide adequate financial support for projects with potential^[14].

4.4. Strengthen the construction of professional institutions and talents, and improve the information communication mechanism

Higher vocational colleges should set up specialized institutions for the transformation of scientific and technological achievements, staffed with professionals, responsible for the evaluation, promotion, docking, and transformation of scientific and technological achievements. At the same time, they should strengthen cooperation with specialized technology transfer institutions to learn advanced experience and improve transformation efficiency. Establish and improve the regular communication mechanism with enterprises, such as actively organizing and participating in the

scientific and technological achievements matching meetings, industry-university-research cooperation forum, and other activities, timely and comprehensively introduce the scientific and technological achievements of the university to enterprises, and deeply understand the technical needs of enterprises^[15]. In addition, make full use of the professional advantages and extensive resource network of intermediary agencies, strengthen cooperation, and provide all-round, one-stop quality services for the transformation of scientific and technological achievements.

5. Conclusion

The transformation of scientific and technological achievements is not only the only way for higher vocational colleges to implement the innovation-driven development strategy, but also the core driving force for the regional economy to achieve high-quality growth, and the key way to enhance their comprehensive competitiveness. Looking forward to the future, higher vocational colleges should actively respond to the national innovation-driven development strategy, continue to strengthen market demand research, and integrate the transformation of scientific and technological achievements into daily teaching and research activities. The government, financial institutions, and enterprises should also work together to provide policy support, financial guarantees, and technical guidance for the transformation of scientific and technological achievements in higher vocational colleges. Only when all parties form joint efforts can the industry fully tap the potential of higher vocational colleges in the field of scientific and technological innovation, promote the efficient transformation of scientific and technological achievements into real productive forces, and contribute to the high-quality development of the national and regional economy.

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Exploration of English Writing Teaching Strategies from the Perspective of Learning Science in the Context of Large-Unit Teaching

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Abstract: Writing is an important part of English teaching in senior high school. It is one of the important language skills that students need to master. Under the background of the new curriculum reform, teachers should pay attention to innovative educational ideas, use large unit teaching methods to teach writing skills, provide students with rich writing opportunities, and promote the improvement of students' writing levels. Based on this, this paper studies English writing teaching strategies from the scientific perspective of large unit teaching, analyzes the value of large unit teaching in English writing teaching, and puts forward specific implementation strategies, aiming to effectively improve students' English writing level by integrating teaching content, improving students' writing ability and understanding of the subject.

Keywords: Large unit teaching; Senior high school English; Writing instruction

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1. Introduction

Big unit teaching emphasizes the theme as the core, through the integration of relevant texts and teaching resources, to improve students' comprehensive quality and writing ability, which is in line with the concept of the new curriculum standard ^[1]. In this regard, teachers should pay attention to the design of teaching based on the concept of large units, create a variety of teaching situations, guide students to imitate writing, creation, etc., develop students' English writing level, and improve the quality of English writing teaching ^[2]. From the perspective of learning science, this paper will explore the application of a large unit teaching strategy in senior high school English writing teaching, to provide new ideas and methods for English writing teaching.

2. The value of English writing teaching in senior high school under large unit teaching

2.1. It is conducive to promoting the reform and optimization of teaching

Large unit teaching emphasizes taking the theme as guidance, integrating relevant knowledge points and skills into a large teaching unit to form a complete teaching system. Under the guidance of large unit teaching, English writing teaching is no longer limited to a single grammar and vocabulary training, but combines writing with reading, listening, speaking, and other language skills to form a comprehensive language learning process, which is conducive to improving students' language application ability and promoting teaching reform to a more scientific and reasonable direction.

2.2. It is conducive to improving students' core English literacy

Core English quality refers to the comprehensive quality of language ability, cultural awareness, thinking quality, and learning strategy formed by students in the process of English learning. The English writing teaching under the large-unit teaching not only pays attention to the improvement of students' language skills but also pays more attention to the cultivation of students' cultural accomplishment and thinking ability^[3]. Through writing, students can have a deeper understanding of the cultural background and social phenomena of English-speaking countries, and enhance their cultural awareness and intercultural communication ability^[4].

2.3. Writing is conducive to promoting students' all-round development

English writing teaching activities based on large units require students to use vocabulary, grammar, and sentence patterns to express ideas, which can exercise students' language organization ability, enhance students' sensitivity and application of the English language, and constantly improve their English level through continuous practice and reflection^[5]. This process can exercise students' logical thinking ability, stimulate students' creative inspiration, and enable students to learn how to look at problems from a unique perspective and how to express their ideas clearly with language^[6].

3. The essence analysis of quality cultivation under the scientific perspective of large unit teaching and learning

3.1. Quality cultivation pointing to the transfer of high channel

In the context of the transformation of the time, the cultivation of literacy has become a common demand in global education. Compared with simple "problem solving", literacy emphasizes more on "creative problem solving"^[7]. In the teaching of large units, English writing is not only a pile of vocabulary and grammar, but also a process in which students use what they have learned, combine personal experience and innovative thinking and express their thoughts and emotions. This teaching mode encourages students to jump out of the traditional framework and try new ways of expression, to cultivate their creative thinking and problem-solving skills.

3.2. Changes in knowledge structure

The change in knowledge structure is one of the core characteristics of large unit teaching. In the teaching of English writing, this is mainly reflected in the following aspects: First, the alternations of new and old concepts make students constantly accept new knowledge while consolidating old knowledge. Secondly, the active degree of concepts is improved, students no longer passively accept information, but actively explore and discover. Finally, the correla-

tion between concepts is strengthened, and students can integrate knowledge from different fields to form a more complete and systematic knowledge system. This change in knowledge structure helps students better understand and use complex concepts and techniques in English writing ^[8].

3.3. The change of teaching concepts

The improvement of the knowledge structure level depends on the change of teaching concept to a large extent ^[9]. In the teaching of large units, teachers need to abandon the traditional cramming teaching and adopt more flexible and diverse teaching methods to stimulate students' learning interest and initiative. Teachers need to focus on cultivating students' critical thinking and independent learning abilities and guide them to learn to think independently and solve problems. The change of teaching concepts will not only help improve students' English writing level but also promote the all-round development of their comprehensive literacy.

4. Large unit teaching: An exploration of English writing teaching strategies from the perspective of learning science

4.1. Analyze the teaching theme of large units and design the writing objectives

From the perspective of learning science, large unit teaching provides a brand new perspective and method for English writing teaching. Teachers should deeply understand the content of textbooks, integrate scattered knowledge points of units, combine key information of units, extract corresponding teaching themes, design clear writing teaching objectives based on the teaching requirements of large units and English curriculum standards, and effectively improve students' writing ability. Cultivate students' critical thinking and innovation ability ^[10]. Take the optional compulsory Volume 3 "Unit 3 Environmental Protection" as an example. The unit's topic context is "environmental protection" and aims to guide students to think deeply about the relationship between humans and the environment, and how students can rationally optimize the environment (**Table 1**). According to the unit teaching content, teachers can list the following teaching objectives: Knowledge objectives: Students should be able to accurately grasp the English vocabulary, phrases, and sentence patterns related to "environmental protection", such as "environmental protection", "sustainable development", "take measures to do something", etc., and use them correctly in writing ^[11]. At the same time, students will be familiar with the structural and linguistic characteristics of different genres (such as argumentative essays, expository essays, proposals, etc.). For example, an argumentative essay needs to have clear arguments and an argumentation process. Skill objective: Through the analysis of reading materials in the unit, learn to extract key information and summarize it, to accumulate writing materials. Be able to use appropriate logical connectives and transitions to organize articles according to different writing task requirements, so that the writing content is clear and hierarchical. For example, when discussing environmental protection measures, one can reasonably use "firstly, secondly, finally" and other connectives. In addition, students should have the ability to revise and polish the language and be able to check and correct grammatical errors and spelling mistakes in the articles to improve the overall quality of the articles. Objective: To have a deep understanding of the importance of environmental protection and enhance students' awareness of environmental protection and social responsibility ^[12]. Encourage students to actively express their views and attitudes on environmental protection in writing, stimulate students' enthusiasm for spreading environmental protection concepts through English writing, and cultivate students' awareness of cross-cultural communication of environmental protection information in English.

Table 1. Unit 3 environmental protection teaching content

Teaching objectives	Ability development
Knowledge objectives	Be able to master relevant English vocabulary, phrases, and sentence patterns accurately and use them correctly in writing; Be familiar with the structural and linguistic features of different genres (such as argumentative essays, expository essays, proposals, etc.)
Skill goals	Learn to extract and summarize key information to build material for your writing
Affective attitude goal	Deeply understand the importance of environmental protection, and enhance students' environmental awareness and social responsibility.

4.2. Summarize the text content of large units and accumulate writing materials

Writing is an important and difficult part of English teaching in senior high school, and there are many learning difficulties for students^[13]. Teachers should help students overcome

problems using large unit teaching, promote students' in-depth understanding and summary of the text content, accumulate writing materials constantly, and improve students' English writing levels. In terms of teachers, teachers should recognize the important value of large unit text content to students' writing activities, and pay attention to guiding students to carry out writing exercises around the textbook text content, to realize the continuous expansion of thinking (**Figure 1**)^[14]. Teachers should deeply study the English textbooks, lead students to read the textbooks and feel the emotions and meanings expressed in the English texts, to consolidate the students' English foundation, master the relevant grammar and sentence patterns of the texts, and apply them in writing, to promote the effective combination of the textbook content and writing. Take high school English "Unit 3 Sports and Fitness" as an example. This unit focuses on sports and health as well as athletic spirit, which can make students feel the charm of sports and deeply appreciate the value contained in athletic spirit. The teacher first guides the students to read the unit fluently to ensure that the students can accurately understand the text information^[15]. In the reading, teachers can set some guiding questions to help students grasp the main idea and details of the passage. For example, for the reading material of Steph Curry and the Chinese Women's Volleyball team, they can ask "What sports spirit did Steph Curry and the Chinese Women's Volleyball team demonstrate respectively?" Such questions can stimulate students' thinking and promote their in-depth understanding of the text content. After establishing a preliminary understanding of the text content, the teacher guided the students to sum up the athletic spirit of Steph Curry and the Chinese Women's Volleyball team. The students were asked to have a group discussion and extract keywords such as "perseverance",

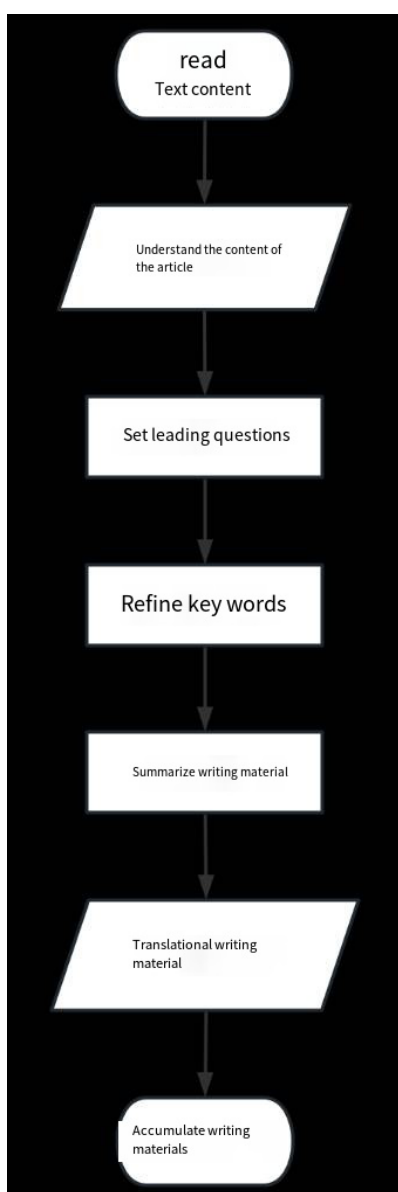


Figure 1. Large unit teaching in English teaching

“courage to challenge” and “teamwork”. Combined with the keywords, the teacher guided the students to transform the essence of the text into writing materials. Such as “In this way, practicing day in and day out helped his skills” and “Sweat your way to good health” which encouraged students to use them in their subsequent writing.

4.3. Read the content of large units of articles, and carry out reading to promote writing

In the implementation of large unit writing teaching, teachers should recognize the relationship between reading and writing, and let students carry out reading promoting writing activities based on reading large unit articles, to improve students' English writing ability^[16]. Through continuous writing and rewriting exercises, students can not only deepen their understanding of the text content but also exercise their imagination and creativity, to comprehensively improve their English writing ability. First, organize continuous writing activities. Continuous writing is a writing method that extends the ideas of the original text and can convey a certain idea or plot of the author. Before continuing writing, students should master the specific issues of the text, understand the main plots, accurately grasp the characteristics of the characters and the views of the text, etc., on this basis, publish a unique personal profile and continue writing according to the theme of the article^[17]. Teachers can guide students to add sentences after reading, for example, “The article is probably about _____. When we say a topic is food for thought, we mean that topic is worth _____ about.” Second, do the rewrite activity. Rewriting refers to the writing method that expresses the ideas of the article in different forms and produces the same meaning as the text, but the expression of the text is different^[18]. Rewriting can effectively exercise students' English writing ability, provide students with independent creation space, and flexibly use what they have learned to paraphrase the text content. For example, the teacher provides the sentence “What he got from the adventure is sheer joy.” “He ate and made money to enjoy life.”, Students can change it to write “The adventure brought him immense joy.” “He earned money to fund his adventures and enjoy life to the fullest.” and so on. When assigning rewriting tasks to students, teachers may ask students to use news reporting to paraphrase the content of the article, and encourage students to add their own opinions and comments appropriately to enrich the content and depth of the article^[19]. Through rewriting, students can not only exercise their language organization and expression skills but also cultivate their familiarity and sensitivity to the news reporting genre^[20].

