

Scientific and Social Research

Honorary Editor-in-Chief

Prakash Chandra Agarwal

Regional Institute of Education, NCERT MHRD, Government of India, India

Editors-in-Chief

Vahid Kouhdaragh

Lancaster University, UK

Fei Liu

Sichuan University of Science & Engineering, China

BIO-BYWORD SCIENTIFIC PUBLISHING PTY LTD

(619 649 400)

Level 10

50 Clarence Street

SYDNEY NSW 2000

Copyright © 2024. Bio-Byword Scientific Publishing Pty Ltd.

Complimentary Copy



Scientific and Social Research

Focus and Scope

Scientific and Social Research publishes papers devoted to quantitative social science research and methodology. The journal features articles that illustrate the use of quantitative methods to empirically test social science theory. The journal emphasizes research concerned with issues or methods that cut across traditional disciplinary lines. Special attention is given to methods that have been used by only one particular social science discipline, but that may have application to a broader range of areas with an ultimate goal of testing social science theory.

All relevant papers are carefully considered, vetted by a distinguished team of international experts, and rapidly published. Original articles, short communications, case studies and comprehensive review articles can be submitted online via the journal's submission and peer review site.

About Publisher

Starting 2022, *Scientific and Social Research* is published by Bio-Byword Scientific Publishing, which is a fast growing peer-reviewed and open access journal publisher located in Sydney, Australia. As a dependable and credible corporation, it promotes and serves a broad range of subject areas for the benefit of humanity. By informing and educating a global community of scholars, practitioners, researchers and students, it endeavors to be the world's leading independent academic and professional publisher. To realize it, it keeps creative and innovative to meet the range of the authors' needs and publish the best of their work.

All Bio-Byword Scientific Publishing journals are free from all access barriers, allowing for the widest possible global dissemination of their manuscripts and highest possible citations. Online submissions made to Bio-Byword Scientific Publishing journals will go through a rapid peer review and production, making the process of publishing simpler and more efficient, which benefit from its user friendly online submission system that reduces the overall time from submission to publication.

Publisher Headquarter

BIO-BYWORD SCIENTIFIC PUBLISHING PTY LTD

Level 10

50 Clarence Street

Sydney NSW 2000

Website: www.bbwpublisher.com

Email: info@bbwpublisher.com

Table of Contents

- 1 The Origin of Culture and Art and the Construction of Artistic Thinking**
Li Wang
- 7 An Analysis of the “Literature +” Teaching Reform of Modern and Contemporary Chinese Literature under the Background of New Liberal Arts**
Cengjie Yang
- 14 Research on Directional Transport of Coupled Brownian Ratchet**
Yuhang Lai, Xinran Ma, Meiqi Li, Liming Fan
- 20 Research on the Construction of Beautiful and Harmonious Villages in the Bayu Region through Art Empowerment in the Context of Rural Revitalization**
Jiaman Tang, Yue Yang, Kunpu Rao, Yuning Mao
- 28 Professional Managers and Rural Social Integration in the Context of Rural Revitalization: Dilemmas and Countermeasures**
Yunqi Feng, Tingting Li, Zixuan Qin
- 36 Promoting Healthier Sugar Intake Habits**
Jintong Liu
- 42 The Role and Challenges of Environmental and Resource Protection Law in Addressing Climate Change**
Yu Gao
- 50 Training Strategies for Agricultural Product Online Live Streaming Sales Anchors**
Wanru Zhu, Ramlan Bin Jantan
- 57 High-Speed Bandwidth Acquisition System Based on Intermediate Frequency Signal Processing**
Ziming Yin, Yunyu Wei, Kuo Wang
- 65 Building Long-term Mechanisms for Medical Students to Find Work in Their Hometowns within the Framework of Rural Revitalization**
Wenxuan Xu, Jingyu Yang, Xinru Zhang, Jiaye Chen, Chunyan Jiang

- 72 The Impact of Rural Population Aging on the Development of Green Agricultural Technology: A Spatial Perspective Study**
Yijuan Xu, Zhenping Xu
- 80 Exploring College Students' Well-Being and Its Influencing Factors**
Li Xu
- 87 Competitiveness of the Tourism Industry in Guizhou Province**
Lu Gan
- 93 Research on the Cultivation Path of “Craftsman Spirit” in the Course Teaching of Chinese Arts and Crafts History**
Yanhua Jiang
- 100 Research on the Development and Design of Quanzhou Tourist Souvenirs**
Wangming Hu, Jiangwei Lu
- 106 Investigation and Analysis of Psychological Pressure Status of Medical Postgraduates**
Chen Xu, Sheng Wang
- 116 Development and Research Status of Hotel Digital Operation in China**
Xianbing Ruan, Xiaodong Ji, Boyang Shu
- 132 Quarterly Temperature Patterns Across China: A 2016–2023**
Xingguang Piao
- 137 On the Application and Reflection of the Theory of Protective Norms**
Wenting Chu
- 143 Diffusion Study of Coupled Brownian Rate**
Tianqi Fu, Boyang Shen, Qi Song, Liming Fan

- 148 An Empirical Study on the Influencing Factors of Short Videos in New Mainstream Media Constructing National Image**
Xiaoxiao Du
- 154 Reflections on Integrating Red Sports Culture into School Physical Education**
Huali Dong
- 165 Research Progress in Synthesis of Itaconic Esters**
Yuzhan Yang, Yuxiao Yang, Chaohe Yang
- 172 Research on the Role of Digital Art in Cultural Inheritance and Innovation Based on the Philosophy of New Media Technology**
Yu Wu
- 179 Research on the Application and Practice of Task-based Teaching Method in College English Teaching**
Hui Zhang
- 186 Exploration of Alternative Solutions to Campus Conflicts in the Context of China and Malaysia**
Yuefeng Wang
- 195 Analysis and Research on Teachers' Professional Happiness**
Shufang Qu, Tong Wooi Chow
- 203 Ecotourism: A Sustainable Path or an Environmental Paradox?**
Junyi Yan (Bruce Yan)
- 210 Digitally Enabled Aging-Responsive Design of Interior Spaces in Chongqing's Healthcare-Integrated Senior Living Institutions**
Linye Gao, Haihe Zhao
- 217 Exploring the Path of Developing the Elderly Human Resources Based on the Background of the Silver Wave Development**
Tingting Dong, Yuan Hu, Chunyu Mu, Yuanzhe Jiang, Xiaoqing Hu

222 Grassroots Operation of Therapeutic Function of Family Justice: Taking Psychological Counseling Mechanism as the Starting Point

Wanying Li

235 Research on the Defects and Perfection of the Criminal Law Protection of Chinese Citizens' Personal Information Rights

Guanzheng Li

241 The Evolution of the “Lying Flat” Mentality and its Social Media Expression: The Youth Perspective

Zihan Zhang, Ming Zhang

The Origin of Culture and Art and the Construction of Artistic Thinking

Li Wang*

Xi'an Innovation College of Yan'an University, Xi'an 710100, Shaanxi, China

*Corresponding author: Li Wang, fs20@163.com

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Culture comes into being along with human thinking activities, which reflect the deep essence of human beings. Its development is a long dialectical process of philosophy. Art, as the embodiment of cultural achievements, has a close relationship with culture, and the construction of artistic thinking based on culture is a more complex process, which is the process of individual re-cognition, re-thinking, and re-reasoning under the influence of culture. Therefore, this kind of artistic thinking constructs the basic structure of the cultural world and is also the basis of the existence of the world of human art phenomena, and together, they constitute an important part of human civilization.

Keywords: Culture; Art origin; Construction of artistic thinking

Online publication: April 3, 2025

1. Introduction

Culture is an important source of art, and the inheritance and development of culture provide excellent materials and inner motivation for art. Art, on the other hand, is an important embodiment of culture, a process of creation, and an expression and display of human emotions and thinking. It can be said that culture is the soil for the growth of art, and art is the reproduction of cultural achievements. Culture and art influence and promote each other to form an important part of human civilization. Usually, art shows people a variety of cultural connotations and spiritual cores through its different forms of expression, and the connection between culture and artistic thinking mode is a complex and in-depth field, whose transformation requires profound cultural accomplishment, keen observation, and unique artistic thinking. Because in the construction of artistic thinking, creators need to fully consider the role of culture in art and the constraints of social background and other factors, this kind of thinking construction is the result of the correlation, interdependence and common development of culture and art, and is a philosophical dialectical unity of human culture and thinking.

2. A preliminary analysis of “culture”

“Culture” is a word with high frequency, and it is also a common concept widely used. Because “culture” is so common, the cognition and definition of the word “culture” are very broad and varied. For example, 30 years ago, two anthropologists, Kroeber and Clark, collected and compiled more than 160 definitions of “culture.” Mr. Yu Yingshi, a well-known overseas cultural scholar, mentioned in his book *The Modern Meaning of Chinese Culture from the Perspective of Value System* that “there are many different views on the discussion of ‘culture’ by modern scholars.”^[1] Today, the concept of “culture” is still being used more and more frequently, and a series of new terms such as “network culture”, “cultural diagnostics”, “cultural framework”, and “cultural dimension” are emerging one after another. The appearance of these phenomena and concepts, on the surface, is a manifestation of “culture”, but in fact, it is a deep and urgent need or anxiety. Therefore, researchers must start from the essence of culture and carry on a deeper exploration of the term “culture” so that they can define it more accurately and completely^[2].

The word “Culture” in the West is “culture”, which comes from the ancient Latin “cult ra”, referring to the land cultivated and labor harvested. The earliest nominal use of Culture is in Middle English in Palladius’s *Lustica* (circa 1450). In modern times (1880s), Culture in *The Oxford English Dictionary* was defined as “The customs and beliefs, art, way of life and social organization of a particular country or group.” And since the introduction of modern Western “Culture”, “Culture” as a free translation of “culture” is quite appropriate. Since then, the Chinese word “Culture” has the same modern meaning as the Western word “culture.”

3. The reanalysis of the word “culture”

Edward Burnet Taylor was a famous British anthropologist who is called “the father of cultural science.” In the first chapter of his famous book *Primitive Culture*, Taylor defined the goal of “science” as “culture”: “In the broad anthropological sense, it encompasses all knowledge, beliefs, arts, morals, laws, customs, and all the gifts and customs of being a member of a society.” It can be seen that sociology is a more comprehensive and profound understanding of human culture and the key to understanding the laws of human thinking and behavior^[3]. Human behavior and thinking are constantly changing with social changes and cultural evolution. Hence, researchers need to look at the changes in culture and thinking from the perspective of history and development rather than viewing them as immutable. Culture at different stages is a distillation and reflection of past history and will also play an inherent role in creating future history^[4]. The integration of social environment, cultural norms, historical background, artistic form, and other factors further contributes to the diversity and complexity of culture, and the analysis and interpretation of it will better promote the construction of human’s artistic thinking.

Anthropologist B.K. Malinowski believes that “culture” must first have a functional analysis to explore evolution and transmission; when the function cannot be explained and the relationship between various elements is not clear, the form of culture cannot be understood.

It is the emergence of culture that turns animal man into a speaker, a thinker, a creator, and an organizer. Whatever the difference between the synchronic concept of culture, which refers to the deep intrinsic nature, and the diachronic concept of civilization, which refers to the form, the relationship between them is clear. Culture and civilization interact with each other and preserve human power in the same substance.

4. The dialectical relationship between art and culture

4.1. The origin of art

Although art has been around for tens of thousands of years, its origin has always been a subject of much debate. The reason for this is that the study of the origins of art is inevitably tinged with conjecture. As for the origin of art, it can be roughly divided into two categories: one is to speculate the origin of art according to people's experience in art practice. For example, Aristotle put forward the "imitation theory"; he believes that art originates from people's imitation instinct, which is due to people's happiness through imitation ^[5]. The other is to deduce according to a certain ideology, such as the "labor theory" of Bicher and others, Shelley's "performance theory", and so on. However, mere conjecture is not enough, so some empirical methods have emerged. The other is to explore the origin of art based on scattered records in ancient books. For example, by quoting the legend about the music and dance of the Getian tribe in Lu's Spring and Autumn Annals, researchers can infer its artistic origin for this reason. Second, based on a large number of original art materials unearthed and existing original tribal art materials, the author makes a comprehensive and systematic investigation of them and finally draws a conclusion.