5. Teaching Suggestions on English writing from the perspective of science

Combined with the author's teaching practice, this study gives the following suggestions for English writing teaching under the large unit: Integrate teaching resources, pay attention to a wide range of resources related to the theme of large units, such as English documentary clips, foreign official reports, etc., and integrate them into writing teaching. Let students have access to real and rich language materials, broaden their horizons, and provide more inspiration and materials for writing. Construct contextual writing tasks. It should be combined with the theme of large units to create real and close to students' life situations, such as simulated English newspaper contributions, international communication emails, etc. so that students can have something to write under the situational drive and stimulate their interest and motivation in writing. Strengthen knowledge integration and transfer. Emphasis should be placed on integrating vocabulary, grammar, discourse, and other knowledge into the theme of the large unit to guide students to use it flexibly in writing. For example, in the unit “Campus Life”, students can integrate vocabulary and sentence patterns describing campus facilities, courses, and activities. Brainstorm before writing to help students sort out their ideas and organize their opinions; Give feedback in time to correct language errors and logic problems; Organize mutual evaluation and reform after writing to promote students' common progress.

6. Conclusion

To sum up, English writing teaching in high school from the perspective of large units can promote the integration and application of curriculum knowledge, improve the integrity and comprehensiveness of teaching, cultivate students' comprehensive literacy and critical thinking ability, and lay a solid foundation for student's all-round development. In the implementation process, teachers should analyze the teaching theme of large units, summarize the text content, and carry out activities to promote writing by reading, which can effectively improve students' English writing ability and understanding of the theme. In the teaching process, new problems and situations will be encountered constantly. Teachers should actively promote and apply the large-unit teaching strategy to create a better environment and conditions for students' English writing learning and improve their English writing ability.

Disclosure statement

The author declares no conflict of interest.

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Inheritance and Innovation of Guangdong Han Opera: Xu Qing's Artistic Practice and Thoughts

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Abstract: This paper focuses on Xu Qing's artistic practice in the field of Guangdong Han Opera, and deeply explores his contributions to the inheritance and innovation of the genre. Through studying Xu Qing's related practical activities, this paper analyzes his specific measures in drama creation, talent cultivation, market expansion, and cultural dissemination, and reflects on the impact and significance of these practices on the development of Guangdong Han Opera. The study finds that Xu Qing's artistic practice provides valuable experience for the inheritance and innovation of Guangdong Han Opera in contemporary society, and is of great value for promoting the sustainable development of Guangdong Han Opera.

Keywords: Guangdong Han Opera; Inheritance and innovation; Xu Qing; Artistic practice

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1. Introduction

As one of the three major opera genres in Guangdong, Guangdong Han Opera has a history of nearly three hundred years^[1]. In 2008, it was listed in the national intangible cultural heritage list, carrying rich historical and cultural connotations and being an important representative of Lingnan culture^[2]. Under the wave of globalization and modernization, Guangdong Han Opera faces many challenges, such as a shortage of inheritors and fierce competition in the performance market. Its inheritance and innovation have become an important issue that needs to be solved urgently^[3].

Xu Qing, a national first-level screenwriter, is currently the vice chairman of the Guangdong Dramatists Association and the vice president of the Guangdong Han Opera Inheritance Research Institute^[4]. He has been dedicated to the field of Guangdong Han Opera for many years and has accumulated a lot of first-hand artistic practice and theoretical experience. With a strong sense of responsibility and mission, he has devoted himself to the inheritance and innovation of the Guangdong Han Opera. Through various practices such as drama creation, talent cultivation, and market expansion, he has made important contributions to the development of the Guangdong Han Opera. The study of Xu Qing's artistic practice helps to understand the contemporary inheritance and innovation path of Guangdong

Han Opera in-depth and provides a useful reference for the sustainable development of Guangdong Han Opera.

2. Overview of Guangdong Han Opera

2.1. Historical origin

Guangdong Han Opera, originally called Waijiang Opera, can be traced back to the late Ming and early Qing dynasties^[5]. At that time, a large number of foreign provincial troupes singing Yiyang Cavity, Qingyang Cavity, and Luantan entered Guangdong. During the Qianlong period of the Qing Dynasty, Waijiang Opera troupes became gradually active in Guangdong. In the 24th year of Qianlong (1759), foreign troupes established the Waijiang Liyuan Guild Hall in Guangzhou. Since then, Waijiang Opera has been widely spread in eastern Guangdong, northern Guangdong, western Fujian, and southern Jiangxi, and has gradually formed Guangdong Han Opera with a unique style through the integration with local folk music, Buddhist and Taoist music, and Zhongjun class music^[6]. In 1933, Qian Rezhū, a native of Dabu County, Guangdong Province, wrote an “Outline of Han Opera”, officially naming Waijiang Opera as Han Opera, which was renamed Guangdong Han Opera in 1956^[7].

2.2. Artistic features

The performance program of Guangdong Han Opera is rich and diverse, and its martial arts belong to the South School, emphasizing the flexibility and agility of the body, with vigorous and powerful movements, showing strong Southern martial arts characteristics^[8]. The face makeup mainly uses black, red, and white, and different colors symbolize different personality characteristics. For example, black represents bravery, red represents loyalty and virtue, while white and cyan represent cunning and treachery^[9].

Stage singing is an important feature of Guangdong Han Opera, which is mainly based on Pi Huang, and also incorporates various voice cavities such as Kunqu, Gaoqiang, Chuiqiang, and minor, preserving a large number of ancient musical scores^[10]. The stage language is Zhongzhou rhyme, reflecting the inheritance of the Central Plains culture by the Guangdong Han Opera. The diversified integration system enables Guangdong Han Opera to appropriately set off the atmosphere according to different plot scenes, enhancing the appeal of the drama.

In terms of role types, Guangdong Han Opera is divided into seven major roles: Sheng, Dan, Chou, Gong, Po, and Jing (Hongjing, Wujing). Each role has its unique performance norms and artistic characteristics, playing an indispensable role in the drama.

The accompaniment instruments are divided into Wen Chang and Wu Chang. The Wen Chang instruments include head strings, erhu, and sanxian, while the Wu Chang instruments include war drums, big drums, and bian drums. The head string, Da Suluo, and haoto are unique accompaniment instruments of the Guangdong Han Opera. As the leading instrument, the head string has a clear and bright tone, which can lead the playing rhythm of the entire orchestra, and is mainly suitable for accompanying adults with false voices; Da Suluo has a majestic and heavy sound, which plays an important role in enhancing the dramatic tension, mainly suitable for accompanying relatively slow and stable tunes; Haoto is often used for the contrast at the beginning or the end, and its loud sound can quickly attract the audience's attention, which is mainly suitable for creating a grand, intense and exciting atmosphere for the play.

3. Xu Qing's artistic practices

3.1. Drama creation: Inheriting classics and introducing innovations

Xu Qing achieved remarkable success in the creation of the Guangdong Han Opera, adhering to the philosophy of

inheriting classics while introducing innovations. His works span a variety of themes, focusing not only on the exploration and interpretation of traditional stories but also on real-life experiences and regional cultures, injecting new vitality into Guangdong Han Opera.

In the rearrangement and adaptation of traditional repertoires, Xu Qing has conducted in-depth research, preserving their essence while innovating to cater to the aesthetic tastes of modern audiences. He has carefully refined the plots, characterizations, and language of the scripts, allowing traditional repertoires to shine with new charm on the contemporary stage. For instance, in the adaptation of the classic repertoire, “Bai Li Xin Recognizes His Wife”, Xu Qing enriched the characters’ inner worlds while retaining the original story framework, showcasing the profound emotions between Bai Li Xin and his wife after enduring hardships, thereby enhancing the repertoire’s emotional appeal.

In creating new repertoires, Xu Qing has primarily focused on red themes, Hakka themes, and regional folklore, tightly integrating Guangdong Han Opera with local culture. For example, his large-scale red theme repertoire “Li Jianzhen” is based on the life story of the revolutionary predecessor Li Jianzhen, showcasing her heroic struggle for the revolutionary cause. This repertoire not only possesses profound ideological connotations but also innovates in artistic expression, combining traditional Guangdong Han Opera performance forms with modern stage technology. Its novel musical composition and stage direction have captivated audiences, earning it the Excellent Work Award from the 11th Spiritual Civilization Construction “Five-One Project” in Guangdong Province in 2019, fully attesting to its artistic value.

Another representative work of Xu Qing’s is “Bai Men Liu”, which won the First Prize for Scriptwriting at the 8th Guangdong Provincial Arts Festival and the Guangdong Lu Xun Literary and Art Award. It was even adapted into a theatrical film. With a unique perspective and captivating storyline, this repertoire showcases the social landscape and character destinies of a specific historical period, innovating in scriptwriting, musical design, and stage presentation, and promoting the external promotion, inheritance, and development of Guangdong Han Opera.

3.2. Talent cultivation: Fostering heritage and building a talent pipeline

Talent is the key to the inheritance and development of Guangdong Han Opera. Deeply understanding this, Xu Qing has dedicated himself to talent cultivation, employing various methods to nurture the next generation and build a reasonable talent pipeline.

Xu Qing places great emphasis on the foundational training of young talents. He collaborates closely with drama schools, establishing student learning and talent cultivation bases. Frequently visiting these schools, he teaches students and personally guides their performance skills, patiently explaining and demonstrating everything from vocal techniques to body movements. He also focuses on cultivating students’ love for Guangdong Han Opera, enhancing their cultural identity and sense of mission through narratives about the genre’s historical stories and artistic characteristics.

At the Guangdong Han Opera Inheritance Research Institute, Xu Qing actively promotes talent cultivation models such as “group-led classes” and “one-on-one” mentoring, fully utilizing the role of veteran artists in passing down their skills and experiences. He organizes experienced artists to work with young actors, providing meticulous guidance in various aspects such as character understanding, emotional expression, and performance pacing, thereby helping young actors continuously improve their performance levels. This model not only enables young actors to grow rapidly but also promotes the inheritance of traditional Guangdong Han Opera skills.

Xu Qing also actively provides young talents with opportunities to showcase their abilities. He encourages them

to participate in various performances and competitions, allowing them to hone their skills in practice. Under his guidance, many young actors have made their mark in significant performances and competitions, emerging as new forces on the Guangdong Han Opera stage. He also recommends outstanding young talents to higher-level artistic platforms for further learning and exchange, broadening their horizons and enhancing their artistic accomplishments.

3.3. Market expansion: Diversified strategies to activate the performance market

Facing the challenge of a shrinking performance market for Guangdong Han Opera, Xu Qing has actively explored diversified market expansion strategies, striving to activate the performing arts market and create broader spaces for the genre's development.

Xu Qing believes that the Guangdong Han Opera should center on and serve the overall situation, fully utilizing its cultural service functions. He promotes the involvement of Guangdong Han Opera in various cultural activities, actively fulfilling performance tasks and public cultural events aligned with the central tasks of the municipal party committee, government, and propaganda department. Through these activities, Guangdong Han Opera not only brings traditional cultural enjoyment to the local community but also enhances its social influence and establishes a positive social image.

Utilizing the advantage of Guangdong Han Opera's use of "Zhongzhou phonology" and Mandarin as its stage language, Xu Qing actively develops new performance markets. He advocates for the redevelopment of performance markets in Guangdong and Chaoshan, strengthening cooperation with units and enterprises in the Pearl River Delta region with performance needs. Through collaborations with local cultural institutions and enterprises, various performance activities are organized, attracting more audiences to the Guangdong Han Opera. He also expands the "cultural benefit" performance market, ensuring consistent government procurement and orderly implementation of activities such as community, village, school, enterprise, and military camp visits. Through these activities, Guangdong Han Opera gradually reaches grassroots audiences, cultivating a large number of potential viewers.

Xu Qing also focuses on strengthening the exploration and development of internal and external resources within the genre, developing "drama derivative" projects that align with market demands. He promotes the integration of Guangdong Han Opera with the cultural and creative industries, developing a series of cultural and creative products with Guangdong Han Opera characteristics, such as drama character dolls, cultural shirts, and postcards. These products not only possess commemorative value but also serve as important carriers for promoting Guangdong Han Opera, further expanding its influence.

3.4. Cultural dissemination: Enhancing influence and promoting Han Opera culture

Xu Qing actively promotes the cultural dissemination of Guangdong Han Opera, utilizing various channels and methods to enhance its popularity and influence and celebrate its cultural heritage.

With the help of the media, Xu Qing intensifies the promotion of Guangdong Han Opera. He strives for support from provincial and municipal mainstream media, setting up special columns and programs on local newspapers, radio stations, television stations, and the internet to vigorously promote the developmental origins, artistic characteristics, and high-quality repertoires of the Guangdong Han Opera. Through comprehensive media coverage, more audiences are exposed to and develop a fondness for Guangdong Han Opera, creating a wave of enthusiasm for the genre in the Meizhou region.

Taking advantage of Guangdong Han Opera's status as a national intangible cultural heritage, Xu Qing integrates resources and taps into the potential of the genre and its repertoires. He promotes the launch of special publi-

cations and albums dedicated to the Guangdong Han Opera, further establishing its image through authoritative promotion by high-end media and marketing strategies. These publications and albums provide in-depth introductions to the history, artistic characteristics, and classic repertoires of the Guangdong Han Opera, offering valuable reference materials for its inheritance and development and elevating its status in academic and cultural circles.

Xu Qing also facilitates the international exchange of the Guangdong Han Opera, allowing it to reach beyond national borders and into the global sphere. Seizing the opportunity to jointly apply for world intangible cultural heritage status with five provincial Han Opera troupes (from Hubei, Fujian, Hunan, Shaanxi, and Guangdong), he continuously advances the project construction of “Guangdong Han Opera (Han Music) Stations” and the “Guangdong Han Opera Overseas Inheritance and Promotion Center.” Through these projects, the influence of Guangdong Han Opera continues to expand overseas, attracting the attention of foreign audiences and scholars and promoting cultural exchanges between China and the rest of the world.

4. The impact and significance of Xu Qing’s artistic practices

4.1. Promoting the inheritance of Guangdong Han Opera

Xu Qing’s drama creation plays a significant role in inheriting the traditions of the Guangdong Han Opera. His re-arrangement and adaptation of traditional repertoires enabled classic works to be passed down and developed, preserving the traditional essence of Guangdong Han Opera. The creation of new repertoires, primarily focusing on red and Hakka themes, tightly integrates Guangdong Han Opera with local culture, enriching its repertoire library and providing more material for its inheritance.

In terms of talent cultivation, Xu Qing has nurtured a large number of Guangdong Han Opera talents through various methods, providing a solid talent foundation for the genre’s inheritance. He emphasizes cultivating young talents’ love and sense of responsibility for the Guangdong Han Opera, ensuring that its inheritance has successors. These young talents not only inherit traditional Guangdong Han Opera skills but also inject new vitality into the genre’s development.

4.2. Facilitating innovation in Guangdong Han Opera

Xu Qing’s innovations in drama creation have brought new developmental ideas to the Guangdong Han Opera. By combining modern elements with the traditional characteristics of Guangdong Han Opera, he has introduced innovations in scriptwriting, musical design, and stage presentation, making the genre more aligned with the aesthetic tastes of contemporary audiences. For instance, in musical composition, he integrates modern musical elements, adding new charm to Guangdong Han Opera’s music. In stage presentation, he draws inspiration from modern drama and dance, enhancing the visual appeal of the Guangdong Han Opera.

Xu Qing’s innovative initiatives have also opened up new paths for the development of Guangdong Han Opera in terms of market expansion and cultural dissemination. He actively explores diversified market expansion strategies, develops “drama derivative” projects, and promotes the integration of Guangdong Han Opera with the cultural and creative industries, creating new economic growth points for the genre’s development. In cultural dissemination, he utilizes new media platforms and external exchange projects to enhance the popularity and influence of Guangdong Han.

4.3. Enhancing cultural identity and exchange

Xu Qing actively promotes the cultural dissemination of Guangdong Han Opera, enhancing its popularity and influ-

ence through various channels and means, and celebrating Guangdong Han Opera culture.

Xu Qing leverages the power of media to intensify the promotion of the Guangdong Han Opera. He strives for support from provincial and municipal mainstream media, establishing special columns on Guangdong Han Opera in local newspapers, radio stations, television stations, and the internet. These columns vigorously promote the developmental origins, artistic characteristics, and excellent repertoire of the Guangdong Han Opera. Through comprehensive media coverage, more audience members can understand and appreciate Guangdong Han Opera, creating a wave of enthusiasm for the art form in the Meizhou region.

Xu Qing takes advantage of the status of Guangdong Han Opera as a national intangible cultural heritage to integrate resources and tap into the potential of the genre and its repertoire. He promotes the launch of a series of special publications and albums dedicated to Guangdong Han Opera as an intangible cultural heritage, further establishing the image of Guangdong Han Opera through authoritative promotion in high-end media and marketing strategies. These special publications and albums provide in-depth introductions to the history, artistic characteristics, and classic repertoire of Guangdong Han Opera, offering important material support for its inheritance and development. They also enhance the status of Guangdong Han Opera in academic and cultural circles.

Xu Qing also facilitates external exchanges for the Guangdong Han Opera, enabling it to reach beyond China's borders and onto the global stage. Taking the opportunity of jointly applying for World Intangible Cultural Heritage status with Han Opera troupes from five provinces (Hubei, Fujian, Hunan, Shaanxi, and Guangdong), he continuously advances the project construction of "Guangdong Han Opera (Han Music) Stations" and "Guangdong Han Opera Overseas Inheritance and Promotion Centers." Through these projects, the influence of Guangdong Han Opera overseas continues to expand, attracting the attention of many overseas audience members and scholars, and promoting cultural exchanges between China and foreign countries.

5. Conclusion

Xu Qing has conducted various artistic practices in the inheritance and innovation of the Guangdong Han Opera, achieving numerous accomplishments. Through work such as drama creation, talent cultivation, market expansion, and cultural dissemination, he has made significant contributions to the development of the Guangdong Han Opera. His practices not only promote the inheritance and innovation of Guangdong Han Opera but also provide valuable experience for its sustained development in contemporary society. However, the inheritance and innovation of Guangdong Han Opera is a long-term and arduous task, still facing many challenges. In future development, more artists and cultural workers like Xu Qing need to make joint efforts. While preserving traditional characteristics, people should continue to strengthen the creation of new dramas, constantly introduce excellent works with era characteristics and cultural connotations, intensify talent cultivation, improve the talent training system, cultivate more high-quality professionals, further expand domestic and foreign markets, innovate market expansion strategies, and continuously improve the market competitiveness of Guangdong Han Opera. People should also strengthen cultural dissemination, enhance the popularity and influence of Guangdong Han Opera, and let the "Southern Peony" of Guangdong Han Opera bloom with more brilliant brilliance in the new era. With continuous efforts from all parties, Guangdong Han Opera will continue to move forward on the path of inheritance and innovation, making greater contributions to promoting excellent traditional Chinese culture and facilitating cultural diversity.

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A Study on the Inheritance and Innovation of Guangdong Han Opera: A Case Study of Xianhua Li as a Representative Inheritor

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Abstract: The Guangdong Han Opera is an important component of Lingnan culture. The Dan role, with its unique performance style and profound cultural connotations, holds significant value for inheritance and innovation. This study focuses on the artistic practices of Li Xianhua, a representative inheritor of the Dan role in Guangdong Han Opera. By examining her fifty-year artistic career, the study analyzes her outstanding contributions to the inheritance, performance innovation, and mentorship in the Guangdong Han Opera. Employing a combination of case studies and literature research, the study emphasizes Li Xianhua's practices in vocal design, performance style, and repertoire innovation, revealing the multiple inheritance pathways of Guangdong Han Opera since the 1970s. The research findings indicate that Li Xianhua has promoted the innovative development of Guangdong Han Opera by integrating traditional techniques with modern artistic elements, gradually attracting the attention of younger audiences. Simultaneously, she has established a systematic succession mechanism in cultivating young actors, providing crucial support for the sustained development of the Guangdong Han Opera. The study also discovers that the application of digital technology and the deepening of international cultural exchanges have opened up new spaces for the dissemination and promotion of the Guangdong Han Opera. The innovation of this research lies in systematically analyzing Li Xianhua's artistic practices and cultural contributions from an individual perspective, unveiling the vitality of Guangdong Han Opera in the contemporary cultural context and its implications for the inheritance of Chinese traditional culture. This provides an important reference for the protection and innovation of intangible cultural heritage and offers theoretical support and practical pathways for the sustainable development of Guangdong Han Opera.

Keywords: Guangdong Han Opera; Li Xianhua; Cultural inheritance; Artistic innovation

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1. Research background and significance of Guangdong Han Opera

Guangdong Han Opera, with its rich history and diverse content, is a typical representative of Lingnan traditional culture^[1-2]. Its unique artistic style, profound cultural foundation, and varied forms of expression make it an integral part of the spiritual and cultural life of the people in Lingnan. Since being listed as a national intangible cultural heritage representative project in 2008, Guangdong Han Opera has begun to attract academic attention. As one of the important roles in Guangdong Han Opera, the Dan role occupies a significant position due to its delicate performance style, elegant singing, and unique character portrayal^[3].

In the context of Lingnan culture, Guangdong Han Opera is not only a performing art but also a crucial carrier of local cultural identity and historical memory. The Dan role in Guangdong Han Opera provides a strong theatrical appeal to the audience by expressing the complex emotions and diverse identities of female characters^[4]. It is not only one of the cores of traditional aesthetic expression in Guangdong Han Opera but also plays an important role in traditional culture dissemination, social education, and emotional communication. However, with the rapid changes in contemporary society in the 1970s, the Dan role in Guangdong Han Opera faced a crisis of inheritance, including audience loss, a gap in actor succession, and difficulties in adapting traditional skills to contemporary aesthetic demands^[5]. Therefore, achieving the modernization of artistic forms while preserving traditional culture became an urgent issue to address.

As a representative inheritor of the Dan role in the Guangdong Han Opera, Li Xianhua's artistic career provides a model for the inheritance and innovation of the Guangdong Han Opera^[6]. She has not only created a series of classic characters but also cultivated a new generation of successors in teaching and guidance. Through in-depth research on Li Xianhua's artistic practices, researchers can better understand the core value and development path of the Dan role in Guangdong Han Opera, providing important insights into the protection and innovation of intangible cultural heritage.

2. Research methods and objectives

This study employs a combination of literature analysis, case studies, and field investigations, focusing on Li Xianhua to explore the inheritance and innovation of the Dan role in Guangdong Han Opera. By analyzing Li Xianhua's artistic career, representative Guangdong Han Opera repertoires, and teaching experience, the study summarizes the characteristics and significance of her artistic practices. Simultaneously, the study integrates anthropological and cultural theoretical frameworks to explore the adaptability and dissemination pathways of the Dan role in Guangdong Han Opera in the contemporary social context. The main objectives of the study are as follows.

To trace the development trajectory of the Dan role in Guangdong Han Opera: By reviewing the historical origins of Guangdong Han Opera, this study reveals the unique position and artistic characteristics of the Dan role in Lingnan culture.

To analyze Li Xianhua's artistic practices: Starting with representative Guangdong Han Opera repertoires and teaching experiences, this study explores her specific contributions to artistic innovation and inheritance, revealing the aesthetic qualities of the Dan role in Guangdong Han Opera.

To discuss inheritance and development strategies: In the context of modernization and globalization, this study explores how the Dan role in Guangdong Han Opera can combine traditional charm with contemporary culture to reach a broader audience.

To propose practical suggestions for protection and innovation: This study aims to provide a theoretical basis

and practical reference for the protection of intangible cultural heritage, promoting the sustainable and dynamic development of the Dan role in Guangdong Han Opera.

3. Overview of Guangdong Han Opera

3.1. Historical origins and characteristics of the Dan role in Guangdong Han Opera

The history of Guangdong Han Opera can be traced back to the late Qianlong period of the Qing Dynasty ^[7]. It originated from the original vocal form spread from the Central Plains and evolved by incorporating local traditional music and dialects. Initially known as “Wai Jiang Xi” (foreign river play), it was introduced to eastern Guangdong by Han Opera troupes in southern Jiangxi, Hubei, and Hunan. Gradually, it combined with the local Chaoshan and Hakka cultures, forming a theatrical form with regional characteristics. Its singing style is dominated by “Xipi” and “Erhuang”, enriched with various performance elements such as Daban and Xiaoqu. This vocal system is in line with the Han Opera of the Central Plains, but it also incorporates local languages and musical characteristics such as Hakka and Chaoshan dialects, reflecting the distinct cultural characteristics of Lingnan.

The Dan role, originating from the female character performances in traditional operas, is a highly expressive role in theatrical culture and an essential component of Guangdong Han Opera ^[8]. It inherits the traditional characteristics of the Dan role in the Han Opera of the Central Plains but presents distinct regional features in its specific manifestations. The performance emphasizes delicate emotional expression, with a soft and melodious singing style. It focuses on shaping characters through delicate body movements and elegant postures, retaining the stylized movements of traditional Dan roles while incorporating the unique artistic style of Lingnan culture. This fusion demonstrates the diversity of the Dan role in the Guangdong Han Opera and its unique position in the Chinese theatrical system.

The classification of Dan roles in the Guangdong Han Opera includes Zhengdan (main female role), Huadan (lively and spirited female role), and Guidan (young and innocent female role) ^[9]. Zhengdan often portrays a gentle and elegant female image, while Huadan focuses on lively and spicy characters. Guidan specializes in depicting the innocence and purity of young girls. This role division enables the Dan role in Guangdong Han Opera to adapt to both the solemnity of historical dramas and the lively diversity of folktales. The core of the Dan role lies in combining singing, recitation, and body movements to give life to the character through delicate performances, achieving emotional resonance and aesthetic experience in theatrical art.

3.2. The status and value of the Dan role in Guangdong Han Opera

As one of the core roles in Guangdong Han Opera, the Dan role not only plays a significant part in performances but also plays an irreplaceable role in promoting the inheritance and innovation of Guangdong Han Opera ^[10].

3.2.1. The core embodiment of expressive power in Guangdong Han Opera (Dan role)

The Dan role maximizes the artistic characteristics of Guangdong Han Opera through delicate performances. Singing, as an essential component of the Dan role in Guangdong Han Opera, best showcases the unique charm of its phonology. The singing style of the Dan role in Guangdong Han Opera retains the traditional “Pi Huang” vocal style while incorporating elements of Lingnan folk music, resulting in rich rhythmic variations and emotional tension. Li Xianhua, known as the “First Dan” of Guangdong, innovates in both singing and performing, skillfully utilizing false voice conversion techniques. Her singing not only preserves the musical characteristics of Guangdong Han Opera but also draws on singing techniques from other drama genres. She focuses on conveying emotions through sound, interpreting the character’s inner world with loud and powerful singing, allowing the audience to experience a richer

auditory sensation.