4.2. The historical investigation of the theory of the origin of art

In the history of aesthetics, the origin of art is often mixed with the origin of beauty, but they are not the same thing. First of all, beauty is the primary social objective existence, which is a special materialized labor, while art is the secondary objective existence, which is the materialized form of aesthetic feeling ^[6]. Secondly, beauty and aesthetics precede art, but art is also the higher form and concentrated expression of beauty. Therefore, to clarify the origin of art, the understanding of beauty and aesthetic characteristics is also of great significance.

As to the origin of art, people have different opinions. Some believe that art comes from the simulation of the real world, which is the inherent nature of human beings. Heraclitus, a Greek philosopher, was the first person to raise this question. Later, Aristotle took the idea further, combining imitation with the biological instinct of man. In his Poetics, he pointed out that "poetry comes into being basically for two reasons, both arising out of human nature" ^[7]. Since childhood, human beings have an imitative nature, and they like to imitate the works of others. This sentence is right because without imitation, the initial "art" of human beings is inseparable from imitation. One of the earliest ancient artifacts, such as the French statue of a naked woman with horns 30,000 years ago, was evolved from the simulation of the woman's body. The huge frescoes of Altamira, where the animals are lifelike. Although the originals themselves are not true works of art, but merely the product of another spiritual activity, they nevertheless possess the characteristics of an artistic activity, a necessary stage of a "pre-art." It can be said that without "imitation", there would be no "art."

Another, more appropriate view is that art is born out of play, and play is the source of human excess energy. Schiller was the main advocate of this idea. In his Books on Aesthetic Education, he wrote, "By what does the barbarian declare the human nature he has attained?" It is "the love of appearance, the love of adornment, the love of play" (Letter 26). In other words, the preoccupation with "appearance", "decoration", and "play" is a characteristic of man's liberation from bestiality. When a man is concerned only with the essence of things and not with the appearance of things, he can still only get the physical and physical needs, so he is still negative and free; Man can only get spiritual satisfaction if he focuses on the outside and not on the material, so that he is in a positive and free state ^[8].

Plekhanov partially took this statement and adapted it. Play, he believed, had its utilitarian side, and its ultimate goal was to serve labor ^[9]. "Play is a product of labor", he said. "The game of the beast also involves

hunting in disguise and fighting in disguise.” In other words, play is seen either as an exercise in preparation for work or as a recreation of the process of work. From this point of view, Marx’s equation of “labor-play-art” is tenable.

4.3. Rethinking the correlation between art and culture

Any cultural phenomenon has both implicit and explicit ones. External culture is beautiful, including the visible and the invisible: the visible things, such as houses, clothes, food, and so on; Intangible things, such as rules, institutions, laws, arts, and so on. It is clear here that art is an “implicit” culture. This relates to the relationship between art and culture. Culture arises when man’s labor reaches a certain level. From the point of view of its origin and nature, “beauty” and “beauty” run through the process of human culture development ^[10]. Therefore, the relationship between art and culture can be said to be a kind of unmediated inclusion, and art is born in this process and its objectified result. This is the fundamental meaning of what Marx called “production according to the aesthetic law.”

Here, art can be regarded as an expression of aesthetic consciousness, which, although essentially the result of human culture and labor practice, is constantly deepened and consolidated until it becomes a conscious consciousness of the subject and finally forms a continuous mental structure. Thus, in this sense, cultural activity promotes the sublimation of aesthetic consciousness and gradually separates it from concrete utilitarian objects, becoming a kind of human emotional value. In this process of sublimation, human appreciation of beauty and art is increasingly liberated, and a standardized materialized form is continuously obtained, especially the primitive form of poetry, dance, painting, or drama, which is not simply in the form of “art” but itself has a strong cultural color ^[11]. After a long history of accumulation, especially with the creation of the aesthetic consciousness formed by the establishment of the subject consciousness, people’s pursuit of spiritual freedom has gone beyond the utilitarian goal and obtained great happiness and satisfaction from it.

To sum up, there is a close relationship between culture and art ^[12]. On the one hand, culture is the soil for the growth of art, providing material and inspiration for artistic creation. On the other hand, art is the embodiment of cultural achievements, conveying specific cultural information and values through image, color, form and other means of expression. Therefore, the study believes that culture provides a standardized form for art and contributes to the birth and development of art.

5. The construction of artistic thinking based on culture

Culture makes the nature of things clear, and the thought method is a key link to finding their internal connections. If one considers an unrelated matter, then one will find that this is a cultural connection that one subconsciously ignored in the past. So, for a very active, very intelligent person, the advantage of cultural thinking is to be able to recall and compare many cultural experiences that have been well understood and to quickly see contradictions and breakthroughs in them so that one can think big ^[13]. This way of thinking can continuously excavate a person’s inner inspiration, which is often very mature and intriguing because it has been washed away by the cultural subconscious for a long time and also has a lot of changes and precipitation under a lot of external stimuli. Therefore, the excavation of this mode of thinking can often be done unconsciously to give full play to one’s own thinking.

It can be said that there is a close relationship between culture and artistic ways of thinking, influencing and

shaping each other. Culture has a profound influence on artistic thinking mode. Different cultural backgrounds shape people's world outlook, values, and artistic thinking mode. Eastern culture emphasizes holistic and comprehensive ways of thinking, focusing on the harmonious relationship between man and nature and man and society, while Western culture puts more emphasis on individualism and logical thinking^[14]. The artistic way of thinking in this cultural context can affect people's decision-making, judgment, and problem-solving abilities. At the same time, the way of artistic thinking will, in turn, affect the evolution and development of culture.

6. Conclusion

Raymond Williams, in his book *Culture and Society*, says, "When we recognize the solitary use of a part of nature, we make adjustments to our behavior based on experience. We slowly learn to pay attention to what is around us, to draw our values from the world as a whole rather than from the scattered pieces, and to draw valuable things from it that work quickly but can be wasted in the long run."^[15] Finally, with this research, people also come to realize that when the dominant environment extends to human beings, no matter how much they achieve in the moment, they will lose all opportunities, no matter how much they achieve in the present.

Funding

"Research on the Transformation Path and Practice Integration of Higher Education Based on Digital Empowerment" of the "14th Five-Year Plan" Education Science Plan of Shaanxi Province in 2024 (SGH24Y3058); 2024 Special Cultivation Program for Major Projects in Philosophy and Social Sciences of Shaanxi Normal University: Research on the Construction and Inheritance of the Art System in Chinese Heritage Sites (2024zdp002)

Disclosure statement

The author declares no conflict of interest.

References

- [1] Wang CY, 2022, Interdimensional Thinking in the Study of Cross-cultural Artistic Influence: A Case Study of the Influence of Chinese Art on Western Creative Circles. *Jiangxi Social Sciences*, 42(2): 166–173.
- [2] Ma JF, 2019, Theoretical Construction of New Media Art Design and Cultural Thinking — Review of New Media Art Design: Creation and Cultural Thinking. *News Enthusiast*, 2019(2): 1.
- [3] Cheng XX, 2020, On the Research of Hunan Embroidery Cultural Elements and Innovative Thinking in the Inheritance of Traditional Culture and Art. *Reading the World (General)*, 2020(27): 1.
- [4] Zhu WS, 2021, Thinking Expansion and Practice Breakthrough Analysis of Culture and Art Management in Intelligent Era. *Art Appreciation*, 2021(26): 126–127.
- [5] Liu ZH, Hu GZ, 2023, Commonality and Individuality: A Preliminary Discussion on the Construction of the Aesthetic Discourse System of Chinese Culture and Art. *Shanghai Vision*, 2023(1): 86–91.
- [6] Ye YB, 2021, Reflections on Public Art Education and the Cultivation of College Students' Innovative Ability. *Art Science and Technology*, 30(11): 409.

- [7] Tu XP, 2019, A Brief Analysis on the Cultural Attainment of Artistic Creation Activities. Popular Literature and Art: Academic Edition, 2019(1): 2.
- [8] Zhu YY, 2020, Educating People through Art and Guiding People through Culture — Construction and Exploration of College Music General Education Curriculum under the Guidance of Cultural Values. Voice of the Yellow River, 2020(1): 2.
- [9] Wang YF, Yang S, 2021, Research on the Integrated Development of Folk Culture and Art Design from the Perspective of Folk Characteristics. Cultural Industry, 2021(33): 55–57.
- [10] Zhuang W, 2021, The Construction of Intersubjective Thinking in Contemporary Digital Art Education. Journal of Anhui Radio and Television University, 2021(3): 59–63.
- [11] Xu XX, 2019, Discussion on the Change of Curatorial Thinking in Modern Museum Culture. Art and Folklore, 2019(2): 8.
- [12] Zhou YX, Jin DW, 2020, Construction of cultural Identity of National Plastic Arts to Modern Design. Journal of Guizhou University: Art Edition, 34(6): 6.
- [13] Liu XG, 2019, Origin of the Spirit of Modern European Art: Culture and Art in Renaissance Florence. Journal of Literature and Art Studies, 2019(4): 1.
- [14] Chen Y, 2020, Thinking and Enlightenment on the Origin of Culture and Art — Based on the Perspective of Information Asymmetry Theory. National Art Forest, 2020(4): 7.
- [15] Peng Q, 2022, From Fine Art to Art: The Origin and Evolution of Chinese Modern Art Concept. Zhejiang University Press, Zhejiang.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

An Analysis of the “Literature +” Teaching Reform of Modern and Contemporary Chinese Literature under the Background of New Liberal Arts

Cengjie Yang*

Zunyi No. 1 Junior High School, Zunyi 563000, Guizhou, China

**Corresponding author:* Cengjie Yang, yangcengjie@outlook.com

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Nowadays, the construction of new liberal arts is facing the educational responsibility of “building a liberal arts talent training system that can reach the world level and has Chinese characteristics”, which undoubtedly puts forward higher new requirements for the teaching of colleges and universities. Therefore, the first thing colleges and universities need to do is to consolidate the curriculum system, grasp the curriculum construction, and continue to promote the curriculum teaching content update to better respond to the new liberal arts construction requirements. However, under the background of the new liberal arts, modern and contemporary Chinese literature, as a compulsory core professional course for Chinese major students in colleges and universities, still has some problems in its teaching, such as reduced class time arrangement, poor learning enthusiasm of students, and single choice of course teaching content. Based on this, this paper puts forward the teaching reform strategy of “literature +”, aiming at cultivating a group of composite applied talents who are more in line with the requirements of the new liberal arts construction, hoping to provide some references for your peers.

Keywords: New liberal arts; Modern and contemporary Chinese literature; “Literature +”; Teaching reform

Online publication: April 3, 2025

1. Introduction

The “new liberal arts” emphasize the integration of new technologies into the courses of literature, philosophy, language, etc., to realize the discipline reorganization of traditional liberal arts courses and the intersection of arts and sciences, to provide a guarantee for students to carry out comprehensive interdisciplinary learning^[1]. Modern and contemporary Chinese literature, as an important compulsory course for Chinese major students in colleges and universities, mainly explains and analyzes various excellent literary works, leads students to have a deep

understanding of the connotation of these literary works, and finally achieves the purpose of cultivating students' ability to analyze and understand literary works independently. Under the background of the new liberal arts, it is necessary for the course of modern and contemporary Chinese literature to actively reform its teaching to further promote educational reform and the construction process of the new liberal arts in colleges and universities.

2. The particularity of the course teaching of modern and contemporary Chinese literature

The development of literature from the May Fourth Movement in 1917 to the present is all within the teaching scope of modern and contemporary Chinese literature courses in colleges and universities^[2]. Specifically, the main purpose of modern and contemporary Chinese literature is to study and explore the occurrence and development of Chinese literature in the past 100 years, to examine which authors and writers were born in important fields, and what literary phenomena, ideas, and movements appeared in the past 100 years^[3]. Therefore, when teachers teach this course, they are bound to touch on the social and cultural development trends behind these literary works^[4].

In the process of the formation and development of modern and contemporary Chinese literature, a series of external factors, such as culture, politics, world, local and reality, in addition to the literary noumenon, will exert an important influence on it. All these are important contents of the course teaching of modern and contemporary Chinese literature^[5]. As for the knowledge content of ideological trend movements, most teachers will devote several class hours to explaining it in detail. As for other literary history phenomena or related knowledge points, they will usually analyze and explain the works of various writers. However, the explanation of these contents often takes up more than half of the total class time^[6]. Therefore, to not reduce the history of literature to a general theoretical introduction, the teaching of modern and contemporary Chinese literature will also introduce knowledge related to the appreciation of works^[7]. It can be seen that the course teaching of modern and contemporary Chinese literature not only covers more than one hundred years of Chinese literature development history but also records the changes of Chinese people's thoughts, emotions, and lives. It can reflect the interpretation and construction of the humanistic spirit by modern and contemporary intellectuals to a certain extent and has unique educational significance.