The traditional aesthetic characteristics of Guangdong Han Opera are fully exhibited through the Dan role's stage performances^[11]. Guangdong Han Opera actors vividly portray the characters' personality traits and emotional states through dynamic body language and diverse facial expressions. For example, Li Xianhua's portrayal of Hong Fenlian, a virtuous and filial daughter who fell into prostitution due to her humble birth and reliance on her father for survival, in the play "Bao Gong and Niu Niu", fully demonstrates the heroine's multiple personalities, successfully creating another typical and elegant ancient female character^[12].

3.2.2. An important carrier for the inheritance and innovation of Guangdong Han Opera

The Dan role, as a crucial component of Guangdong Han Opera, serves as the core link for its inheritance and innovation. Typically, Guangdong Han Opera actors pass down traditional skills and artistic styles through intergenerational transmission. For instance, in her artistic career, Li Xianhua not only inherited the performance characteristics of her mentor Liang Suzhen but also incorporated modern musical elements and stage technology innovations into her performances, giving new vitality to the Dan role. In the Guangdong Han Opera film "Jin Lian", Li Xianhua's portrayal of Pan Jinlian breaks through traditional moral constraints, redefining the character with complex psychological layers and a unique female perspective, showcasing the diverse possibilities of the Dan role in Guangdong Han Opera.

Additionally, the inheritance of the Dan role in the Guangdong Han Opera is reflected in the training and guidance of young actors. As a national intangible cultural heritage inheritor, Li Xianhua ensures the intergenerational continuation of the Dan role in Guangdong Han Opera through the cultivation of outstanding actors such as Huang Lihua, Ji Bing, Guan Leying, Liao Yaming, and Xu Shangmei. These young actors inject new vitality into the Dan role of Guangdong Han Opera by continuously innovating based on inheriting traditional skills.

3.2.3. A bridge to enhance emotional resonance with the audience

The Dan role plays a significant role in emotional communication with the audience in Guangdong Han Opera. Through the delicate display of female characters' emotions, the Dan role can evoke emotional resonance in the audience, thereby enhancing their understanding and identification with traditional Chinese culture. For example, in the representative new repertoire of Guangdong Han Opera, "Butterfly Dream", Li Xianhua skillfully portrays two distinct characters, the young woman fanning the grave and Tian Shi, not only showcasing the characters' emotional conflicts but also deepening the audience's appreciation for the artistic expressiveness of Guangdong Han Opera.

The dissemination of the Dan role in Guangdong Han Opera is not limited to the Lingnan region of China but has also become an important bond for forging a sense of community among the Chinese people through overseas dissemination. During the overseas dissemination of the Guangdong Han Opera in Mauritius, the Dan role has become a widely popular segment among overseas audiences due to its delicate emotional expression and elegant performance style. Through overseas theater performances and exchange activities, Guangdong Han Opera has established cultural connections in overseas Chinese communities, laying a foundation for its dissemination and development on the international cultural stage.

3.2.4. Reflecting the diversity of Lingnan culture

The singing style and performance style of the Dan role integrate elements of Central Plains Han culture, Hakka culture, and Lingnan local culture, exhibiting the characteristics of multicultural intersection. For instance, in music, the

singing style of the Dan role in Guangdong Han Opera combines the rhythm of Central Plains operas with the liveliness of Lingnan folk tunes, making the artistic expression of Guangdong Han Opera more distinctive. In terms of performance, the Dan role focuses on both the stylized movements of traditional operas and incorporates the unique delicacy and elegance of Lingnan culture, showcasing its unique cultural charm.

In conclusion, the Dan role, as an essential component of Guangdong Han Opera, is not only a significant embodiment of theatrical performance art but also plays a central role in cultural inheritance, emotional communication, and artistic innovation. Studying the Dan role in the Guangdong Han Opera can deepen our understanding of traditional theatrical art aesthetics and provide valuable references for the protection and inheritance of Lingnan culture. As a treasure of Lingnan culture, the Dan role possesses profound academic research and practical application value.

4. The artistic career and performance characteristics of representative inheritor Li Xianhua

4.1. Li Xianhua's artistic growth journey

Li Xianhua, the representative inheritor of Guangdong Han Opera (Dan role), is known as the founder of the "Xian Style" and is a recipient of the "Double Mei Flower Award" in Chinese drama. She is also a provincial-level representative inheritor of Guangdong Han Opera, a national intangible cultural heritage. Her artistic career began in a family full of dramatic atmosphere. Under the guidance of her mother, she came into contact with and studied Guangdong Han Opera from a young age, demonstrating extraordinary artistic talent.

In 1973, at the age of only 11, Li Xianhua stood out in fierce competition and was admitted as a student to the Han Opera class at the Meizhou Regional Drama School. There, she received systematic professional training in the Guangdong Han Opera, laying a solid foundation for her performance. After completing her studies, she joined the Guangdong Han Opera Theater and studied under the famous Dan actor Liang Suzhen. Liang Suzhen, the second-generation main Dan role of the Guangdong Han Opera, played a significant guiding role in Li Xianhua's artistic growth with her delicate performances and proficient skills.

Li Xianhua's early representative works include playing Chai Junzhu in "Zhuangyuan Mei" and successfully rescuing the scene in "Lin Zhao de and Wang Jin'ai", demonstrating her deep understanding of the characters and proficient mastery of singing and performance skills. In "Hua Deng An", her portrayal of Chen Caifeng injected new vitality into the Dan performance of the Guangdong Han Opera with her crisp and lively voice and delicate emotional expression. Later, she won the first prize for performance at the Second Guangdong Provincial Arts Festival for her portrayal of the filial daughter Hong Fenlian in "Bao Gong and Niu Niu."

In 1991, to further enhance her artistic attainments, Li Xianhua went to study at the China Drama Academy during her pregnancy. This eight-year learning experience allowed her to encounter more traditional drama genres and expression techniques. Especially under the influence of Peking Opera and Kunqu Opera, her performance skills and artistic style were further enriched and expanded. During this period, she not only consolidated her understanding of Guangdong Han Opera but also tried to incorporate the essence of different art forms into the performance of Guangdong Han Opera, laying a solid foundation for her future artistic innovation.

4.2. Performance skills: Singing innovation and stage performance

Li Xianhua's singing skills are known for their innovation and expressiveness. Based on inheriting the traditional vocal style of Guangdong Han Opera, she attempts to innovate by switching between true and false voices and diversifying rhythmic changes, making the singing more emotionally tense and artistically appealing. For example, when

portraying the filial daughter Hong Fenlian in “Bao Gong and Niu Niu”, she skillfully switched between true and false voices, vividly expressing the character’s innocence and subtle changes in inner emotions. She focuses on the fit between sound and emotion in her singing design, allowing the audience to directly feel the character’s inner world through unique timbre and rhythm.

In terms of performance, Li Xianhua emphasizes combining traditional stylized movements with modern stage performance. Every movement and expression on stage has been carefully considered to ensure an accurate portrayal of the character’s image. For instance, when portraying Tian Shi in “Butterfly Dream”, she successfully crafted an elegant and dignified yet enduring female image through delicate body movements and precise expression management. Additionally, Li Xianhua explores new musical expressions in the Guangdong Han Opera. In some repertoires, she incorporates modern musical elements and bel canto, enriching the singing of the Guangdong Han Opera. For example, in the 2024 Guangdong Han Opera film “Jin Lian”, she combines traditional singing with bel canto, giving the character unique artistic charm through redesigned tones and rhythms. This innovation not only expands the dissemination scope of Guangdong Han Opera but also attracts more young audiences.

4.3. Analysis of representative repertoires of Guangdong Han Opera Dan role

4.3.1. “Bao Gong and Niu Niu”

“Bao Gong and Niu Niu” is an important representative work in Li Xianhua’s artistic career. Her portrayal of Hong Fenlian in the play, with lively performances and superb singing skills, shapes a classic character full of emotional tension. She focuses on emotional expression in her singing design, exhibiting delicate emotions through the conversion of true and false voices and rhythmic changes. Simultaneously, her body movements are highly infectious, vividly presenting the character’s personality traits through precise actions and expressions.

4.3.2. “Jin Lian”

“Jin Lian” represents Li Xianhua’s significant exploration of artistic innovation. This Guangdong Han Opera film is based on the image of Pan Jinlian from the Chinese classical masterpiece “Jin Ping Mei”, but it breaks through the traditional drama’s simplistic interpretation of Pan Jinlian’s image in character portrayal. Li Xianhua delicately portrays Pan Jinlian’s complex human characteristics and diversified emotional expressions through psychological layers. In her singing design, she incorporates modern bel canto elements, making the character’s inner world more vivid through music. Meanwhile, she adds modern lighting and prop designs to the stage performance, enhancing the drama’s visual impact and emotional appeal. This play not only successfully attracts young audiences but also provides a successful example of the modernization of the Guangdong Han Opera.

4.3.3. “Butterfly Dream”

“Butterfly Dream” is one of Li Xianhua’s most representative repertoires. In this play, she portrays two distinctly different characters simultaneously: a clever and lively young woman and a dignified and elegant Tian Shi. Through delicate portrayals of these two characters, Li Xianhua demonstrates her deep understanding of Dan’s performance and precise grasp of the character’s inner world. In her singing performance, she focuses on expressing the character’s emotional transitions through tone and rhythm changes. In terms of performance skills, she successfully portrays two distinct yet realistic characters through flexible body movements and expression changes. This play not only showcases Li Xianhua’s artistic attainments but also reflects the significant potential of the Guangdong Han Opera (Dan role) in emotional expression and artistic innovation.

Li Xianhua's artistic career and performance characteristics primarily focus on the inheritance and innovation of the Guangdong Han Opera (Dan role). Through in-depth research on traditional skills and new attempts at modern artistic elements, she has not only shaped a series of classic characters but also provided important references for the future development of Guangdong Han Opera. Her artistic achievements are not only a personal resume but also a model for Guangdong Han Opera (Dan role).

5. The inheritance and development of Guangdong Han Opera

5.1. Li Xianhua's role in the inheritance of Guangdong Han Opera

Li Xianhua has long been committed to the inheritance and innovation of Guangdong Han Opera. Her artistic career has not only accumulated rich artistic experience for the Dan role of Guangdong Han Opera but also laid a foundation for its inheritance and development.

With over 50 years in the art, Li Xianhua injected new vitality into Guangdong Han Opera in the 1970s through her skilled performance and innovative spirit. As a representative inheritor, she is well aware of the responsibility to protect and pass on traditional culture. She not only showcases the charm of Guangdong Han Opera (Dan role) through her own stage performances but also promotes its dissemination among different social groups through diverse forms. For example, by participating in national and provincial art exhibitions and other activities, she has brought the Guangdong Han Opera to a wider audience. Especially in overseas cultural exchanges, artists such as Li Xianhua, Yang Xiuwei, Xie Renchang, Zhang Guangwu, Zhong Lijun, Li Huanxia, Huang Lihua, Ji Bing, and Guan Leying made multiple visits to Europe, America, Southeast Asia, and other regions in the 1990s, contributing to the international promotion of Guangdong Han Opera.

Li Xianhua's inheritance work is also reflected in the restoration and innovation of repertoires and skills. For instance, she successfully restored the "pole-carrying skill" in the repertoire "Yin Yang He" and, through careful research on traditional singing and movement patterns, ensured the continuation of many classic Dan role skills of Guangdong Han Opera. She also innovated based on this, making it more suitable for the aesthetic needs of contemporary audiences.

In the process of inheritance, Li Xianhua pays special attention to cultivating a new generation of Dan role actors. She believes that inheritance lies not only in the continuation of technology but also in the understanding and recognition of artistic spirit and cultural values. Through meticulous guidance and patient teaching, she has trained a group of outstanding young actors for the Guangdong Han Opera. Based on inheriting traditional skills, these actors further enrich the expressive forms of the Guangdong Han Opera (Dan role) through innovative practices.

5.2. Innovative practices of the Dan role in the new era

In the early 20th century, the Guangdong Han Opera (Dan role) faced the dual challenges of inheritance and development. To adapt to the aesthetic needs of contemporary audiences, Li Xianhua carried out artistic innovation based on traditional skills. Her innovative practices are mainly reflected in singing design, stage performance, and the application of modern technology.

5.2.1. Singing innovation

Li Xianhua incorporates modern musical elements into her singing design, such as adding bel canto techniques, making the singing more layered and artistically appealing. Through the conversion of true and false voices and the diversification of timbres, she enriches the expressive form of the Dan role singing. For example, in the Guangdong Han

Opera film “Jin Lian”, she enhances the character’s emotional expressiveness by redesigning the rhythm and melody of the singing. This innovation not only preserves the traditional charm of Guangdong Han Opera (Dan role) but also brings it closer to the aesthetic needs of contemporary audiences.

5.2.2. Stage performance innovation

In terms of stage performance, Li Xianhua enhances the visual impact of the Guangdong Han Opera (Dan role) through innovative use of props, lighting, and costumes. For instance, in “Changing Faces to Fight the Father”, she combines traditional skills like chair work and feather work with modern stage design, making the character more three-dimensional and vivid.

5.2.3. Crossover cooperation

With the development of multiculturalism, Li Xianhua also attempts to promote Guangdong Han Opera through crossover films. For example, she has participated in the filming of multiple Guangdong Han Opera drama films, bringing the art form to a broader audience through the medium of film.

5.2.4. Guangdong Han Opera repertoire innovation

Li Xianhua actively explores innovations in Guangdong Han Opera repertoires. For example, she invested in the creation and adaptation of “Bai Men Liu” and its sequel “Zhang Tai Qing Liu”, enriching the emotional clues and storylines of the characters to make the repertoires more aligned with the aesthetic needs of contemporary audiences. This innovative practice not only injects new vitality into Guangdong Han Opera but also demonstrates the potential for the integration of traditional art and modern culture.