3. The construction of new liberal arts and the development opportunities of modern and contemporary Chinese literature course teaching

The course of modern and contemporary Chinese literature mainly explains to students the literary trend of thought, literary schools, literary writers and their works after the "May Fourth Movement", and guides them to learn and master the overall picture of the development of Chinese literature in the past century more systematically, to achieve the purpose of improving students' historical cognition, value orientation and aesthetic concept^[8]. However, with the continuous development of the social era, all kinds of new industries and new technologies have gradually emerged and developed rapidly. In this situation, the needs and requirements for talents in all walks of life have changed significantly. Therefore, many colleges and universities have strengthened the construction of science and engineering courses, which has led to the gradual weakening of the position of literature courses, and the course of modern and contemporary Chinese literature has been gradually ignored. The proposal of "new liberal arts" provides a good opportunity for the construction and development of college literature courses. The Ministry of Education pointed out that the construction of the new liberal arts needs to

shoulder the educational responsibility of cultivating liberal arts talents in the new era who “know China, love China and can take on the great task of national rejuvenation”^[9]. It can be seen that the proposal of the new liberal arts undoubtedly greatly affirms the important value of liberal arts curriculum teaching. As an important part of the teaching of liberal arts, the course of modern and contemporary Chinese literature should firmly grasp the development opportunities brought by the construction of new liberal arts, give full play to its curriculum advantages, and contribute to the cultivation of liberal arts talents in the new era.

4. Existing problems in the course teaching of modern and contemporary Chinese literature under the background of new liberal arts

4.1. The schedule of course hours has been reduced

In recent years, with the continuous reform and development of the education system in colleges and universities, the setting of various general courses, professional basic courses, and practical activities in and out of class has been significantly increased^[10]. Under this influence, the class hours of the course of modern and contemporary Chinese literature have been reduced. Some universities even cut the course’s class schedule by nearly half, to just four hours a week. Obviously, this poses a great challenge to the teaching of modern and contemporary Chinese literature. In actual teaching, to catch up with the teaching progress, many teachers can only explain relevant basic knowledge to students in a hurry but fail to incorporate more malleable content. Only in this way can students successfully learn the development knowledge of modern and contemporary Chinese literature for more than 100 years^[11]. Under such circumstances, students often have only a partial understanding of this course, and their cognition of modern and contemporary Chinese literary writers and their works is limited to the basic framework, and they cannot fully understand the emotions and connotations of these literary works. Therefore, in the context of the new liberal arts, teachers must think about teaching methods that are more adaptable to the new situation to better meet this challenge.

4.2. Students’ enthusiasm for learning is poor

At present, many students do not have a high enthusiasm for the study of modern and contemporary Chinese literature. There are two main reasons for this: First, for those students who are passively transferred to the Chinese major, their enthusiasm for the study of literature courses is not very high, and they usually just pursue not failing the exam and successfully getting the graduation certificate^[12]. Second, for students who take the initiative to major in Chinese, some of them hope to realize their literary dreams by studying Chinese literature. However, the curriculum of modern and contemporary Chinese literature is more systematic and disciplinary, and the content is rather boring, and the time for text analysis is limited, so it is easy to lead to some students’ strangeness and rejection of their learning. In addition, under the pressure of college entrance, many students have very limited literature reading and reading experience in middle school. They will be affected by the employment pressure after entering university, and it is difficult for them to spend more time and energy on researching literary works, which will also affect the teaching effect of modern and contemporary Chinese literature courses to a certain extent.

4.3. The teaching content of the course is single

In the past, teachers’ explanations of modern and contemporary Chinese literature were mostly representative works of writers, and occasionally, some popular works were involved^[13]. However, on the whole, the selection of course teaching content is still relatively simple, and the lack of integration with other subject knowledge easily

leads to students' knowledge being narrow, closed, and divorced from reality, which is not conducive to students' application of what they learn.

5. Practice exploration of “Literature +” teaching reform of modern and contemporary Chinese literature under the background of new liberal arts

5.1. Combining modern and contemporary Chinese literature with text experience to transform the teaching mode

Under the background of the new liberal arts, teachers should actively change the teaching mode when carrying out the teaching of modern and contemporary Chinese literature, insist on taking students as the main body, and pay more attention to students' in-depth understanding and personal experience of literary works to ensure the teaching effect. For this reason, teachers may wish to combine the course of modern and contemporary Chinese literature with the text experience. For example, they can reproduce the cultural context and historical background of literary works with the help of modern technological means, so that students can be immersed in it, so that they can get an immersive learning experience, and urge them to have a dialogue with the author and literary works in a three-dimensional and visual learning context. In this way, not only can students fully stimulate the enthusiasm of learning, but it also promotes students to have a more profound thinking about literary works.

In addition, to bring students a more authentic text learning experience, teachers can also organize students to perform classic literature works, guide students to review classics, and interpret their literary connotations by guiding them to in-depth study of scripts. Take the performance of the classic drama *Thunderstorm* as an example. First, teachers can ask students to read the work independently according to the guided reading task, ask them to analyze the personality characteristics of each character according to their own cognitive experience, and guide students to pay more attention to the complexity of each role. For example, Zhou Ping is not only Zhou Ping in the shadow of Zhou Puyuan but also Zhou Ping, a rebel. Secondly, under the guidance of the teacher, students should discuss the script according to the relevant materials provided by the teacher, analyze and interpret the script from many different angles, and dig deep into its meaning. In this process, teachers need to provide timely advice and guidance for students and answer questions and doubts. After that, teachers can encourage students to give full play to their creativity, let them adapt and rehearse the play reasonably based on retaining some original elements, and put forward some targeted improvement suggestions if necessary. Finally, after the students' performance, teachers need to make on-site comments on the students' performance and encourage students to conduct self-evaluation and peer evaluation to ensure the comprehensiveness of teaching evaluation. In this way, through the complete script performance activities, students can realize the effective dialogue with classical literary works and can also deeply feel the cultural connotation and value implication contained in them, which is conducive to the further development of their literary understanding ability.

5.2. Combining modern and contemporary Chinese literature with disciplinary integration to broaden their academic horizons

The soul of the construction of the new liberal arts mainly lies in breaking through and integrating, that is, breaking through the boundaries of the original curriculum teaching and promoting the organic integration of different disciplines or educational activities^[14]. Therefore, when teachers carry out the teaching of modern and contemporary Chinese literature, they can combine it with other disciplines to break the teaching boundaries and further broaden students' academic vision.

On the one hand, teachers should break the internal barriers of the curriculum and introduce literary works with similar themes and nature into the teaching at the same time to realize cross-topic teaching. For example, when leading students to discuss the theme of women's independence, teachers can combine literary works such as "The Dead" and "One Man's War" and let students make a comparative analysis of these works, helping them to have a deeper understanding of the main course of the change of women's independence theme along with the development of social times. On the other hand, teachers should break the external barriers of the curriculum, for example, they can combine the teaching of modern and contemporary Chinese literature with philosophy, introduction to literature, sociology, psychology, etc., to help students analyze literary works from different perspectives, to cultivate and exercise students' comprehensive analysis and interpretation ability of literary works. In addition, for contemporary Chinese students, many of them regard "holding a pen in one hand and a camera in the other" as their learning and future development goals. In this regard, teachers can also combine modern and contemporary Chinese literature with film and television art, promote the organic integration of traditional media and modern media, and lead students to deeply analyze the artistic characteristics of film and television works to better meet the learning and development needs of contemporary college students.

5.3. The combination of modern and contemporary Chinese literature with ideological and political education can enrich the teaching connotation

Considering that the course of modern and contemporary Chinese literature is closely related to the history of China's revolutionary development, teachers may wish to combine this course with ideological and political education, dig deep into the ideological and political elements of the course, further enrich the connotation of the course teaching, to realize the effective cultivation of students' ideological values.

On the one hand, teachers can lead students to appreciate classical red literature works in the teaching, to realize the patriotic education of students, to achieve the purpose of stimulating students' national self-confidence and cultivating students' correct view of history. Modern and contemporary Chinese literature is not only the development history of a course, but also the true portrayal of the history of the Chinese people's unremitting self-improvement. It contains a wealth of classic red literature works, showing the century-old history of the rejuvenation of the Chinese nation, all of which reflect the national spirit of patriotism and perseverance. By explaining these works, teachers can better make students have emotional resonance, give them a strong sense of national pride, and help to further deepen the connotation of teaching. On the other hand, in teaching, teachers should guide students to explore various possibilities of national character transformation under a specific historical background with a scientific spirit to realize the organic penetration of ideological and political elements such as feelings of home and country, social responsibility, humanistic spirit, and scientific spirit. For example, when explaining *Midnight*, teachers should not only lead students to analyze the character image of Wu Sun Fu, but also guide them to think about why the road of national capitalists to save the country by industry is not working, to stimulate students' national consciousness and feelings of family and country^[15]. In addition, teachers can also connect more with the current real life in teaching and actively infiltrate ideological and political elements with more characteristics of the new era to ensure the practicability of curriculum teaching, to better promote the construction and development of the new liberal arts.

6. Conclusion

In general, the new liberal arts construction brings a new development opportunity for the teaching reform of Chinese college literature courses, which is conducive to providing a solid guarantee for the cultivation of liberal arts talents in the new era. Under the background of the new liberal arts, modern and contemporary Chinese literature courses, as an important component of literature courses, should conform to the development trend of the social times and actively explore new teaching ideas. From the perspective of “Literature +”, teachers can combine modern and contemporary Chinese literature with text experience, discipline integration, ideological and political education to further enrich the teaching connotation of this course, fully highlight the characteristics of modern and contemporary Chinese literature, to better train students to become compound liberal arts talents.

Disclosure statement

The author declares no conflict of interest.

References

- [1] He J, He W, 2024, Integration and Innovation: Teaching Reform Practice of Chinese Modern and Contemporary Literature under the Background of New Liberal Arts — A Case study of Dianchi College of Yunnan University. *Chinese Character Culture*, 2024(24): 30–32.
- [2] Wang XS, Zhang Y, Zhao BY, 2024, Real Life as a Method: Research on Teaching Innovation of “Chinese Modern and Contemporary Literature” Course. *Journal of Science and Education*, 2024(24): 135–138.
- [3] Li ZG, Li N, 2024, Exploration and practice of Chinese Modern and Contemporary Literature Curriculum Teaching under the Background of Curriculum Ideology and Politics. *Friends of Chinese Teaching*, 43(12): 27–29.
- [4] Zhou Y, 2024, Application of PBL Teaching Model in Chinese Modern and Contemporary Literature Curriculum. *Jia Ying Literature*, 2024(19): 163–165.
- [5] Xue XX, 2024, Research on Curriculum Reform of Modern and Contemporary Chinese Literature under the Background of Teacher Professional Certification. *Popular Literature and Arts*, 2024(16): 178–180.
- [6] Qiao L, 2024, Multi-modal Teaching and Value Output of Chinese Modern and Contemporary Literature Course from the perspective of “Three Whole Education”. *Shanxi Youth*, 2024(13): 172–174.
- [7] Chen ZG, Guan XF, 2024, Exploration of Chinese Modern and Contemporary Literature Teaching from the Perspective of New Liberal Arts. *Educational Observation*, 13(16): 59–62.
- [8] Shen FH, 2024, A Study on the Teaching of Chinese Modern and Contemporary Literature and the Cultivation of College Students’ Humanistic Spirit. *University of China*, 2024(3): 27–30.
- [9] Shen XP, Lv J, 2024, Out of Middle School Thinking: A New Theory on Curriculum Construction of Modern and Contemporary Chinese Literature from the Perspective of New Liberal Arts. *Chinese Teaching Communication Journal (Academic Journal)*, 2024(1): 9–12.
- [10] Lin XY, 2024, Based on Humanistic Quality and Returning to Spiritual Home — On the Penetration of Humanistic Quality Education in Modern and Contemporary Chinese Literature Teaching. *Journal of Science*, 2024(4): 45–48.
- [11] Guan J, 2023, Research on the Implementation Path of Ideological and Political Construction of Chinese Modern and Contemporary Literature Curriculum. *University Education*, 2023(24): 97–101.
- [12] Rui R, 2023, Innovative Practice in Classroom Teaching of Chinese Modern and Contemporary Literature from the Perspective of New Liberal Arts. *Chinese Character Culture*, 2023(22): 44–46.

- [13] Huang HC, 2023, The Inheritance and Innovation of Modern and Contemporary Chinese Literature Teaching in the New Era Background. *Chinese University Teaching and Learning*, 2023(10): 50–55.
- [14] Zhao ZS, Xu TS, Wang Y, 2023, Hybrid Teaching under the Background of Modern and Contemporary Chinese Literature Teaching Strategy to Explore. *Journal of Public Relations Worldwide*, 2023(6): 111–113.
- [15] Li N, 2022, Reflection and Practice on Ideology and Politics of Modern and Contemporary Chinese Literature Course in Applied Colleges and Universities. *Journal of Xichang University (Social Science Edition)*, 34(4): 118–122.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Research on Directional Transport of Coupled Brownian Ratchet

Yuhang Lai, Xinran Ma, Meiqi Li, Liming Fan*

College of Physical Science and Technology, Shenyang Normal University, Shenyang 110034, Liaoning, China

*Corresponding author: Liming Fan, lmfan@synu.edu.cn

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Molecular motors, as important nanomachines in cells, drive directional motion through ATP hydrolysis and play a key role in life processes such as DNA replication and material transport. In this paper, the kinetic evolution of coupled Brownian particles is described based on the overdamped Langevin equation, and the mean velocity of the coupled particles is obtained. By using the second-order Runge-Kutta algorithm, the dynamic characteristics of the directional transport of the coupled ratchet system can be studied theoretically. This research can provide a new approach for the design of nanomechanics and the mechanism analysis of biomolecular motion.

Keywords: Coupled Brownian ratchet; Langevin equation; Mean velocity of center of mass; Runge-Kutta algorithm

Online publication: April 3, 2025

1. Introduction

Brownian motors, also known as Brownian ratchets, are systems that can convert unbalanced drives into directional motion of Brownian motors in asymmetrical periodic potentials (ratchets). The system can be modeled as a coupled Brownian particle, and exploring the statistical properties of its directional transport is an important scientific problem^[1-4]. In particular, the statistical parameters of the Brownian motor, such as speed, efficiency, diffusion coefficient, and Pe number, have received wide attention^[5-8].

Biomolecular motors exist in the interior of cells and are proteases that achieve mutual conversion between chemical reactions and directional movements. Their dimensions are several or tens of nanometers, making them a kind of natural nanomachines. Molecular motor can catalyze the hydrolysis of ATP and use its released energy, because the motor itself is designed very delicate structure, the chemical energy released by the local process can further promote the motor to produce a larger size conformational change, as long as the motor and the orbital combination, this idea change will make it produce the corresponding relative motion, thus having the “movement.” Studies have shown that molecular motors play an important role in all the basic processes of life, such as DNA replication, gene transcription, translation, material transport, ATP synthesis, and muscle contraction. As a result,

diseases related to molecular motors have been discovered. For example, myosin mutations are associated with dilated or hypertrophic cardiomyopathy; Cardiovascular diseases, for example, are associated with overexpression of a certain driver gene.

Various models of the Brown ratchet are derived from Feynman's ratchet and pawl system, which consists of a so-called ratchet and a pawl^[9]. The ratchet is reminiscent of a circular saw with asymmetrical, serrated teeth, and the pawl allows the teeth to move effortlessly in one direction, eliminating rotation in the opposite direction. The ratchet and pawl are connected by a shaft with a windmill, the blades of which are surrounded by gas at a temperature of T_1 . The ratchet and pawl are kept at different temperatures of T_2 ($T_2 < T_1$). Random collisions of surrounding gas molecules with the blades will cause the ratchet to spin forward. This thermal noise correction can be used to perform tasks such as lifting loads.

In earlier studies of the ratchet model, the structure of the motion protein was completely ignored, treating it as a point Brownian particle with no internal degrees of freedom. The individual Brownian particles were small in speed and efficiency compared to the experimental data. In fact, the motor protein is usually a dimer. A conventional motor protein consists of two identical proteins connected by a neck region, each with a motor domain (head) and a carrier-binding domain. Recently, some authors have studied the transport of two coupled particles theoretically. For example, Klumpp et al. considered the multiplicative potential fluctuation problem in the case of strong coupling^[10]; Stratopoulos et al. have proposed a simple Newtonian model where two motor head particles are connected by a neck coil spring^[11]; Dan and Jayannavar consider the inverse correlation coupling case^[12]. Wang and Bao studied the transport of two coupled particles in a ratchet potential^[13].

In this paper, the coupled Brownian particles in a ratchet of arbitrary coupling strength are studied, and the transport characteristics of the coupled Brownian (motor) are discussed by a numerical method^[14–15]. This study will help to understand the rich behavior of molecular motion in cells.

2. Theoretical study of coupled Brownian ratchet

In the microscopic environment inside the cell, the movement of the molecular motor is limited by many factors. This paper mainly studies the motion of coupled Brownian motors under asymmetric periodic potential, whose dynamic behavior can be described by the dimensionless overdamped Langevin equation:

$$\dot{x}_i = -\frac{\partial W_i}{\partial x_i} + \xi_i(t), \quad i = 1, 2, \quad (1)$$

Where the x_i coordinates represent the i -th Brownian particle, W_i represents the potential energy of the i -th particle, and its expression is:

$$W_i = U_i + V_i, \quad (2)$$

In the above equation, U_i represents the interaction potential between two elastic coupled particles:

$$U_i(x_1, x_2) = \frac{1}{2}k(x_1 - x_2 - a)^2, \quad (3)$$

k is the coupling strength between particles, a is the coupling free length. V_i is the external force to which the

I -th Brownian particle is subjected:

$$V_i(x_i) = -V_0 \left[\sin\left(\frac{2\pi x_i}{l}\right) + \frac{\Delta}{4} \sin\left(\frac{4\pi x_i}{l}\right) \right], \quad (4)$$

Where V_0 is the barrier height of the external potential, Δ is the degree of asymmetry, l is the period of the external potential. In the formula (1), $\xi_i(t)$ is Gaussian white noise, which satisfies the following statistical relationship.

$$\langle \xi_i(t) \rangle = 0, \quad (5)$$

$$\langle \xi_i(t) - \xi_j(t') \rangle = 2D_0 \delta_{ij} \delta(t - t'), \quad (6)$$

In the formula, $i, j=1, 2$, $D_0 = \gamma k_B T$, is thermal noise intensity, and γ is the damping coefficient; k_B is the Boltzmann constant, and T is the temperature environment.

To further study the directional transport of the Brownian ratchet, this paper uses the mean velocity of the centroid of the Brownian ratchet to calculate the speed of the quantized directional transport. The mean velocity of the centroid of the I -th Brownian particle is

$$\langle v_i \rangle = \lim_{n\tau \rightarrow \infty} \frac{1}{n\tau} \int_{t_0}^{n\tau+t_0} \dot{x}_i(t) dt, \quad i = 1, 2, \quad (7)$$

In the formula, τ is the period time, n is the number of periods of system evolution, t_0 is the initial moment, $n\tau$ represents the evolution time of coupled particles, and $\langle \rangle$ represents the ensemble average.

3. Algorithm implementation of coupled Brownian ratchet

The numerical simulation method of the Langevin equation has been widely used in the study of Brownian ratchet transport, and the second-order Runge-Kutta method is mainly used in this study.

First of all, set the initial value $y = y(x) \in [a, b]$, according to the differential mean value theorem, there must be $\zeta \in [x_n, x_{n+1}]$, so

$$y(x_{n+1}) = y(x_n) + h\dot{y}(\zeta) = y(x_n) + hf(\zeta, y(\zeta)) \quad (8)$$

Set $y_n = y(X_n)$ and remember $K^* = F(\xi, y(\xi))$, then

$$y(x_{n+1}) = y_n + hK^* \quad (9)$$

In the formula, K^* is $y(x)$ the average slope on $[x_n, x_{n+1}]$ top. So, by giving the average slope K^* an algorithm, the equation (9) can be turned into a numerical formula, for example, K^* by substituting $K_1 = f(x_n + y_n)$, that is Euler's formula, and then continuing to $K_2 = f(x_{n+1} + y_{n+1})$ substitute K^* , one can get the backward Euler formula, and then K_1, K_2 substitute the average value of K^* , one can get the two echelon formula. Suppose that if one can predict the slope of $[x_n, x_{n+1}]$ more points, and also use their weighted average instead, one can get a numerical

solution with higher precision K^* , which is the basic idea of the Runge-Kutta algorithm.

Runge-kutta formula in general form:

$$\begin{cases} y_{n+1} = y_n + h \sum_{i=1}^r c_i k_i \\ K_1 = f(x_n, y_n) \\ K_i = f\left(x_n + \lambda_i h, y_n + h \sum_{j=1}^{i-1} \mu_{ij} K_j\right) \end{cases} \quad (10)$$

Where K_i is the predicted value of $y = y(x)$, the slope at the $x_n + \lambda_i h$ ($0 \leq \lambda_i \leq 1$) point; c_i, λ_i, μ_{ij} , are constants chosen to improve the accuracy of formula (10).

According to the general form of the Runge-Kutta algorithm (which is taken from the formula $i = 1, 2$ and i is a positive integer), the numerical algorithm for the position of the first particle through the formula (8) and (9) is as follows.

$$x_1(t+h) = x_1(t) + \frac{1}{2}h(F_{11} + F_{21}) + \sqrt{2Dh}Y_1, \quad (11)$$

Where

$$F_{11} = f(x_1(t)), \quad (12)$$

$$F_{21} = f(x_1(t) + hF_{11} + \sqrt{2Dh}Y_1), \quad (13)$$

The position of the second particle is

$$x_2(t+h) = x_2(t) + \frac{1}{2}h(F_{12} + F_{22}) + \sqrt{2Dh}Y_2, \quad (14)$$

Among

$$F_{21} = f(x_2(t)), \quad (15)$$

$$F_{22} = f(x_2(t) + hF_{21} + \sqrt{2Dh}Y_2), \quad (16)$$

Where Y_2 is a standard Gaussian random number, that is, the mean is 0 and the variance is 1. Y_1 Formulas (11) and (14) are the numerical simulation calculations used in this paper. Accordingly, it can be calculated as follows.

$$\langle v_1 \rangle = \lim_{t \rightarrow \infty} \frac{\langle x_1(t) \rangle - \langle x_{01}(t) \rangle}{t}, \quad (17)$$

$$\langle v_2 \rangle = \lim_{t \rightarrow \infty} \frac{\langle x_2(t) \rangle - \langle x_{02}(t) \rangle}{t}, \quad (18)$$

Further, the mean velocity of the center of mass of the coupled particle:

$$\langle v \rangle = \frac{\langle v_1 \rangle + \langle v_2 \rangle}{2}, \quad (19)$$

Where, $x_1(t)$, $x_2(t)$ denotes the position of the coupled particle at time t ; $x_{01}(t)$, $x_{02}(t)$ represents the position of the coupled particle at the initial moment. According to formula (19), the directional transport problem of a multi-

body coupled system can be studied numerically.

4. Conclusion and prospect

In recent years, Brown motor's directional transport has attracted extensive attention from scholars, and a lot of results have been achieved. Brownian motors are capable of transforming unbalanced drive into directional motion, a property that makes them of vital significance in many subject fields, such as biology and physics. Molecular motors inside cells, in particular, function as natural nanomachines and are involved in almost all the fundamental processes of life, such as DNA replication, gene transcription, and material transport. These molecular motors are only a few or tens of nanometers in size, but they can efficiently catalyze the hydrolysis of ATP, use the released chemical energy to promote their own conformational changes, and then produce directional motion. In this study, the coupled Brownian ratchet model is used to build a theoretical model of the molecular motor, and the directional transport speed of the molecular motor is further discussed by the numerical algorithm.