5.2.5. Young actor training and succession mechanisms in Guangdong Han Opera

Li Xianhua views the training of young actors as a crucial task for the inheritance of the Guangdong Han Opera. In her view, young actors are not only the hope for the future development of Guangdong Han Opera but also the key to the continuation of the Dan role. Therefore, she focuses on comprehensive training for young actors from both technical and artistic perspectives.

5.2.6. Technical training

On the technical level, Li Xianhua emphasizes rigorous training in basic skills for young actors, including singing, posture, recitation, and movement patterns. In teaching, she stresses the refinement and standardization of skills, requiring each young actor to solidly grasp the core skills of the Guangdong Han Opera. For instance, in the Dan role teaching, she particularly emphasizes the use of true and false voices and timbre changes, expecting students to exhibit rich emotional layers in their singing performances. Additionally, through demonstration performances and detailed explanations, she imparts complex Dan role movement patterns to students, helping them master key techniques.

5.2.7. Artistic training

On the artistic level, Li Xianhua focuses on cultivating young actors’ ability to understand characters and artistic expressiveness. Through analyzing the plot and character personalities, she guides students to deeply explore the emotional clues of characters and learn to convey their inner worlds through body language and expressions. She emphasizes that actors need to “lead sound with emotion and emotion with sound”, enhancing the artistic appeal of their

performances through the fusion of sound and emotion.

5.2.8. Practical opportunities and stage guidance

Li Xianhua provides many practical opportunities for young actors to hone their skills in actual performances. For example, she leads students to participate in provincial and national opera exhibitions, creating chances for them to showcase their talents on large stages. During stage guidance, she helps students identify and improve issues in their performances through on-site corrections and post-performance summaries. Furthermore, she encourages students to bravely experiment on stage, integrating their personal artistic styles into the Dan role performances to form unique performance styles.

5.2.9. Construction of succession mechanisms

To ensure the intergenerational inheritance of the Guangdong Han Opera, Li Xianhua also actively promotes the construction of succession mechanisms. For instance, she has established a dedicated training class within the Guangdong Han Opera Theater to systematically cultivate young actors. Simultaneously, she collaborates with local governments and cultural institutions through non-heritage inheritor programs and drama-in-school activities, aiming to spread the artistic charm of the Guangdong Han Opera to a broader social group.

5.2.10. Effectiveness and impact

The group of young actors trained by Li Xianhua has injected new vitality into the Dan role of Guangdong Han Opera. Outstanding actors like Huang Lihua and Ji Bing have won multiple awards at provincial art festivals, becoming important successors of the Dan role in Guangdong Han Opera. These young actors not only inherit Li Xianhua's artistic style but also incorporate their own innovative elements into their performances, further promoting the development of the Dan role in Guangdong Han Opera.

In summary, Li Xianhua plays a significant role in the inheritance and development of the Dan role in Guangdong Han Opera. Thanks to Li Xianhua's promotion and dissemination, Guangdong Han Opera has not only continued the protection of traditional skills but has also expanded its influence. Her inheritance practices provide a classic example of the protection and innovation of other drama arts, laying a solid foundation for the future development of the Dan role in Guangdong Han Opera.

6. Challenges and prospects of modern Guangdong Han Opera (Dan role)

6.1. Dilemmas of cultural globalization and the survival of traditional arts

Driven by the wave of globalization, cultural diversity and local characteristics are facing increasingly severe challenges. Guangdong Han Opera, as a representative of traditional theater in the Lingnan region, is confronted with multiple difficulties in its survival in modern society.

6.1.1. Audience gap and market reduction

Cultural globalization has brought diversification in modern forms of entertainment, with movies, television, and streaming media becoming the primary cultural consumption methods for contemporary people. In contrast, the audience for traditional operas like Guangdong Han Opera has shrunk, especially among the new younger generation, where the appeal of traditional arts has significantly declined. The Dan role, as an essential part of Guangdong Han Opera, relies on a stable audience base for its inheritance and development. However, in the current cultural market,

the performance opportunities and commercial value of traditional operas need to be improved. Therefore, the key issues that need to be addressed are how to effectively interact with the new generation of young audiences, establish stable links, increase performance opportunities each year, and continuously disseminate and promote it on a larger scale.

6.1.2. Weakening of the inheritance mechanism

The inheritance of the Guangdong Han Opera mainly relies on the apprenticeship system and family inheritance model. However, with changes in the socio-economic structure, more and more young people prefer to leave their hometowns to work outside and pursue other professions. This phenomenon can limit the selection of intergenerational inheritors of the Guangdong Han Opera.

6.1.3. Weakening of cultural identity

The cultural exchange brought about by globalization has gradually diluted the uniqueness of local cultures. Guangdong Han Opera, as an important carrier of Lingnan culture, has seen a gradual weakening of its cultural identity among the younger generation. Some audiences tend to embrace cultural products with universal appeal and global influence, showing significantly reduced interest in traditional arts. This weakening of cultural identity can affect the influence of Guangdong Han Opera.

6.2. New paths for art dissemination through digital technology

Despite the aforementioned difficulties, the rapid development of digital technology provides new possibilities for the dissemination and innovation of Guangdong Han Opera. By utilizing digital technology, Guangdong Han Opera can break through the limitations of traditional stage performances and reach a broader dissemination space.

6.2.1. Practice of dramatic visualization

Currently, the dissemination and promotion of Guangdong Han Opera are no longer confined to the stage. Through cross-boundary filming of opera movies and the production of video resources, this traditional art form can be disseminated to a wider audience. For instance, Li Xianhua's involvement in Guangdong Han Opera films like "Jinlian", "Baimenliu", and "Hudie Meng" not only conveys the traditional skills of Guangdong Han Opera but also enhances its expressiveness through imaging technology. This visualization practice not only helps preserve the classic repertoires of Guangdong Han Opera but also attracts the attention of more young audience.

6.2.2. Online education and opera promotion

The application of digital technology can open up new channels for the education and promotion of Guangdong Han Opera. For example, through online courses and live streaming platforms, the teaching content of the Guangdong Han Opera can be conveyed to a global audience. Guangdong Han Opera teachers and actors can disassemble opera excerpts, singing styles, and movements of various roles step by step through online teaching methods, helping students intuitively understand Guangdong Han Opera culture. This online education model not only overcomes geographical limitations but also improves the efficiency of Guangdong Han Opera's external dissemination.

6.2.3. Application of virtual reality and augmented reality

Virtual Reality (VR) and Augmented Reality (AR) technologies will provide innovative ways to display traditional arts. For instance, VR technology can offer an immersive theatrical experience for the audience, allowing them to feel

the stage charm of the Guangdong Han Opera. Through AR technology, the audience can interact with Guangdong Han Opera performers, enhancing the fun and appeal of Guangdong Han Opera. The application of digital technology will not only expand the expressive forms of Guangdong Han Opera but also attract more young audiences to this traditional art.

6.2.4. Digital archives and data analysis

Digital technology can be used to establish digital archives for Guangdong Han Opera. By digitally preserving classic repertoires, singing styles, movements, and performance videos of the Guangdong Han Opera, important resources can be provided for its research and dissemination. Additionally, through big data analysis, the needs and preferences of audiences from different regions can be better understood, providing data support for the external dissemination and development of Guangdong Han Opera. For example, analyzing the interactive behaviors of young audiences on social media can help the Guangdong Han Opera Inheritance Research Institute design new repertoires that better align with contemporary aesthetics.

6.3. Potential of Guangdong Han Opera in international dissemination

As a representative art form of Lingnan culture, Guangdong Han Opera has significant dissemination potential in international cultural exchanges. In recent years, with the advancement of cultural diplomacy and the “Belt and Road” initiative, the influence of the Guangdong Han Opera on the international stage has gradually expanded.

6.3.1. Cultural bond in overseas Chinese communities

Guangdong Han Opera has a long history of dissemination in regions like Southeast Asia and has a certain audience base among overseas Chinese communities. It not only maintains the cultural identity of overseas Chinese Hakka communities but also strengthens the overseas dissemination of the Chinese national community consciousness.

6.3.2. Window for international cultural exchanges

Guangdong Han Opera inheritors like Li Xianhua have made multiple performances in Southeast Asia, Europe, and other places, making significant contributions to the overseas dissemination of Guangdong Han Opera. In these overseas cultural exchange activities, they have successfully attracted audiences from different cultural backgrounds with their delicate performances and unique artistic styles. For instance, repertoires like “Hudie Meng” and “Jinlian” have touched many overseas audiences through vivid characters and emotional plots, earning Guangdong Han Opera a wide international reputation.

6.3.3. Challenges and countermeasures in cross-cultural dissemination

Although Guangdong Han Opera has a certain influence in overseas Chinese (Hakka) communities, expanding its international influence requires considering how to attract the attention and interest of an international audience. Overseas cross-cultural dissemination faces challenges such as language and cultural backgrounds. For example, the language barrier in the Guangdong Han Opera may affect the international audience’s understanding of the plot and characters. To address this, methods like subtitle translation, multilingual commentary, and background knowledge introduction can be employed to help international audiences better understand the cultural connotation of Guangdong Han Opera and stimulate their interest in learning Chinese through it.

Furthermore, by collaborating with diverse international art forms, the expressive forms of Guangdong Han Opera can be expanded. For instance, combining Guangdong Han Opera with modern dance, musicals, and other forms

while preserving its traditional characteristics can enhance its cross-cultural appeal. Such innovation will not only enrich the diverse expressiveness of the Guangdong Han Opera but also attract more attention to it in international cultural exchanges.

7. Summary

Guangdong Han Opera is an important representative of Lingnan culture, and its inheritance and innovation reflect the continuous development of intangible cultural heritage. By analyzing the fifty-year artistic practice of Li Xianhua, a representative inheritor, this study explores multiple paths for the inheritance, innovation, and dissemination of the Guangdong Han Opera (Dan Role). Li Xianhua demonstrates the core value of Guangdong Han Opera's inheritance through her artistic career. She not only inherits traditional skills but also makes a series of innovations in singing style design, character shaping, and stage performance, giving Guangdong Han Opera a contemporary form of expression. Simultaneously, she combines modern education with the traditional apprenticeship system to establish a systematic inheritance mechanism and continue the intergenerational inheritance of Guangdong Han Opera through the training of young actors.

The study also finds that digital technology provides new opportunities for the dissemination of the Guangdong Han Opera (Dan role). From drama visualization to online teaching and the application of virtual reality technology, Guangdong Han Opera will gradually break through geographical and temporal limitations, attracting the attention of more young audiences. Furthermore, Guangdong Han Opera inheritors like Li Xianhua promote the overseas dissemination and promotion of Guangdong Han Opera in international exchanges, further enhancing the global influence of Lingnan culture. The case study reveals the vitality of the Guangdong Han Opera (Dan role) in the contemporary cultural context and clarifies the importance of its inheritance and innovation. In the future, while preserving its traditional characteristics, Guangdong Han Opera will further integrate contemporary aesthetics and digital technology development, moving towards a broader cross-cultural dissemination space and promoting the revival and overseas development of traditional Chinese culture.

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The Dilemma and Outlet of Higher Education Management Research

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Abstract: Under the background of continuous deepening of domestic education reform, higher education management research is facing many challenges. Based on this, this paper explores the development process of China's higher education, reveals the problems existing in the current management process of China's higher education, such as concept deviation, system and mechanism ossification, and then finds a way out from the aspects of concept innovation, system optimization, team construction, etc., to promote the development of higher education management research, improve the quality of higher education, enhance the strength of China's higher education in the international competition, and provide strong support for the cultivation of high-quality talents needed by the times.

Keywords: Higher education management; Development history; Predicament; Way out

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1. Introduction

As an important part of the national innovation system, higher education plays an important role in personnel training, scientific research, and social services. With the acceleration of global economic integration and scientific and technological revolution, the development environment of higher education has changed greatly. In this context, it is very necessary to explore the dilemma and outlet of higher education management research. On the one hand, the traditional management mode of higher education has exposed many shortcomings in the process of dealing with new challenges, such as low management efficiency, unreasonable resource allocation, and other problems that are increasingly apparent. On the other hand, with the continuous improvement of the quality and innovation ability of higher education, educators must re-examine the direction and methods of management research. The study of these problems can promote the reform and innovation of higher education management and realize sustainable development.

2. The development of higher education in China

The development of higher education in China has gone through several important stages, each of which is closely related to the social background at that time and has different development tracks. In ancient times, the main body of higher education was government schools and private schools, such as the imperial college and academy of classical learning, which focused on Confucian classics to cultivate talents for feudal rule. Its educational philosophy is to attach importance to moral cultivation and practical application, and its teaching methods are mostly teaching, reading, and discussion.

In modern times, with the aggravation of the national crisis caused by the invasion of foreign powers, China began to introduce the Western education system and set up new schools. The establishment of the Beiyang public school in 1895 and the Capital University in 1898 marked the beginning of modern higher education. These schools introduced Western natural science and social science courses, adopted new teaching and management modes, and started the modernization process of higher education.

After the founding of the people's Republic of China, under the planned economic system, the state implemented unified planning and management of higher education, set up many industry-oriented professional colleges and universities, focused on cultivating professional and technical talents, and closely focused on the needs of the country's industrialization construction, laying the foundation for economic development.