In this paper, the dimensionless overdamped Langevin equation is used to describe the directional motion of the coupled Brownian motor under asymmetric periodic potential. At the same time, the mean velocity of the center of mass is introduced to describe the speed of directional transport. In the aspect of numerical simulation, this paper gives the concrete process of solving the motion equation by the second-order Runge-Kutta algorithm. Based on the differential mean value theorem, the algorithm improves the precision of the numerical solution by predicting the slope of multiple points and taking the weighted average. Compared with the traditional Euler method, the Runge-Kutta algorithm shows higher accuracy and stability when dealing with the Langevin equation of coupled particles and can simulate the dynamic behavior of particles in a complex coupled environment more accurately, which greatly saves the time cost. However, the Runge-Kutta algorithm has certain requirements for the continuity of the solution, and its accuracy may not be as good as that of Euler's method when dealing with problems with poor continuity. Therefore, in the practical application, it is necessary to choose the appropriate algorithm according to the characteristics of the specific problem to ensure the accuracy and reliability of the simulation results.

The theoretical research method in this paper can be applied to the design of nanomachines and particle separation technology. In the following work, the researchers can further optimize the algorithm, develop the self-adaptive step length Runge-Kutta algorithm, combine machine learning and artificial intelligence technology to optimize the parameter selection, and improve the performance and adaptability of the algorithm in complex scenarios; In addition, further expand on theoretical issues, expand the connection between Langevin equation of coupled particles and theories ~~such as~~ quantum mechanics, study the collective behavior and directional motion of multi-particle coupled systems under quantum effects, build a solid theoretical foundation for understanding the macro properties of complex systems, and promote the development and innovation in related fields.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Hanggi P, 1996, *Nonlinear Physics of Complex Systems — Current Status and Future Trends*. Springer, Berlin.

- [2] Astumian RD, 1997, Thermodynamics and Kinetics of a Brownian Motor. *Science*, 276(5314): 917–922.
- [3] Julicher F, Adjari A, Prost J, 1997, Modeling Molecular Motors. *Reviews of Modern Physics*, 1997(69):1269.
- [4] Reimann P, 2002, Brownian Motors: Noisy Transport Far from Equilibrium. *Physics Reports*, 2002(361): 57.
- [5] Wang HY, Bao JD, 2003, Brownian Free Energy Ratchets. *Physica A: Statistical Mechanics and its Applications*. Elsevier, 323(C): 197–212.
- [6] Igarashi A, Tsukamoto S, Goko H, 2001, Transport Properties and Efficiency of Elastically Coupled Brownian Motors. *Physical Review E, Statistical, Nonlinear, and Soft Matter Physics*, 64(5 Pt 1): 051908.
- [7] Bier M, Astumian RD, 1999, Generalized Efficiency and its Application to Microscopic Engines. *Physical Review Letters*, 1999(83): 903.
- [8] Freund JA, Schimanasky-Geier L, 1999, Diffusion in Discrete Ratchets. *Physical Review E*, 60(2 Pt A), 1304–1309.
- [9] Feynman RP, Leighton RB, Sands M, 1963, Ratchet and Pawl, in *The Feynman Lectures on Physics*. Addison-Wesley, Reading.
- [10] Klumpp S, Mielke A, Wald C, 2001, Noise-induced Transport of Two Coupled Particles. *Physical Review E*, 63(3 Pt 1): 031914.
- [11] Stratopoulos GN, Dialynas TE, Tsironis GP, 1999, Directional Newtonian Motion and Reversals of Molecular Motors. *Physics Letters A*, 252(3–4): 151–156
- [12] Dan D, Jayannavar AM, 2003, A Biologically Inspired Ratchet Model of Two Coupled Brownian Motors. *Physica A: Statistical Mechanics and its Applications*, 318(1–2): 40–47.
- [13] Wang HY, Bao JD, 2003, The Roles of Ratchet in Transport of Two Coupled Particles. *Physica A: Statistical Mechanics and Its Applications*, 2003(337): 13–26.
- [14] Rousselet J, Salome L, Ajdari A, 1994, Directional Motion of Brownian Particles Induced by a Periodic Asymmetric Potential. *Nature*, 370(6489): 446–448.
- [15] Faucheux LP, Bourdieu LS, Kaplan PD, et al., 1995, Optical Thermal Ratchet. *Physical Review Letters*, 74(9): 1504–1507.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Research on the Construction of Beautiful and Harmonious Villages in the Bayu Region through Art Empowerment in the Context of Rural Revitalization

Jiaman Tang*, Yue Yang, Kunpu Rao, Yunying Mao

Chongqing Institute of Engineering, Chongqing 400056, China

**Corresponding author:* Jiaman Tang, 18983477914@163.com

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: As a major national strategic deployment, rural revitalization has profound significance for promoting the integrated development of urban and rural areas and realizing the modernization of agriculture and rural areas. To fully implement the national rural revitalization development strategy, Chongqing has set a goal to build 1,000 unique and livable villages suitable for both living and working by 2027. As of 2023, 107 demonstration villages have been established. This report aims to provide strategic support for rural revitalization from the perspective of “art empowerment for the construction of beautiful and harmonious villages in the Bayu region” through in-depth research, analysis of the current status of village construction, and exploration of industry trends.

Keywords: Rural revitalization; Beautiful and harmonious villages in the Bayu region; Art; Strategic support

Online publication: April 3, 2025

1. Construction status of beautiful and harmonious villages in the Bayu Region

“Beautiful and harmonious villages” is a new concept in rural construction, which further enriches and expands the idea of beautiful villages suitable for living and working. “Harmony” mainly emphasizes the cultural core and spiritual outlook of the village, reflecting harmonious coexistence, harmony in diversity, and harmonious relations. It values harmony between humans and nature, as well as harmony among people. “Beauty” focuses on the construction of modern villages that are visible and tangible, including villages with complete basic functions while retaining their rural charm and style. These are new villages suitable for both living and working that possess both inner harmony and outer aesthetic appeal. The construction of beautiful and harmonious villages in the Bayu region and the promotion of comprehensive rural revitalization are fundamental projects for building a modern and new Chongqing. They are the basic work to promote the integrated development of urban and rural

areas, bringing large cities, rural areas, mountainous regions, and reservoir areas together. They also serve as the fundamental support for advancing high-quality development, creating a high-quality life, and achieving efficient governance ^[1]. According to surveys, through self-evaluation, third-party assessment, and municipal-level review, combined with a comprehensive evaluation and public satisfaction scores, 107 villages (including agriculture-related communities) such as Nanqiao Village in Ganning Town, Wanzhou District, have been approved as demonstration villages suitable for living, working, and being beautiful and harmonious in 2023 ^[2]. Among them, there are 43 five-star demonstration villages, 37 four-star demonstration villages, and 27 three-star demonstration villages. Among the 107 demonstration villages in Bayu, there are currently 11 villages with a collective economic scale of over 2 million, 12 villages with over 1 million, and 13 villages with over 0.5 million (**Table 1**). Among them, Chuanxi Village in Lirang Town, Liangping District, has a current collective economic scale of 370 million yuan.

Table 1. Current collective economic scale of 107 demonstration villages in Chongqing in 2024

Amount	Over 0.5 million	Over 1 million	Over 2 million
Villages	Linfeng Village, Linfeng Town, Changshou District	Jin’ao Village, Tiaodeng Town, Dadukou District	Sanhe Village, Fengwen Street, Shapingba District
	Langjia Village, Wutan Town, Jiangjin District	Guopo Village, Bozi Town, Tongnan District	Huangzhuang Village, Yongxing Town, Jiangjin District
	Chashan Village, Hongchiba Town, Wuxi County	Jinlong Community, Shuangjiang Town, Tongnan District	Guanfeng Village, Gulu Town, Wuxi County
	Shichaomen Village, Mawu Town, Fuling District	Liangfeng Village, Guanba Town, Wansheng Economic Development Zone	Lvshui Village, Conglin Town, Wansheng Economic-Technological Development Zone
	Wanbao Village, Zhisheng Town, Rongchang District	Qingshan Village, Jinqiao Town, Wansheng Economic Development Zone	Zhuji Village, Shaping Town, Dianjiang County
	Shinian Village, Fenshui Town, Wanzhou District	Xinle Village, Longtan Town, Fuling District	Lingquan Village, Zhuxi Town, Kaizhou District
	Shaijing Village, Renhe Street, Yunyang County	Central Community, Mingyu Town, Nanchuan District	Ganquan Village, Manyue Town, Kaizhou District
	Quanfa Village, Quchi Township, Wushan County	Hongyan Village, Sanjiao Town, Qijiang District	Lieshen Village, Zhushan Town, Liangping District
	Baiguoping Village, Runxi Township, Pengshui County	Zhenxing Village, Longsheng Town, Qijiang District	Xinglong’ao Village, Meijiang Town, Xiushan County
	Shengtian Village, Huimin Street, Banan District	Heshui Village, Tuqiao Town, Tongliang District	Shiquan Village, Shihao Town, Qijiang District
	Tieqiao Village, Sanqu Town, Dazu District	Jingzhu Village, Xiannvshan Street, Wulong District	Wangpu Village, Jingguan Town, Beipei District
	Jiangjun Village, Qitang Town, Bishan District	Bailin Village, Chengjiang Town, Beibei District	
	Heyan Village, Zhengxing Town, Bishan District		
Quantity	13 villages	12 villages	11 villages

More importantly, approximately 80% of the villages mentioned above have benefited from the involvement of art in the development of their tertiary industries. For instance, Sanhe Village in Fengwen Sub-district, Shapingba District, focuses on developing unique industries such as cultural and creative arts, educational

experiences, mid-to-high-end homestays, and dining, aiming to create a modern urban “poetic countryside” model known as an “artist village.” Baoping Village in Xianfeng Town, Jiangjin District, utilizes artistic design to establish distinctive “Nine Houses and Nine Scenes,” a nostalgia hall, and a rural innovation center, leveraging a wedding photography base to drive a large-scale, comprehensive rural eco-agricultural industry chain. Longchi Village in Tongcheng Town, Wuxi County, themed around the 24 solar terms, divides the village into four groups: “Spring Growth, Summer Flourishing, Autumn Harvest, and Winter Rest.” It aims to forge a cultural soul and vitalize industries through art, striving to become China’s first immersive traditional 24 solar term culture and folklore village. Pingxi Village in Heyu Township, Chengkou County, revolves around farming elements, offering experiences that showcase the charm of farming. It includes a museum, an experience field, a children’s playground, and performances of the “Mountain Love and River Fish” scenario, establishing it as a 3A-level farming tourism scenic spot. Wangpu Village in Jingguan Town, Beipei District, combines elements of the flower and tree industry and red culture, promoting red element artistic bonsai sales, and has earned the titles of “Hometown of Chinese Flowers and Trees” and “Hometown of Chinese Wintersweet.”

2. The significance of art in empowering the construction of beautiful and harmonious villages in Chongqing

The integration of art into rural construction as a means to achieve the goal of rural revitalization refers to incorporating artistic design into rural development. This approach focuses on the original ecological and cultural environments of the villages, respects the needs of rural residents, and aims to create a rural landscape that balances ecological and cultural considerations according to corresponding design principles ^[3]. The emphasis of art empowerment lies in the interventional nature of artistic actions, tailored to the actual conditions of the villages. Through art empowerment, villages are endowed with artistic connotations, promoting traditional culture, tapping into the inherent value of the villages, and utilizing art as a tool to advance the revitalization of rural culture, ecology, and industries ^[4]. Art empowerment in rural construction manifests in various forms, such as rural lifestyle, environment, culture, and production, representing a significant trend in rural development under the current rural revitalization strategy. The significance of art empowerment in the construction of beautiful and harmonious villages in Chongqing is reflected in the following aspects.

2.1. Illuminating green mountains and blue waters, boosting rural economic development

Art possesses multiple attributes, including appreciation and economic and cultural values. Combining art empowerment with rural construction can provide valuable support for economic development in rural areas. The involvement of art can effectively meet people’s aspirations and pursuits for a better life. The primary means of addressing these aspirations is by enhancing economic income in rural areas. Additionally, economic issues constitute the core of rural construction and serve as the foundation for artistic development. As a unique resource, the integration of artistic design into rural construction can further tap into the artistic resources inherent in the villages, leveraging their value and transforming them through reasonable means to enhance economic benefits. For instance, rural cultural tourism represents a successful case of art empowerment in rural construction, driving the development of rural economic industries.

2.2. Strengthening the “roots” and “soul” to reconstruct rural human relationships and order

Rural revitalization requires both shaping the physical environment and cultivating the soul ^[5]. Cultural revitalization is undoubtedly the soul-building project of rural revitalization. In the long-term development process, rural society has formed a unique ethical mechanism, which has provided extremely important assistance for stable rural development. However, with the development of the times, especially the application of technologies such as the internet, many foreign cultural concepts have had a significant impact on the original cultural order of the countryside. While the original cultural order is being destroyed, a new cultural order has not yet been established, resulting in a relatively chaotic state of rural cultural order. The cultural order constituted by rural ethical culture is an important means for stable and orderly rural development ^[6]. Art has extremely strong inclusivity and universality, which can assist in the formation of rural social ethical order. Art has high moral value, which can effectively condense and strengthen the common consciousness of the community, and guide and regulate this common consciousness. Once this common consciousness exceeds utilitarianism, it can better unite people's hearts and unify people's spiritual world, thereby stimulating resonance at the emotional level of the group and forming a new emotional connection. In this regard, art-enabled rural construction can effectively build a cultural order based on rural common consciousness, guide and restrain villagers, and then achieve harmonious and stable rural development, injecting intrinsic spiritual motivation into rural revitalization.

2.3. Injecting a new era atmosphere to promote high-quality development

For a long time in the past, the industrial development path of the countryside was mostly planting and animal husbandry, which was single and low value-added, and the driving force for income increase was not very strong. Entering a new era, people have discovered that there are actually more choices. Village houses, customs, culture, local culture, etc., are all resource advantages of traditional villages. To comprehensively promote rural revitalization, it is necessary to speed up the modernization process of agriculture and rural areas, promote high-quality, efficient, and low-carbon agricultural development, create more employment and income-increasing opportunities, and fully realize the prosperity and affluence of farmers ^[7]. The “Art+” village development model has greatly promoted the economic development of the village. Many villagers who went out to work in the past have now chosen to return home for employment. Villagers can participate in the operation of the courtyard with artists and enjoy the dividends of collective companies; at the same time, they can also operate their own industries, such as farmhouse inns, baking, and brewing ^[8]. Many villages that once faced serious hollowing-out problems have gradually improved in this wave.

3. Exploring strategies for art-enabled construction of beautiful and harmonious villages in Bayu

3.1. Adding vitality through design transformation

Beautiful and harmonious villages should not only be beautiful in appearance but also take into account the improvement of quality of life. Many designers are boldly innovative and continuously improving rural production and living conditions. In Shangwei Village, Longhua District, Shenzhen City, Guangdong Province, facing the current situation that many idle and abandoned old houses are not easy to demolish and rebuild, architects stabilize the original walls by inserting modular prefabricated panel structures, rebuild modern living spaces, and expand the capacity of old houses. Some designers also enhance emotional communication among villagers by creating

poetic public spaces ^[9]. The “Bamboo Awning Countryside Hall” in Shangcun, Jixi County, Xuancheng City, Anhui Province, has found a balance between traditional village protection and sustainable development. Using local materials and cooperating with villagers, architects have transformed abandoned courtyards into a public living room that combines artistic beauty with multiple functions. Projects such as the Wushui Information Platform, which is dedicated to solving rural water safety issues, and the “Toilet Revolution” project in Huatian Township, Youyang Tujia and Miao Autonomous County, Chongqing, all focus on leveraging the service function of design to improve the quality of rural life. Stepping into Shiquan Village, Changxing County, Huzhou City, historical buildings and modern dwellings complement each other, and the ancient rhyme of Jiangnan is infused into the green mountains and blue waters; walking in Dongziguan Village, Fuyang District, Hangzhou City, it feels like being in the Jiangnan water town described by Wu Guanzhong. The artistically transformed Hangzhou-style dwellings with white walls and black tiles are scattered among the fields and mountains, forming an impressionistic landscape of ink Jiangnan. This not only beautifies the villagers’ lives but also boosts local tourism ^[10].

Integrating artistic creativity into daily rural life and allowing beauty to flow in the countryside, the practice of art participating in rural construction has become increasingly rich. Various rural art festivals use shared models to carry out aesthetic education; a series of children’s art workshops allows children to improve their aesthetic literacy through hands-on activities. These aesthetic education activities continuously extend the reach of art in assisting rural construction, further nourishing beautiful souls and cultivating a civilized rural atmosphere.

3.2. Cultural advancement as a driving force

Cultural development is a crucial component of rural revitalization. Revitalizing rural culture through art cannot be confined to the activation of local traditional resources. According to Zhang Ying, a researcher at the Sichuan Fine Arts Institute, revitalizing rural culture requires a holistic approach, encompassing concepts such as harmony between nature and humanity, urban-rural integration, and the coexistence of beauty and utility. By utilizing the unique aesthetic forms of the region, it can embody people’s pursuit of a better life ^[11]. This implies that art’s involvement in rural construction should not merely create simplistic visual landscapes or exist as an isolated artistic behavior. Instead, it should generate value and meaning that local residents are willing to accept, promoting material prosperity and spiritual enrichment. The design and renovation of Qingtian Village in Shunde District, Foshan City, Guangdong Province, can be considered a beneficial exploration. Designers, based on the local history, environment, farming, and folk arts, employed emotional integration and multi-stakeholder interaction to guide villagers in rediscovering rural values and enhancing their cultural identity and sense of belonging through systematic artistic construction ^[12].

Making villages more conducive to business is a vital aspect of rural revitalization. Many regions have actively carried out relevant practices to activate local cultural resources and promote the benign interaction between rural cultural development and economic and social progress ^[13]. In Rongjiang County, Guizhou Province, artists, architects, designers, and local intangible cultural heritage inheritors gathered in the countryside to innovate and revitalize the ancient indigo dyeing craft ^[14]. Simultaneously, an increasing number of designers are attempting to unleash new momentum for rural development through project planning tailored to local conditions. In Jiunvfeng, northern Daolang Town, Daiyue District, Tai’an City, Shandong Province, designers utilized local natural resources to devise two eye-catching public spaces: the Jiunvfeng Study Room and the Soaking Pool. Respecting the original rural texture and mountain environment, they renovated villagers’ houses

and idle courtyards. This not only boosted local tourism but also drove local employment ^[15]. Creating regional IPs, building maker spaces, introducing emerging formats, and establishing homestay clusters. Various artistic practices with unique characteristics continuously expand new paths for rural revitalization.

Rural natural and cultural resources vary from place to place, and development paths differ accordingly. Regardless of the artistic form used to participate in rural construction, it is imperative to respect the history and cultural traditions of the village, its natural and ecological resources, and the villagers' lifestyle and customs. Only by providing design services rich in cultural connotation and quality from the perspective of "symbiosis" can people stimulate the endogenous driving force of the countryside.

3.3. School-local collaboration builds synergy

Art's participation in rural construction involves disciplines such as anthropology, sociology, economics, architecture, design, and art. This not only requires cross-disciplinary thinking for design planning but also demands multi-stakeholder involvement in implementation and co-construction.

Universities are crucial grounds for cultivating talent and are the main force behind art's participation in rural construction. This is evident in the art empowerment rural revitalization exhibitions held in various regions. To achieve sustainable development of art-driven rural revitalization, many universities have collaborated with localities, actively exploring talent cultivation mechanisms. For instance, the China Academy of Art adheres to the principle of "taking the countryside as the academy," establishing over 100 "Rural Academy" workstations in cities, towns, villages, and hamlets, forming a practical network rooted in Chinese soil. Every year, about 10,000 teachers and students travel to various places, leveraging their professional strengths to promote rural revitalization. The Sichuan Fine Arts Institute has also been committed to integrating art-driven rural revitalization efforts with the fundamental task of cultivating people with morality and talent. According to President Pang Maokun, the institute insists on the integration of cultural tourism and design-based poverty alleviation, parallel aesthetic education, and social education, contributing to the Sichuan Fine Arts Institute's experience in serving society through art. As an applied comprehensive university, Chongqing Institute of Engineering keeps pace with the pulse of national higher education reform and development in the new era. Based on its local and applied orientation, it focuses on the integration of industry and education, innovative education, and actively adapts to and serves local economic and social development needs. With "information technology +" as its professional talent training feature, it has cultivated a large number of high-quality, practical, and advanced professionals with "good foundations, high quality, and strong abilities", who have practically participated in the construction of beautiful and harmonious villages in Bayu. From a long-term perspective, whether it is to strengthen the construction of artistic talent teams or improve the interdisciplinary talent cultivation mechanism, it is of positive practical significance to offer professional directions related to rural construction in major universities.

4. Summary and outlook

The art-driven construction of beautiful and harmonious villages in Bayu requires the convergence of multiple forces. Establishing a mature and implementable artistic rural construction mechanism is key. At the new starting point of comprehensively promoting rural revitalization, it is crucial for culture and art to play their due roles in building a beautiful, prosperous, and harmonious socialist new countryside. The countryside provides inspiration for artistic innovation, while art empowerment fuels the revitalization of rural industries. Art's participation in rural

revitalization is a systematic project that requires systematic planning and a long-term perspective.

The art-driven construction of beautiful and harmonious villages in Bayu is an important task and mission entrusted to culture and art in the new era. Artistic creation can artistically process and transform local resources, thereby broadening villagers' income channels extended from local resources in the context of urban-rural integration and harmonious coexistence between humans and nature. This empowers the construction of livable, workable, and beautiful villages, realizing villagers' aspirations for a better life.

Based on the art-driven construction of beautiful and harmonious villages in Bayu, comprehensively promoting rural revitalization and building livable, workable, and beautiful villages is the inevitable path for rural development. Beautiful and harmonious villages should embody both formal beauty and cultural beauty. The goal of being "livable, workable, and beautiful" indicates that China's rural construction has generally transitioned from survival-oriented to development-oriented. The value of China's villages is not reflected through a single economic indicator but through a combination of economic, ecological, and cultural aspects. For the nation to be revitalized, the countryside must be revitalized. The rural construction action, which promotes rural creativity through artistic creativity, is not only the fulfillment of the mission of the times by artists and literary workers in the process of rural revitalization but also their commitment to realizing the Chinese Dream of national rejuvenation. Only by rooting art in local traditions and deeply integrating it into rural life can people paint a happy picture of the construction of beautiful and harmonious villages in Bayu.

Funding

2024 Chongqing Social Science Federation Research Project, "Promoting the Construction of 'Beautiful and Harmonious Villages in Bayu Region' in Chongqing with 'Rural Operation' as the Starting Point" (ZXXM202410009).

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Zhu Y, 2024, Art Empowerment Helps Rural Construction Reach a New Level, accessed on November 7, 2024. https://topics.gmw.cn/2024-05/16/content_37326645.htm.
- [2] Wu YL, 2023, Art Empowerment for Rural Revitalization — Building a Livable, Workable, and Beautiful Homeland. *People's Daily*, May 8, 2023, 2.
- [3] Mo WJ, 2023, *Finding the Soul of the Countryside*. Publishing House of Electronics Industry, Beijing.
- [4] Mo WJ, 2023, *Finding the Way for the Countryside*. Publishing House of Electronics Industry, Beijing.
- [5] Qiu LM, Qian J, Chen XM, et al., 2024, Research on Rural Development Paths Under the Concept of Rural Operation — Taking Xiaogucheng Village in Hangzhou as an Example. *Architecture and Culture*, 2024(3): 66–68.
- [6] Zhou CM, 2012, Exploration of Urban and Rural Overall Planning Based on the Concept of "Rural Management" — Taking the Urban and Rural Overall Planning of Kaijiang County, Sichuan Province as an Example. *Interior Design*, 2012(2): 42–48.
- [7] Shen MR, 2020, From Rural Construction to Rural Operation — The Effectiveness and Dilemmas of Government

Project Market Trusteeship. *Urban Planning*, 44(7): 9–17.