After the reform and opening up, the resumption of the college entrance examination has restored the normal operation of higher education. Since then, higher education has been continuously reformed, expanding the autonomy of colleges and universities, adjusting specialty settings, and strengthening international exchanges and cooperation. The implementation of the "211 Project" and "985 Project" has improved the overall level of higher education in China.

In the new era, higher education has gradually shifted from elitism to popularization. Driven by the "double first-class" construction strategy, educators will pay more attention to connotative development and focus on cultivating students' innovation, practice, and comprehensive quality. With the wide application of new technologies such as the Internet and artificial intelligence, the online and offline integrated teaching mode has been promoted, which has brought new opportunities and challenges to higher education ^[1].

3. The main difficulties faced by China's higher education management

3.1. The management concept is out of touch with the development of the times

In today's rapidly changing era, some university management concepts have not kept pace with the times. First of all, in terms of professional planning, it failed to connect the dynamic changes of industrial change and market demand accurately. The demand for interdisciplinary talents in emerging industries surged, but colleges and universities failed to adjust the professional curriculum in time, resulting in the disconnection between the students' knowledge and skills and the actual work. The second is teaching management. The previous "one-way indoctrination" mode still exists, ignoring students' independent exploration needs in the learning process. At the same time, in the course arrangement, the proportion of practical teaching is insufficient, which makes it difficult to meet the needs of students to improve their practical ability.

Finally, in terms of international exchanges, some universities only regard international cooperation as a short-term task, lacking long-term strategic planning. The introduction of international cutting-edge education concepts and teaching methods is not systematic, and it is difficult to integrate them into the school's teaching system, missing the opportunity to use international resources to improve the quality of education.

3.2. The management system lacks flexibility and coordination

At present, the management system of higher education is rigid. First, the internal management structure of colleges and universities is complex, and multi-level management leads to slow information transmission and lengthy decision-making processes. Second, the definition of responsibilities between different departments is vague, and the phenomenon of buck-passing often occurs when encountering cross-department affairs, which reduces the management efficiency. Third, in terms of personnel management, teachers' career development path is limited by fixed assessment standards and promotion rules. The evaluation method of emphasizing the quantity of scientific research achievements and ignoring the teaching quality and actual contribution makes teachers devote a lot of energy to the publication of papers, which affects the teaching investment. At the same time, the phenomenon of seniority restricts the growth space of young teachers.

Fourth, the resource allocation mechanism lacks a scientific basis. Most of the resources are allocated by administrative instructions, and the development potential and actual needs of the discipline are not fully considered. The resources of popular specialties and key disciplines are accumulated, while the resources of emerging interdisciplinary disciplines are scarce. In addition, the collaborative cooperation between colleges and universities and the outside world is superficial, and the industry university research cooperation is mostly short-term projects, lacking in-depth integration, which is difficult to form a strong joint force to promote the development of education.

3.3. There are shortcomings in the construction of teaching staff

First, the knowledge structure of some university teachers is aging and cannot keep up with the development of the frontier of disciplines. In terms of teaching methods, they still rely on traditional lecture teaching and lack the application of new methods such as case teaching and project-based learning. This is due to the lack of close ties with the industry and the lack of practical experience of teachers. Therefore, educators integrated actual cases into teaching.

Second, the channels of teachers' professional development are narrow and lack diversified promotion paths. The school's incentive mechanism for teachers focuses on material rewards but does not pay enough attention to their sense of professional achievement and academic reputation. This leads to a lack of motivation for teachers' work and a serious setback in their enthusiasm for innovation.

Third, in the process of talent introduction, colleges and universities follow the trend, blindly introduce highly educated talents, and fail to fully consider the compatibility of talents with the university's discipline characteristics and development strategy. After the introduction, the lack of supporting training and support system makes it difficult for talents to give full play to their maximum efficiency, resulting in a waste of talent resources.

3.4. Imperfect teaching quality assurance system

The loopholes in the teaching quality assurance system in colleges and universities have existed for a long time. The monitoring of the teaching process lacks a proper and dynamic process, and it is mostly regular inspection, which cannot find and solve problems in time. The quality control of online teaching, practical teaching, and other emerging teaching forms is insufficient.

At the same time, the teaching quality evaluation system is not scientific and comprehensive, students' evaluation of teaching is vulnerable to subjective factors, and peer evaluation and leadership evaluation are not deep and professional. The evaluation index does not reflect the characteristics of different disciplines and courses, and the evaluation results cannot reflect the teaching quality.

The feedback and application mechanism of evaluation results is also not perfect, and it is difficult for teachers

to get effective suggestions for improvement from the evaluation. In addition, there are great differences in teaching quality evaluation standards among colleges and universities, and there is no universality and comparability, which is not conducive to mutual learning and common improvement among colleges and universities. This makes the improvement of teaching quality lack external reference and motivation.

3.5. Management needs lag behind information construction

At present, although the informatization construction in colleges and universities has made some progress, it still cannot meet more and more management needs. This is mainly due to the lag in the construction of network infrastructure in some colleges and universities and the lack of network bandwidth, which affects the smooth broadcasting of online teaching resources and the development of large-scale online examinations.

At the same time, the education management information system has its own way; the data is stored dispersedly, the format is not unified, and the data integration is difficult. For example, student information is entered repeatedly in different department systems, and the data is inconsistent, which brings great inconvenience to the management work.

Finally, the ability of teachers and managers to apply information technology is uneven. Some people only use information technology for simple data recording and document processing and fail to make full use of big data analysis, artificial intelligence decision-making, and other functions to strengthen management efficiency and accuracy. This limits the role of informatization in optimizing the educational management process and innovating the management mode ^[2].

4. The trend and outlet of higher education management research

4.1. Innovate the management concept and conform to the development trend of the times

The innovation of the management concept is the key to promoting the development of higher education. Therefore, colleges and universities should establish the management concept of student-centered, market-oriented, and international vision. Taking students as the center requires colleges and universities to pay attention to students' individual differences and comprehensive development and provide diversified educational services and support. For example, according to students' interests and abilities, educators should formulate personalized learning plans, provide rich elective courses and practice opportunities, and cultivate students' innovative thinking and practical ability.

The market-oriented management concept urges colleges and universities to pay close attention to the market demand and industry dynamics, and timely adjust the professional settings and curriculum content; Establish a dynamic adjustment mechanism for majors, regularly assess the market demand and employment prospects of majors, increase investment in majors with strong demand, and adjust or cancel majors with employment difficulties. At the same time, educators should strengthen cooperation with enterprises and invite enterprises to participate in the course design and teaching process so that students' knowledge can be closely combined with actual work needs.

The international perspective requires universities to actively carry out international exchanges and cooperation and introduce foreign advanced educational concepts and teaching resources. Encourage teachers and students to participate in international academic exchange activities, carry out joint training programs and exchange student programs with foreign universities, broaden the international vision of teachers and students, and enhance the international influence of universities ^[3].

4.2. Optimize the management system, enhance management efficiency and vitality

Optimizing the management system is an important guarantee for improving management efficiency and quality. First, within colleges and universities, educators should promote the simplification and optimization of management institutions, clarify the responsibilities and authorities of various departments, and build a collaborative and efficient management mechanism. For example, by establishing a cross-departmental working group or project team, educators can break down departmental barriers and improve work efficiency. In terms of personnel management, educators should improve the teacher evaluation and incentive mechanism, establish a diversified teacher evaluation system, comprehensively consider teachers' teaching quality, scientific research achievements, social services, etc., and stimulate teachers' enthusiasm and creativity.

Second, outside colleges and universities, the government should further transform its functions and implement the autonomy of colleges and universities. Reduce the direct intervention in colleges and universities, and guide the healthy development of colleges and universities through the formulation of policies and regulations, financial support, quality assessment, and other means. At the same time, the government should build a bridge between colleges and universities and society, promote the cooperation between colleges and universities and enterprises, scientific research institutes, etc., and create a good external environment for the development of colleges and universities. At the same time, the local government should strengthen the overall management of colleges and universities, guide the rational positioning of colleges and universities, optimize the allocation of resources, and improve the ability of colleges and universities to serve the locals according to the needs of local economic and social development.

4.3. Strengthen the construction of teaching staff and improve the quality of teachers

Strengthening the construction of teaching staff is the center of improving the quality of higher education. On the one hand, colleges and universities should improve the construction of teacher training and development systems and provide teachers with a variety of training opportunities. For example, teachers are often organized to participate in teaching method training, academic frontier lectures, enterprise practice exercises, etc., to improve their teaching ability and professional quality. At the same time, teachers are encouraged to research and reform teaching, and excellent teaching achievements are rewarded and supported.

On the other hand, educators should improve the incentive mechanism for teachers, paying more attention not just to teachers' professional development and spiritual needs but also their material rewards. Through the establishment of honorary titles such as famous teacher award and outstanding contribution award in scientific research, outstanding teachers are commended and publicized to enhance teachers' sense of professional honor and achievement, provide more promotion opportunities and development space for teachers, and encourage teachers to keep forging ahead in teaching, scientific research and social services.

In terms of talent introduction, colleges and universities should formulate a scientific and reasonable talent introduction plan in combination with their own development strategy. Educators should not only pay attention to the introduction of high-level talents with innovative ability and practical experience but also take into account the discipline background and team cooperation ability of talents to ensure the quality and efficiency of talent introduction. After the introduction of talents, it is necessary to provide them with good working and living conditions, build a development platform, and enable them to enter the school as soon as possible to maximize their efficiency.

4.4. Improve the teaching quality assurance system and promote the steady improvement of education quality

First of all, colleges and universities should establish a whole process and all-around teaching quality monitoring mechanism to carry out strict quality monitoring from the formulation of teaching plans, the implementation of courses, practical teaching to examination and evaluation. For example, educators should formulate a teaching quality supervision system and organize experts to regularly inspect and evaluate the teaching process. The use of information technology means, such as real-time monitoring and analysis of teaching data, allows for the timely discovery of existing problems to take improvement measures.

Secondly, establishing a scientific and reasonable teaching quality evaluation system to evaluate the teaching quality scientifically and reasonably is the key to accurately evaluating the teaching quality. The evaluation system should include students' learning effect, teachers' teaching quality, curriculum rationality, and other aspects, and ensure the objectivity and fairness of the evaluation results through student evaluation, peer evaluation, expert evaluation, employer evaluation, and other evaluation methods. At the same time, according to the characteristics of disciplines and specialties, different evaluation indexes are formulated to enhance the pertinence and effectiveness of the evaluation.

Finally, educators should strengthen the feedback and application of teaching quality evaluation results, link the evaluation results with teachers' performance appraisal, professional title evaluation, post promotion, etc., and encourage teachers to continuously improve teaching. For the problems found in the evaluation, teachers should be organized to conduct training and learning in time to help teachers improve their teaching level. In addition, the tracking mechanism of teaching quality improvement should be established to continuously track and evaluate the implementation effect of improvement measures to ensure the continuous improvement of teaching quality.

4.5. Strengthen information construction and help modernize education management

Promoting the informatization construction of higher education is an inevitable choice to conform to the development of the times. In practice, colleges and universities should increase investment in information infrastructure, improve the stability and speed of campus network, and ensure the smooth development of online teaching and management; Build an integrated education management information platform, integrate teaching management, student management, scientific research management and other information systems, and realize the centralized management and sharing of data. This includes establishing a unified identity authentication system and data standards, breaking the information island, and improving management efficiency.

Strengthen the informatization training of teachers and managers and improve their information technology application ability. Set up special information training courses to help teachers master online teaching tools, teaching resource production software, etc., and improve the level of teaching information. Carry out training on information system operation and data analysis for managers so that they can skillfully use information means to make management decisions.

In addition, educators should use big data, artificial intelligence and other technologies to understand students' learning behavior and needs and implement personalized teaching through in-depth analysis of teaching data; Through the development of artificial intelligence technology, intelligent teaching aids, such as intelligent tutoring system and intelligent examination system, can improve the teaching quality and management efficiency. At the same time, educators should strengthen the monitoring and evaluation of the teaching process and quality using informatization to realize the accuracy and intelligence of education management ^[4].

5. Conclusion

To sum up, in the face of the challenges of globalization and the development of the times, China's higher education management must face up to the existing difficulties and make breakthroughs from the aspects of concept, system, teachers, quality assurance, and information construction. Only in this way can educators continuously improve the management level of higher education, help the good development of China's higher education, cultivate more innovative talents that meet the needs of the times for the society, occupy a more favorable position in the international higher education competition, and become a powerful country in higher education.

Disclosure statement

The authors declare no conflict of interest.

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The Innovation, Integration, and Development Path of AI Art in the Framework of Smart Cities

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Abstract: The deep integration of smart city construction and artificial intelligence technology provides technical support and cultural context for the innovative development of AI art. Through interdisciplinary research methods, this paper constructs a three-dimensional analysis framework of “technology empowerment-scene reconstruction-ecological collaboration” to systematically explore the integration mechanism and practical path of AI art in smart cities. The study found that AI art has reshaped the spatial narrative of urban public art through data-driven creation, algorithmic style transfer, and real-time interactive design. It demonstrates unique value in the revitalization of cultural heritage, citizen participatory creation, and industrial digital transformation. However, issues such as technical ethical controversies, data sovereignty games, and aesthetic paradigm shifts need to be urgently addressed. This study proposes a collaborative development path of “policy guidance-algorithm transparency-cultural embedding” to provide a theoretical reference for enhancing the humanistic value of smart cities.