- [8] Tan Q, 2024, Reform and Tackle Difficult Problems to Build a Beautiful Bayu Countryside. *Contemporary Party Members*, 2024(19): 51.
- [9] Geng GL, 2024, Chongqing Liangping: Taking the “Liangping Path” Out of the Construction of a Beautiful Bayu Countryside. *Green China*, 2024(14): 8–15.
- [10] Wang C, 2024, Deeply Implementing the “Four Thousand Actions” to Build a Demonstration Area of a Beautiful Bayu Countryside. *Chongqing Daily*, April 23, 2024, 10.
- [11] Qian JC, 2024, Learning from the “Thousand Villages Demonstration, Ten Thousand Villages Renovation” Project Experience to Accelerate the Construction of a Beautiful Bayu Countryside Demonstration Area. *Chongqing Administration*, 25(2): 19–26.
- [12] Chongqing Municipal People’s Government, 2024, Implementation Opinions on Learning from the “Thousand Villages Demonstration, Ten Thousand Villages Renovation” Project Experience to Accelerate the Construction of a Beautiful Bayu Countryside and Solidly Promote Comprehensive Rural Revitalization. *Chongqing Daily*, April 10, 2024, 1.
- [13] Zhang L, 2024, Using the Experience of the “Thousand and Ten Thousand Project” to Build a Beautiful Bayu Countryside. *Contemporary Party Members*, 2024(5): 44–45.
- [14] Yang F, Zhang J, 2024, Learning from the Experience of the “Thousand and Ten Thousand Project” to Build the Rural Background for the Construction of a Modern New Chongqing. *Chongqing Daily*, January 6, 2024, 1.
- [15] Yan A, Zhao WP, 2024, Seeking the Way of Constructing a Beautiful Bayu Countryside. *Chongqing Daily*, January 5, 2024, 4.

Publisher’s note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Professional Managers and Rural Social Integration in the Context of Rural Revitalization: Dilemmas and Countermeasures

Yunqi Feng, Tingting Li*, Zixuan Qin

School of Economics and Management, Dalian University of Science and Technology, Dalian 116000, Liaoning, China

*Corresponding author: Tingting Li, ltt19900521@dlust.edu.cn

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: In the process of promoting the rural revitalization strategy, rural professional managers are crucial to the development of rural industries, and their integration with rural society affects rural revitalization. This study explores the development of rural professional managers through 355 valid questionnaires. It is found that the gender participation of the team is more balanced, but there is a large proportion of middle-aged, low-educated, and experienced people. They face problems such as low salary, low satisfaction, and insufficient interaction with villagers, and are also constrained by the shortage of talents, insufficient policy support, and imperfect remuneration and incentive mechanisms. For this reason, the introduction of talent training should be strengthened, the policy support system should be improved, and institutional innovation should be promoted to facilitate integration and the implementation of the rural revitalization strategy.

Keywords: Rural revitalization; Rural professional managers; Rural social integration

Online publication: April 3, 2025

1. Introduction

By 2023, the China Central Government's No.1 Document delineated pivotal objectives for the comprehensive advancement of rural revitalization, underscoring the significance of intensified endeavors in promoting digital rural development^[1]. The integrated development of the rural industry requires the cooperation and division of labor among multiple subjects, the effective docking of multiple elements, the integration of multiple types of resources, and the sharing of information on multiple platforms, and it is a systematic project. However, China's rural areas have long been in a state of development without governance, and this situation must change^[2]. With the promotion of the rural revitalization strategy, the role of rural professional managers has become increasingly important as key promoters of rural industrial development. The study found that external rural professional managers mainly face the dilemma of four dimensions: institutional integration, resource integration, economic

integration, and cultural integration^[3]. This constitutes a major obstacle to its effectiveness.

2. Development status of rural professional managers in the context of rural revitalization

2.1. Basic information

In this study, a total of 355 questionnaires were collected, and after excluding 0 invalid questionnaires, 355 valid questionnaires remained, with an effective rate of 100%, and the output results are shown in **Table 1**.

The gender distribution of rural professional managers is balanced, with women accounting for 54.1% and men 45.9%. The 31–45 age group, making up 76.3%, is the main force, while the 18–30 age group has a low participation rate of 7.3%. 68.7% have a high school education or below, indicating the overall educational level needs improvement. Those with 3–5 years of experience account for 64.8%, showing some stability, but there are not enough long-term practitioners as those with less than 1 year account for 8.2% and those with more than 5 years only 12.4%. In summary, the proportion of middle-aged, low-educated, and experienced people is large, and the team structure needs optimization and overall quality upgrade.

Table 1. Descriptive statistical analysis of the survey sample

Demographic variables	Categorization	Frequency	Percentage
Gender	Male	163	45.9%
	Female	192	54.1%
Age	18–30 years	26	7.3%
	31–45 years	271	76.3%
	46–60 years	38	10.7%
	60 years and over	20	5.6%
Educational background	High school and below	244	68.7%
	Junior college	41	11.5%
	Undergraduate	47	13.2%
	Master's degree or above	23	6.5%
Working experience	Less than 1 year	29	8.2%
	1–3 years	52	14.6%
	3–5 years	230	64.8%
	More than 5 years	44	12.4%

2.2. Correlation analysis between job satisfaction and monthly income

Table 2 shows that the Spearman's correlation coefficient is 0.543, indicating a moderate positive relationship between job satisfaction and monthly income. The P -value of $0.007 < 0.01$, close to zero and much lower than the common significance level, clearly demonstrates a strong positive correlation between the monthly income range and job satisfaction among rural managers. In other words, as monthly income rises, the job satisfaction of rural managers also increases.

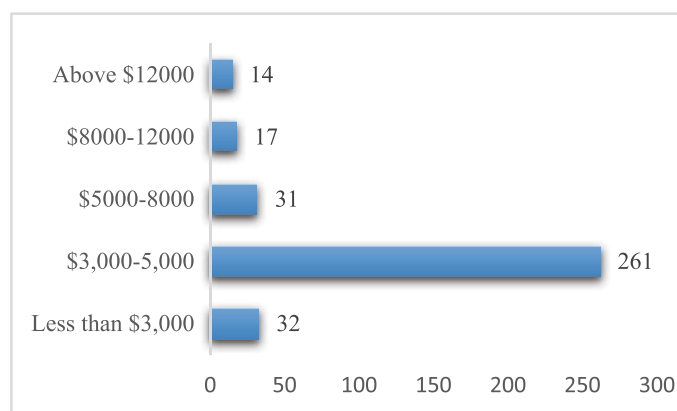
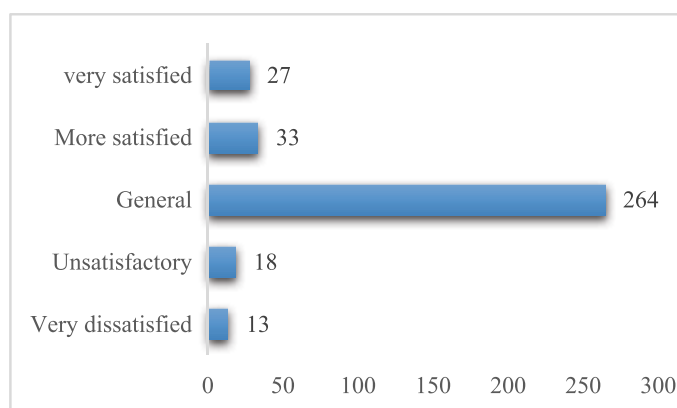
Table 2. Correlation analysis between job satisfaction and monthly income

	Variant	Job satisfaction	Monthly income range
Spearman's rho		1	.543**
	Job satisfaction		0.007
		355	355
		.543**	1
	Monthly income range	0.007	
		355	355

Note: **The correlation is significant at a confidence level (two-test) of 0.01

Among the surveyed rural professional managers, **Figure 1** shows that about 73% have a monthly salary of 3,000–5,000 yuan, indicating a relatively low salary level. **Figure 2** reveals that around 74% report an average job satisfaction, reflecting a lack of work experience and professional fulfillment.

This low-satisfaction and low-salary situation not only hinders rural professional managers' personal development but also thwarts rural revitalization. It dampens their enthusiasm, limits professional growth, and heightens talent-loss risks. As crucial for rural revitalization, their unstable employment seriously impacts rural industry, resource integration, and governance modernization, slowing rural revitalization's overall pace.

**Figure 1.** Manager monthly income range**Figure 2.** Managers' satisfaction with their current jobs

2.3. Correlation analysis between years of working experience and villagers' awareness level

As **Table 3** shows, the Spearman's correlation coefficient is 0.667, indicating a moderate positive correlation between working years and villagers' awareness. The P -value of $0.002 < 0.01$, close to zero and much lower than the common significance level, implies a strong positive correlation between the tenure of village managers and villagers' awareness of them.

Statistical data reveal that the average tenure of village professional managers is relatively short. Limited by this, they cannot fully build deep familiarity with villagers during interaction and communication, which in turn leads to their insufficient understanding of local rural culture.

Table 3. Correlation analysis table between years of working experience and villagers' awareness level

	Variant	Working experience	Level of awareness among villagers
		1	.667**
Spearman's rho	Working experience		0.002
		355	355
		.667**	1
	Level of awareness among villagers	0.002	.
		355	355

Note: **The correlation is significant at a confidence level (two-test) of 0.01

2.4. Multiple linear regression model

From the linear regression **Table 4**, the F value is 2.330 corresponding to the significance value less than 0.05, so this linear regression model is good. The monthly income range and job satisfaction variable t value is positive, corresponding to a significance value of 0.037 less than 0.05. In this model monthly income range significantly and positively affects the level of satisfaction with the job of rural managers. R-square value is 0.283, and the monthly income range explains 28.3% of the dependent variable satisfaction with the current job. Finally, the regression model is constructed as $\text{satisfaction with current job} = 0.102 * \text{Monthly income range} + 2.743$.

Table 4. Linear regression analysis table of independent variables on job satisfaction

Model	Non-standardized coefficient	Standardized factor		Significance	Covariance statistic	
	B	Trial version	t	Sig.	Tolerances	VIF
(Constant)	2.743		19.736	0		
Monthly income range	0.102	0.111	2.09	0.037	0.998	1.002
Low level of villagers' awareness of professional managers	-0.131	-0.086	-1.623	0.105	0.999	1.001
R ²			0.283			
(math.) F-value			2.330			

Note: a. Dependent variable: Satisfaction with the current job

3. Dilemmas facing the development of rural professional managers in the context of rural revitalization

3.1. Shortage of talent

In the context of unbalanced urban-rural development, significant disparities have long persisted between urban and rural residents in social public services like employment, education, social security, healthcare, and social infrastructure such as transportation. The city exerts a strong siphoning effect on the rural population, causing a large number of rural elite labor forces to leave, and the structural problems of the rural population's aging and low quality are becoming more and more prominent^[4].

Figure 3 indicates that in the educational structure of rural professional managers, high-school and below-high-school education accounts for 69%, reflecting a relatively low overall educational level. This may limit their ability to absorb new knowledge and management concepts. College education is 12%, bachelor's degree 13%, and master's degree and above 6%, showing a scarcity of highly-educated talents, in line with villages' talent-attraction difficulties.

Figure 4 shows that the 31–45-year-old age group, accounting for 76%, is the main force among rural professional managers. They have rich experience and energy, beneficial for rural development, but also suggest an aging trend in the team.

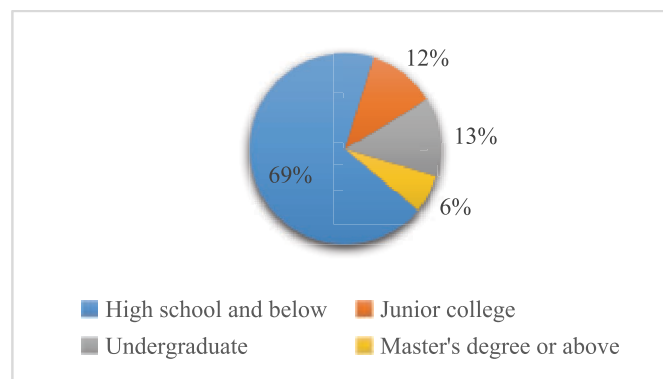


Figure 3. Educational background of managers

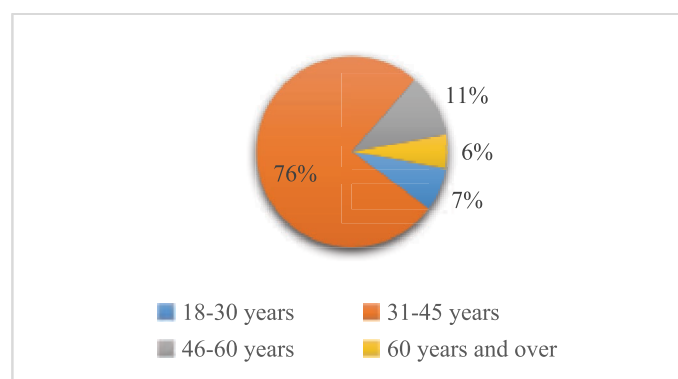


Figure 4. Age distribution of rural professional managers

3.2. Insufficient policy support

During the development of rural professional managers, the absence of specialized policy support obscures their development path. Current policies mainly target overall rural-industry development, with fewer supportive

measures for the specific group of professional managers. For instance, there are no unified standards for professional qualifications and practice norms, leading to varying competency levels of rural professional managers in the market. Meanwhile, the issue of unclear rights and responsibilities is prominent, and the boundaries of responsibilities among government departments, village collectives, and professional managers need to be clarified. In project promotion, overlapping management or management vacuums often occur, reducing decision-making and implementation efficiency.