Keywords: Smart city; AI art; Generative adversarial networks; Urban aesthetics; Technical ethics

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1. Introduction

In the process of deep integration of global urbanization and digital technology, smart cities have evolved from the stage of technical infrastructure to a new paradigm of humanistic value reconstruction. According to statistics from International Data Corporation (IDC), the global smart city market size will exceed US\$2.3 trillion in 2024, with 62% of investment flowing into cultural digital innovation. This trend marks a fundamental shift in urban development logic, from infrastructure efficiency optimization to human-centered meaning production. In this context, AI art, as a cutting-edge carrier of technical aesthetics, is reshaping the urban cultural ecology through data mapping and algorithm generation. Its integration with smart cities is not only about technological innovation but also involves deep-level changes in social relationships, cultural identity, and governance ethics. Current research presents an imbalance between “technology priority” and

“humanistic lag.” On the one hand, international academic circles focus on the technical implementation of AI art (such as GAN’s generative ability optimization) and short-term application effects (such as tourist participation in public spaces) but ignore its long-term social impact and cultural penetration effects. On the other hand, domestic research mostly stays at the level of macro value demonstration, lacking critical reflection on key issues such as local cultural adaptability and implicit control of algorithmic power. What is more alarming is that the existing theoretical framework generally splits the interactive relationship between “technology-space-humanities”, making it difficult to explain how AI art reconstructs the meaning network of urban space. For example, the London “Data Sculpture Park” project has verified the aesthetic value of real-time data visualization but has not touched on the potential impact of algorithmic narrative on citizens’ cognitive models. Similar domestic projects are mostly limited by departmental data barriers, leading to fragmented cultural expression ^[1].

2. Symbiotic logic of smart cities and AI art

As a product of digital transformation, the technical architecture of smart cities forms a deep symbiotic relationship with the innovative needs of AI art. From a technical perspective, the three core layers of smart cities—data layer, algorithm layer, and interaction layer—provide infrastructure support for AI art. The data layer collects real-time environmental data (such as traffic flow and air quality) and social data (such as citizen behavior trajectories and cultural consumption preferences) through the Internet of Things (IoT) in cities, building a dynamically updated art material library. For example, the “Digital Twin of the Bund” project in Shanghai synchronizes physical and virtual space data in real time through a 5G network, enabling the AI-generated Huangpu River light show to respond to tidal changes and tourist density. The algorithm layer is centered on Generative Adversarial Networks (GAN) and neural style transfer technology, breaking through the physical limitations of traditional artistic creation. The Stable Diffusion model can generate architectural design schemes that integrate urban context through semantic analysis. For example, in an AI-generated scheme for a landmark building in the Xiong’an New Area, the algorithm combines Han dynasty patterns with modern steel structures, realizing the digital translation of historical symbols. The interaction layer relies on Augmented Reality (AR) and Mixed Reality (MR) technologies to reconstruct the sensory experience of public spaces. The “Data Forest” installation at the Shenzhen Light and Shadow Art Season uses AR glasses to convert the walking speed of citizens into the growth rate of virtual plants, forming an immersive narrative of human-machine symbiosis. Meanwhile, the feedback effect of AI art on smart cities is reflected in two dimensions: cultural governance and space activation. In terms of cultural governance, the “Digital Nostalgia” program in Hangzhou uses AI to generate historical images of old neighborhoods, which are played in a loop on community screens, improving young residents’ awareness of urban changes by 37%. In terms of space activation, the dynamic lighting system in Singapore’s Marina Bay adjusts light color and brightness based on real-time pedestrian density, increasing the utilization rate of public spaces at night by 28%. This two-way empowerment mechanism reveals a core proposition: a smart city is not only a physical entity integrated by technology but also a network of meanings intertwined with algorithms and humanities ^[2].

3. Innovative integration practices of AI art

At the technical empowerment level, AI art has evolved from being an auxiliary tool to being an independent

creative subject. Generative design tools like Midjourney generate city landmark schemes through semantic analysis, with an iteration efficiency far exceeding traditional design processes. In the project of reconstructing the soundscape of Suzhou gardens, an AI system based on the LSTM network restores the courtyard sound effects of the Ming and Qing dynasties with 95% accuracy, including specific seasonal birdsongs and running water sounds, with an error rate controlled within 3%. The rise of algorithmic curation further expands the boundaries of art. The NFT art platform of Shanghai West Bund Art Museum utilizes blockchain technology to achieve work confirmation and automated accounting, with a single exhibition transaction volume exceeding 2 million yuan, verifying the commercial feasibility of technology empowerment. The innovation of application scenarios is reflected in the reconstruction of algorithmic narratives in public spaces. In the field of cultural heritage activation, the AI restoration project of the Dunhuang Research Institute uses the StyleCLIP algorithm to complement the defective parts of the wall paintings, extending the average daily stay of tourists in Mogao Cave 45 from 25 minutes to 35 minutes. In citizen participatory creation scenes, Shenzhen's "Everyone is an Artist" AR interactive wall receives over 5,000 citizen graffiti inputs daily. The AI system converts them into stylized wall paintings, with 23% of the works being included in the city's digital art library. Environmental perception art strengthens social responsibility through data visualization. New York's air quality dome installation converts PM2.5 concentration into gradual light colors, increasing community garbage classification participation by 19%. The reconstruction of the industrial ecology presents the characteristics of full-domain penetration of the value chain. In the upstream field, SenseTime and the Central Academy of Fine Arts have jointly developed a cultural heritage gene bank, using knowledge graph technology to correlate more than 100,000 cultural relic patterns, providing algorithmic support for cultural and creative product design. In the midstream link, Alibaba's "Luban" design system is open to small and medium-sized businesses through the API interface, and the click-through rate of its automatically generated e-commerce posters is 12% higher than manual design. At the downstream consumer end, the metaverse gallery Cryptovoxels introduces virtual curators to recommend artistic works based on user browsing history, increasing the transaction conversion rate by 8 times. This closed loop from technology research and development to commercial application marks the maturity of the AI art industry ecology^[3].

4. Development paths and strategic choices

Policy guidance is the core driving force for promoting the deep integration of AI art and smart cities. Currently, major global economies have gradually established differentiated regulatory frameworks. The European Union has included AI art in the "limited risk" category through the Artificial Intelligence Act, requiring that generated content must indicate the source of the algorithm. China, relying on the "New Generation Artificial Intelligence Development Plan", has established "AI Art Innovation Pilot Zones" in pilot cities such as Hangzhou and Chengdu, allowing enterprises to test new technologies in a "regulatory sandbox" mode. For instance, the "Algorithm Art Park" in Hangzhou Future Sci-Tech City has gathered 47 startups. Its dynamic sculpture "Flowing City", generated based on city traffic data, attracts 23,000 interactions daily, becoming a typical case of policy deregulation stimulating innovation. Technological research and development need to break through single-modal limitations. The "Multi-modal Art Engine", jointly developed by Tsinghua University and the Central Academy of Fine Arts, can convert city noise data

into abstract paintings and electronic music in real-time. Its application in the Xiong'an New Area Civic Center has increased public satisfaction with city governance by 28%. The core technology of this system lies in the cross-modal alignment algorithm, which achieves semantic mapping between sound wave spectra and color matrices through contrastive learning. The research paper has been accepted by CVPR 2024 ^[4].

Structural changes are urgently needed in the talent training system. The "Smart Aesthetics Lab" model pioneered by the Bauhaus University in Germany is worth learning from. This lab requires students to complete interdisciplinary courses in "Algorithmic Programming + Art History and Theory + Urban Sociology" within three years and participate in practical projects of smart city public art in Berlin. Data shows that the Munich Airport AI Light and Shadow Installation Project, led by graduates, analyzes flight take-off and landing data to generate dynamic light tracks, reducing passenger anxiety by 19%. China can promote a "dual-track" training program: At the university level, the "Science and Technology Art" undergraduate program at the China Academy of Art has introduced a compulsory course in generative AI, where students use Stable Diffusion to complete urban space transformation designs. At the enterprise level, Tencent and the Palace Museum have jointly established a "Digital Cultural Relics Training Camp" to cultivate interdisciplinary talents proficient in both cultural relic restoration and algorithm parameter adjustment through practical exercises. The "Pattern Intelligent Generation System" developed by the first group of trainees has been applied to the digitization of 6,000 cultural relics ^[5].

Industrial collaboration requires the construction of a "technology-capital-culture" ternary driving ecology. The practice of the Shanghai West Bund Art District shows that establishing an AI art industry fund can effectively solve the financing problems of startups. Its special fund of 1 billion yuan has incubated 14 AI art projects worth over 100 million yuan each through the "competition-investment" model. Simultaneously, it is necessary to strengthen cross-industry IP operation capabilities. The "Digital Flying Apsaras" platform, jointly built by Dunhuang Research Institute and Huawei Cloud, licenses mural elements to the gaming and film industries, and derivative works have generated over 300 million yuan in output value. It is worth noting that the unification of underlying technical standards is crucial. The IEEE is developing the P3146 standard (AI Art Generation Protocol) to standardize data input formats and copyright information embedding rules. Shenzhen has taken the lead in implementing this standard at the "Bay Area AI Art Biennale," reducing copyright dispute rates by 73% ^[6].

5. Challenges and governance strategies

The ethical dilemma of data presents a complex trend in AI art practices. On the one hand, public data collection faces a conflict between privacy protection and creative freedom. An AI art installation in Shanghai generated dance images using unauthorized gait data from subway passengers, sparking public controversy. The issue was resolved by implementing local data processing through federated learning technology. On the other hand, the commercial use of cultural heritage data touches on cultural sovereignty issues. The British Museum used GAN to restore Parthenon sculptures and sold the digital models to the metaverse platform, prompting a cultural property rights lawsuit from the Greek government. To address this, researchers can learn from Canada's "data trust" model by establishing a third-party management agency to desensitize and allocate permissions for sensitive data. The Montreal AI Art Season successfully coordinated the legal use of Aboriginal totem patterns through this mechanism.

The risk of cultural homogenization is increasingly prominent in the algorithmic model of globalization. According to research, European and American artworks account for 82% of Stable Diffusion's training data, leading to cultural misinterpretations, such as perspective errors in generated traditional Chinese landscape paintings. Chengdu's "localization of algorithms" project requires that more than 40% of training data must come from the local cultural heritage database, which has improved the accuracy of generated Shu embroidery patterns from 58% to 89%. A more fundamental solution lies in the development of culturally aware algorithms. The "Cultural Embedding Vector" (CEV) technology developed by the MIT Media Lab can encode regional aesthetic characteristics into 128-dimensional vectors. In the design of the mascots for the Hangzhou Asian Games, the system successfully fused the patterns of Liangzhu jade cong and kinematic curves, winning an international design gold award ^[7].

The crisis of creative subjectivity has triggered deep reflection at the philosophical level of art. As AI can independently complete the entire process from concept generation to style iteration, the role of the artist is facing reconstruction. The "Human-Machine Symbiotic Creation Camp" at the Central Academy of Fine Arts has explored a new paradigm: artists set initial aesthetic rules (such as "Song Dynasty Minimalism"), AI generates 100 candidate designs, and humans select 5 for secondary creation. Works created under this model achieved a 320% premium rate at Christie's auction, proving that human-machine collaboration can create incremental value. To prevent algorithmic power monopolies, it is necessary to establish a creative process tracing mechanism: The Museum of Modern Art (MoMA) in New York requires all AI artworks to publicly disclose their training datasets and hyperparameter settings. Its "Eye of the Algorithm" exhibition records 287 generation parameters for each work through blockchain, providing a verifiable technical text for art criticism.

The issue of lagging technological regulation is becoming more severe with rapid iteration. Shenzhen's pilot "agile governance" mechanism provides new ideas: the government has formed a dynamic committee consisting of technical experts, ethicists, and artists to evaluate the risk level of emerging technologies every quarter. When the Disco Diffusion model showed gender bias amplification, the committee issued a temporary restraining order within 48 hours, requiring all public art projects to pass deviation detection. Additionally, it is necessary to be vigilant against cultural impoverishment caused by technology dependence—a community in Seoul relied entirely on AI to generate public murals, leading to a significant decline in residents' art appreciation ability. To address this, Berlin has initiated the "Human Curator Guarantee Program," which stipulates that human creation must account for no less than 30% of public art projects to maintain cultural and ecological diversity ^[8].

6. Conclusion and future prospects

The deep integration of AI art and smart cities marks a paradigm shift in urban development from "functional optimization" to "meaning production." This study reveals three key transformations: the creative subject shifts from human-centered to human-machine symbiosis, cultural expression transitions from static display to dynamic interaction, and industrial value evolves from chain division to ecological collaboration. Future research should focus on three cutting-edge directions. Firstly, the application of neuro-symbolic systems in artistic creation, such as MIT's attempt to constrain GAN generation boundaries using logical reasoning algorithms, ensuring both innovativeness and cultural compliance in artworks; secondly, the governance of

digital twin art in the context of the metaverse, requiring the establishment of a cross-platform copyright tracking system; and thirdly, the reconstruction of aesthetic experiences through brain-computer interface technology. Experiments at Zhejiang University have shown that adjusting AI generation parameters based on electroencephalogram feedback can enhance viewers' emotional resonance by 67% ^[9]. The ultimate goal of technology should be to serve people's spiritual needs. In the symbiotic evolution of smart cities and AI art, adhering to the principle of "algorithm for good" and building a dual guarantee mechanism of technical ethics and cultural identity is essential to achieve sustainable enhancement of the humanistic value of cities in the digital age.

Disclosure statement

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Research on the Optimization Path of Industry-Education Integration Model in Vocational Education from the Perspective of Lifelong Learning

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Abstract: In the context of the rapid development of new productive forces, the industry-education integration model in vocational education faces adaptive issues such as a mismatch of talent supply and demand, lack of coordination mechanisms, and lagging service systems. Based on the perspective of lifelong learning, this study analyzes the connotation of industry-education integration in a broad sense and constructs a three-dimensional optimization path of “time-space-technology.” In the time dimension, it connects academic education with continuing education. In the spatial dimension, it integrates formal and informal learning environments. In the technical dimension, it promotes the collaborative development of digital technology and digitization, forming an industry-education integration ecosystem that covers the entire career cycle.

Keywords: Lifelong learning; Vocational education; Industry-education integration; Optimization path

Online publication: March 12, 2025

1. Introduction

With the continuous development of new productive forces, vocational education has assumed more important responsibilities for skilled talent cultivation. To better adapt to the demand for skilled talents in the modern economy, the new vocational education law points out that vocational colleges and enterprises need to establish more long-term cooperation mechanisms. The outline of the 14th five-year plan for national economic and social development and the long-range objectives through the year 2035 emphasizes promoting skill upgrading for all groups through the implementation of a lifelong learning system and building a learning society, further clarifying the important role of lifelong learning in continuously improving the quality of citizens and the skills of workers.

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) believes that lifelong learning is an educational system designed to provide learning opportunities for people of all ages and from all walks of life ^[1]. As an important mechanism of vocational education, industry-education integration is a key mechanism to achieve deep alignment between education and industry. However, the traditional industry-education integration model focuses more on the cultivation of basic vocational skills on campus, lacking discussion on industry-education integration serving lifelong education and continuing education stages for vocational skill improvement, and thus cannot effectively connect the education chain with the industry chain. Therefore, exploring the optimization path of the industry-education integration model in vocational education from the perspective of lifelong learning is of great significance for optimizing the industry-education integration model and improving the adaptability and coverage of vocational education ^[2].

2. Significance of optimizing the industry-education integration model from the perspective of lifelong learning

Industry-education integration is one of the important paths for connecting the education chain with the industry chain. The connotation of industry-education integration can be divided into narrow and broad senses. In the narrow sense, industry-education integration focuses on the integration of on-campus education and industry, directly connecting with enterprise needs through school-enterprise cooperation, internships, and other on-campus practical activities to optimize on-campus teaching content and enhance students' competitiveness in the labor market. In the broad sense, industry-education integration expands in terms of cooperation subjects and spatiotemporal coverage. In addition to schools and enterprises, it includes multiple subjects such as governments, industry associations, and social groups to collaboratively build a resource-sharing and information-interconnected educational ecosystem ^[3]. In terms of spatiotemporal coverage, industry-education integration breaks through campus boundaries, extending on-campus education to various stages of career development, emphasizing real-time updates and feedback on industrial needs, and ensuring dynamic alignment between talent cultivation and industrial needs. Therefore, from the perspective of lifelong learning, industry-education integration has the connotative characteristics of full career cycle coverage, diversified subject cooperation, flexibility and adaptability combination, and innovation-driven development ^[4]. From the perspective of lifelong learning, optimizing the industry-education integration model has the following important significance.

2.1. It is conducive to leveraging the important role of vocational education in lifelong learning

A lifelong learning perspective on industry-education integration enables vocational education to no longer be limited to cultivating talents needed in the primary labor market. Instead, through the sharing and co-construction of industry-education resources, it provides full career cycle learning support for both on-campus students and in-service personnel, enabling knowledge updates, skill enhancement, and career development. Therefore, through industry-education integration, vocational colleges become centers for lifelong learning and continuing education resources, playing the role of a coordinator in the community of practice and providing a strong educational guarantee for the lifelong cultivation of vocational skills for all, becoming an important force in promoting the construction of a learning city and a learning society.

2.2. It is conducive to breaking through the spatiotemporal limitations of traditional industry-education integration

Traditional industry-education integration has obvious spatiotemporal limitations. The on-campus classroom learning stage and the off-campus practice stage cannot be integrated, and the on-campus training room also cannot fully exhibit the real production environment of the enterprise. Both on-campus teachers and enterprise mentors cannot comprehensively evaluate students' overall practical level. This spatiotemporal fragmentation leads to the problem of “disunity of knowledge and action”^[5]. The industry-education integration model from the perspective of lifelong learning can promote the vertical and horizontal integration of educational resources, extending from vocational education to continuing education, and promoting the alignment of the education chain with the industry chain through co-research, co-construction, and sharing of resources between schools and enterprises.

2.3. It is conducive to improving the flexibility and adaptability of vocational education

Through multi-subject collaborative industry-education integration and tracking the skill enhancement needs of in-service personnel, vocational colleges can timely capture industry development trends and technological progress needs, learn and absorb enterprise cases and experiences, and dynamically optimize professional settings and course content to improve the flexibility and adaptability of talent training programs and curriculum systems. On this basis, school-enterprise co-research can upgrade industry-education integration courses, forming a virtuous cycle.

Therefore, in the process of optimizing the industry-education integration model, vocational colleges need to face the complexity and uncertainty brought about by technological development by enhancing the collaborative interaction of multiple subjects, improving the ability to adapt to external changes, reserving space for innovation and trial and error, and promoting the sharing of resources and information.

3. Current situation and problem review of industry-education integration from the perspective of lifelong learning

In recent years, policies such as the vocational education law of the People's Republic of China, the implementation plan for reforming vocational education in China, and the action plan for improving the quality of vocational education have been implemented to strengthen industry-education integration and promote diverse cooperation between schools and enterprises. School-enterprise cooperation has gradually shifted from the traditional order model to deep cooperation. However, industry-education integration still faces many difficulties. The current situation and problem review of industry-education integration from the perspective of lifelong learning roughly include:

3.1. Talent supply and demand mismatch: Talent cultivation is difficult to quickly adapt to the needs of new productive forces

The mismatch between talent cultivation and industrial needs has been a long-standing issue in industry-education integration. In the context of new productive forces development, technological changes have accelerated changes in industrial needs, resulting in a mismatch between talent supply and industrial needs in terms of structure, quality, and level^[6]. The lack of a long-term and effective information communication mechanism between vocational colleges and enterprises, as well as information asymmetry, has caused delays

in professional research, talent cultivation program adjustments, and training room construction compared to market demand. Even if schools capture changes in technological and market demand, there is still a time difference between the training cycle of vocational education and the iteration of industrial technology, further exacerbating the mismatch between talents and positions. Therefore, vocational colleges have long been in a passive state of chasing technology with insufficient systematic planning and construction.

3.2. Lack of coordination mechanisms: Incomplete industry-education integration mechanisms lead to difficulties in deep cooperation

Currently, due to the lack of scientific and long-term cooperation mechanisms in industry-education integration, issues such as cost sharing and delayed benefits have led to vagueness in the distribution of benefits and cooperation models between schools and enterprises, resulting in insufficient motivation for cooperation. The cooperation model is also relatively single, with more school-enterprise cooperation staying at the level of internship base construction. Some industry-education integrations only exist at the agreement level or employment level, and it is difficult to carry out substantive cooperation in terms of curriculum systems and internships, making it difficult to form a long-term mechanism. Therefore, industry-education integration is difficult to deepen, and there are implementation difficulties and the phenomenon of “one-sided enthusiasm”, with the depth and breadth of cooperation still needing improvement ^[7].

3.3. Lagging service system: The industry-education integration system fails to cover lifelong education effectively

The existing industry-education integration system still focuses on full-time academic education and lacks a comprehensive lifelong learning service system. Educational resources are unevenly distributed, with more resources concentrated on full-time academic education, while resources for technical education and vocational skill enhancement are relatively scarce. Additionally, the curriculum is not flexible enough. For example, there is a lack of modular courses that support continuous learning for diverse social personnel during online course development, as well as a shortage of “loose-leaf” textbooks and “work manual” textbooks suitable for employee training. These factors hinder in-service personnel and adult learners from accessing adequate learning resources and platform support. Simultaneously, the absence of a comprehensive vocational skill assessment, certification, and enhancement system leaves students without systematic skill improvement support after graduation. This lack of support for lifelong learning mechanisms not only impacts individual career development but also limits the long-term effectiveness of industry-education integration in promoting lifelong learning and technical skill enhancement.

4. Optimizing the path of industry-education integration in vocational education from the perspective of lifelong learning

Lifelong learning is a complex historical process, and its unique dynamic mechanism can be deeply analyzed from three dimensions: time, space, and technology. This paper constructs a theoretical framework for optimizing the path of industry-education integration in vocational education from these three dimensions, reflecting the balanced, coordinated, and inclusive characteristics inherent in the development of industry-education integration ^[8].

4.1. Focusing on the collaborative optimization path of formal education and continuing education in the time dimension

Time is the primary dimension of lifelong learning theory and the first path for optimizing the industry-education integration model from a lifelong learning perspective. Industry-education integration under the lifelong learning lens places greater emphasis on the social time spanning from childhood to adulthood, requiring a balance between short- and long-term goals. Short-term goals should focus on enhancing students' practical abilities and employment competitiveness, while long-term goals need to consider changes in industrial structure and continuous technological development, with a focus on the continuing education stage after graduation to improve vocational skill levels sustainably.

Therefore, centering on the collaboration between formal education and continuing education, several steps should be taken. Firstly, dynamically adjust the industry-education integration curriculum system by regularly updating teaching content and methods based on industrial needs and technological advancements. Encourage the development of modular course resources and the compilation of loose-leaf and work manual textbooks to ensure that students' knowledge and skills align with the latest trends in industry development. Secondly, establish a collaborative and seamless mechanism between vocational education and continuing education to promote lifelong learning, facilitate talent growth pathways, and achieve dual integration and enhancement of academic qualifications and vocational skill levels. This enables students to adapt to the constantly changing professional environment and continuously enhance their competitiveness. Finally, establish a graduate career development tracking mechanism through platforms such as alumni associations and industry forums to maintain regular contact with graduates and enterprises, understand their latest needs and feedback, and develop relevant national vocational skills training programs to guide students and promote the development of graduates' continuing education ^[9].

4.2. Focusing on the collaborative optimization path of formal and informal learning in the space dimension

Space is the second path for optimizing the industry-education integration model from a lifelong learning perspective. Space can be divided into private and social spaces. This dimension liberates learning from fixed spaces (such as schools) and places it within a broader social learning space, where formal and informal learning environments collaborate to optimize the industry-education integration model.

Specifically, several measures can be taken. Firstly, establish a mutual exchange mechanism between schools and enterprise teachers, appointing enterprise experts as "industry professors" on campus and promoting school experts to serve as "technology vice presidents" in enterprises. This achieves two-way flow and effective integration of teacher resources between schools and enterprises. Enterprise teachers can start teaching on campus early, and school teachers can also engage in industry-education integration learning and improvement in enterprises, eliminating barriers formed by field restrictions. Secondly, dynamically develop industry-education talent training programs that break the limitations of traditional academic systems such as "2+1" or "2.5+0.5." By establishing more flexible industry-education integration learning mechanisms, such as a "5+1" month or even a "4+1" day learning schedule per semester, the combination of learning and practice becomes more flexible and closely integrated. Encourage the utilization of student clubs to facilitate more flexible participation in multi-industry enterprise practices. Thirdly, promote on-campus innovation and entrepreneurship by introducing enterprises into schools, breaking the spatial limitations of traditional

school-enterprise cooperation. Establish on-campus enterprise practice bases and innovation laboratories to attract enterprises to introduce production, research and development, and other links into the campus. By leveraging the school's resources and facilities for technological innovation, students can gain more practical experience through participation in real enterprise projects. Strengthen school-enterprise interaction by holding technology exhibitions, project roadshows, and other exchange activities, achieving a win-win situation.

4.3. Collaborative optimization path of digital technology and digital teaching in the technical dimension

Lifelong learners are technological learners with rich prior learning experiences and life histories. Technology will be integrated into learners' perceptual experiences, becoming an organic component of learners and enabling them to develop themselves fully. Therefore, in the process of optimizing industry-education integration, it is essential to focus on both the cultivation of digital technology application abilities and the promotion of digital technology use in teaching.

Specifically, several steps should be taken. Firstly, innovate and collaborate on digital teaching paradigms by actively introducing advanced educational technologies such as AI and AIGC. Develop digital teaching platforms such as virtual training and virtual research offices to promote the development of digital teaching methods like online learning, virtual training, and virtual research, thereby enhancing teaching quality and efficiency. Secondly, focus on cultivating digital technology application abilities by integrating digital technology application practices into the industry-education integration training plan. Combine job skills with digital skills to improve students' proficiency in applying cutting-edge professional technologies and cultivate general technical abilities such as data mining and analysis. Thirdly, encourage interdisciplinary technology integration and industry-education collaborative innovation. By combining knowledge and skills from different disciplines, such as engineering, design, and business management, students' ability to solve complex problems can be enhanced, thus meeting the demand for cultivating compound talents.

5. Conclusion and outlook

Starting from the broad connotation of industry-education integration, this paper clarifies the significance of optimizing the industry-education integration model from a lifelong learning perspective. It reviews the current status and existing problems of industry-education integration. Based on this, it constructs an optimized path for the industry-education integration model in vocational education from three dimensions: time, space, and technology. The paper proposes that optimizing the industry-education integration model requires achieving collaboration between academic and technical education in time, integrating formal and informal learning environments in space, focusing on digital technology application in technology, and simultaneously building digital teaching platforms and promoting digital teaching methods. The three-dimensional optimization path of "time-space-technology" is conducive to enhancing the flexibility and adaptability of vocational education, providing strong support for the construction of a learning society system.

Meanwhile, this study still has limitations, such as the need for further validation of implementation effects and the possibility of applicability differences across industries and regions. Future research can

further focus on the actual needs of a specific industry, explore the implementation effects of optimized paths in different contexts, and conduct follow-up evaluations of the implementation effects.

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