3.3. Inadequate remuneration and incentive mechanisms

Low pay undermines the stability and attractiveness of rural professional managers. Compared to urban counterparts, they face harsher working conditions and lower salaries, hampering rural talent-attraction (**Figure 5**). Moreover, the lack of effective incentives, mainly short-term material rewards without long-term ones like equity incentives, fails to fully motivate them. This causes managers to focus on short-term gains at the expense of long-term rural industry development. Thus, establishing a reasonable salary system, raising pay levels, and creating a diversified long-term incentive mechanism are crucial to boosting their motivation and creativity.

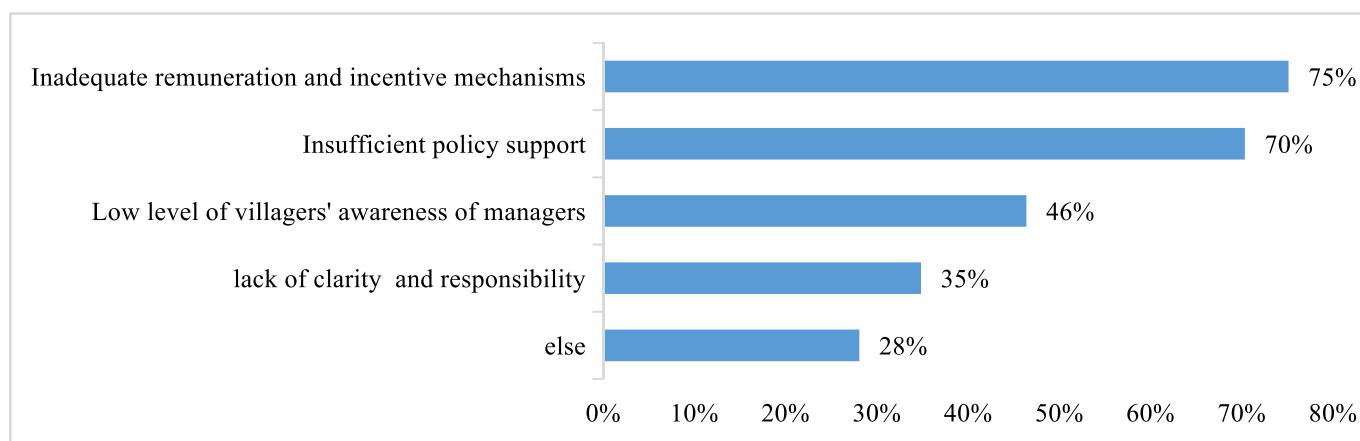


Figure 5. Difficulties encountered in the work of rural professional managers

4. Policy recommendations to promote rural professional managers and rural social integration

4.1. Strengthening the cultivation and introduction of talents

With the proposal of a rural revitalization strategy, the demand for talents in rural development is increasing, the countryside needs a large number of cultured, technologically savvy, managerial, good management, and rural-loving practical talents ^[5]. Set up a talent exchange and cooperation platform to draw outstanding urban talents to rural areas. Meanwhile, optimize the talent-training mechanism by regularly organizing on-the-job training to update professional managers' knowledge structures, enabling them to adapt to evolving market demands and industrial development trends. It is also essential to strengthen rural talent training and introduction to improve the competitiveness and innovation capability of rural industries ^[6].

4.2. Improving the policy support system

The government plays an active role in encouraging and guiding enterprises and individuals to participate in

the development of rural industries through policies, regulations, financial support, and the optimization of the business environment ^[7]. To improve the policy support system, the government should act multi-dimensionally. In policy-making, introduce preferential policies like tax cuts and subsidies to encourage participation. Strengthen regulation by improving laws to protect rights and standardize behavior. In finance, guide institutions to offer low-interest loans and micro-credit. Optimize the business environment by simplifying approvals and lowering access thresholds to attract social resources for rural development.

4.3. Promoting institutional innovation

Establishment of a mechanism for entry and exit from the industry. In terms of entry, qualification standards covering management ability, agricultural knowledge, professional ethics, and other dimensions will be formulated, and certification and assessment will be carried out by professional organizations to ensure the quality of practitioners. When exiting, based on clear specifications, the performance does not meet the standards, violators of the timely withdrawal, to protect the vitality of the industry and standardization. At the same time, strengthen the resource integration system innovation. Build a resource-sharing platform, break the barriers to the circulation of factors, promote the optimal allocation of land, capital, technology, and other resources, guide rural professional managers to participate in resource integration and synergistic development, and help rural industrial upgrading and revitalization through institutional innovation.

5. Conclusion

This paper, through questionnaires and data analysis, studies rural professional managers and their integration into rural society during rural revitalization. The current rural professional manager team has a balanced gender ratio but is mainly middle-aged with low education. Their low salaries, which greatly influence job satisfaction, impede both personal development and rural revitalization. Also, short working years lead to limited interaction with villagers and poor understanding of rural culture. Facing dilemmas such as talent shortages, insufficient policy support, and an imperfect salary-incentive mechanism, the paper proposes solutions including strengthening talent cultivation and introduction, building exchange platforms and improving training; enhancing the policy support system in policy, regulations, and finance aspects; and promoting institutional innovation by setting up a reasonable entry-exit mechanism and strengthening resource-integration systems to boost their integration into rural society and rural revitalization.

Funding

2025 College Students' Innovation and Entrepreneurship Training Plan Project "Rural CEOs to Help the Internet of Things Forestry Carbon Research on Innovation and Agricultural Development of Sink Models"

2024 College Students' Innovation and Entrepreneurship Training Plan Project "Innovation and development of the forestry carbon sink mode of the Internet of Things under the domain" (Project number: 202413207008)

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Luo G, Yang Y, Wang L, 2023, Driving Rural Industry Revitalization in the Digital Economy Era: Exploring Strategies and Pathways in China. *Plos One*, 18(9): e0292241.
- [2] Xiang HX, Zhai BL, Yang Y, 2024, The Realization Logic of Rural Revitalization: Coupled Coordination Analysis of Development and Governance. *Plos One*, 19(6): e0305593.
- [3] Zeng Y, Ma Y, Li X, 2024, Settle Down in an Unfamiliar Village. *Youth Studies*, 2024(4): 42–55 + 95.
- [4] Tang LX, 2021, Practical Exploration of Talent Demand and Solutions under the Rural Revitalization Strategy. *Guizhou Social Sciences*, 2021(1): 161–168.
- [5] Wei HK, 2018, Talent: The Most Critical and Dynamic Factor in Rural Revitalization. *Rural Work Communications*, 2018(9): 45.
- [6] Yue A, Nekmat E, Beta AR, 2019, Digital Literacy Through Digital Citizenship: Online Civic Participation and Public Opinion. *Evaluation of Youth Minorities in Southeast Asia*, 2019(7): 100–114.
- [7] Luo G, Yang Y, Wang L, 2023, Driving Rural Industry Revitalization in the Digital Economy Era: Exploring Strategies and Pathways in China. *Plos One*, 18(9): e0292241.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Promoting Healthier Sugar Intake Habits

Jintong Liu*

Johns Hopkins University, Maryland 21218, United States

*Corresponding author: Jintong Liu, jliu359@jh.edu

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Sugar intake regulation is a huge public health problem in the United States, as excessive and insufficient consumption carries significant health risks. On the other hand, a lack of adequate sugar intake, often related to restrictive eating habits or health conditions such as diabetes, can lead to hypoglycemia, fatigue, dizziness, and many other adverse effects. While knowledge is growing about the health consequences associated with excessive sugar consumption, many Americans still find it very difficult to achieve a healthy balance in their diets.

Keywords: Sugar consumption; Dietary behavior; Health education; Marketing influence; Nutrition awareness

Online publication: April 3, 2025

1. Introduction

Marketing plays a central role in influencing dietary choices, particularly through targeted campaigns that present sugary products as either appealing or deceptively healthy. Sugar-sweetened beverages make up nearly half of the added sugar consumed by people in the United States, making them a leading contributor to excessive sugar intake. To compound this problem, processed food products with hidden sugars further exacerbate this, making it difficult for consumers to make healthy choices. Moreover, socioeconomic disparities play a critical role in dictating eating habits, as it makes excessive sugar intake more probable in younger age groups, economically disadvantaged families, and individuals from certain geographical regions. Another factor is psychological: ignorance about nutrition and social influences, which exacerbates the trend because most people would rather opt for taste, convenience, or price over health.

To address these challenges, this study proposes a multi-pronged approach that targets the root causes of excessive and insufficient sugar consumption. Personalized nutrition education is essential to ensuring people gain the necessary knowledge to make informed diet choices. A tailored online forum, together with community workshops, would provide access to information and tools to guide consumers toward better behavioral practices, focusing on the risks emanating from high and low sugar consumption levels. Applying simpler food labeling, such as color coding, would make it easier to identify products that conform to their dietary needs. To further encourage

healthier choices, behavioral cues such as “Smart Sugar Choices” tags at retail stores and restaurants can nudge people toward better choices. Leveraging technology, a customized app could help people track their sugar intake, plan meals, and receive personalized reminders to maintain balance. In addition, social media campaigns would help create awareness and institute the normalization of healthier habits through engaging content that highlights the importance of balanced sugar consumption.

2. Current situation

Managing healthy sugar intake has long been an important public health issue in the United States. A survey conducted in 2021 indicates that about 38.4 million Americans of all ages are reported to have diabetes, accounting for roughly 11.6 percent of the U.S. population ^[1]. Excessive or insufficient sugar intake both cause harm to human health. On the one hand, excess sugar consumption has been associated with increased obesity rates, type 2 diabetes, cardiovascular disease, and tooth decay. Conversely, consuming too little sugar, which is often caused by restrictive diets or underlying medical disorders such as diabetes, can result in hypoglycemia, lightheadedness, lethargy, and other negative health consequences.

In defining the sugars people consume, sugars such as sucrose, fructose, and glucose that are added during the food production or preparation process to enhance flavor are referred to as added sugars, while the naturally occurring sugars found in honey, fruit juices, and syrups are referred to as free sugars ^[2]. Since increasing evidence has associated free or added sugars with diabetes, heart disease, and dental decay, many organizations, including the World Health Organization (WHO) and the American Heart Association (AHA), have issued guidelines to promote healthy sugar consumption. However, research shows that the total sugar consumption in the United States has shown an upward trend in the past ten years, increasing from more than 10 million tons in 2009/2010 to more than 11 million tons in 2019/2020 ^[3]. Notably, excessive consumption of added sugars is widespread among American adults. The National Health and Nutrition Examination Survey (NHANES) 2017–2020 indicates that the average amount of added sugar consumed by US adults aged over 20 was 16.64 tsp, 19.28 tsp for men, and 14.19 tsp for women, substantially higher than the recommended amount of 9 tsp for men and 6 tsp for women by the American Heart Association ^[4–5]. Similarly, the survey shows that people’s average intake of added sugars as a percentage of calories was 12.7 percent, which equates to an average of 67.8 grams per day. However, according to the Dietary Guidelines for Americans 2020–2025, added sugars ought to constitute less than 10% of daily calories ^[6]. Therefore, despite the growing familiarity with the dangers of excessive added sugar, food containing added sugar is still very attractive to many people, and the behavior of excessive sugar consumption is still widespread.

3. Background analysis: The role of marketing in the problem

The heavy investment in marketing food high in sugar has had a profound impact on customers’ dietary choices. In digital life today, food advertisements and drinks high in sugar are so easily accessible to everyone. Children and teenagers are especially vulnerable to the influence of marketing. From posters on the street and snack shops to online ads and social media, “huge sums of money are spent to reach these groups because they influence family decisions on what to buy and because of their potential for brand loyalty” ^[7]. Starting from the children’s requests, food and beverages high in sugar enter the household and are eventually consumed by the family together, including the adults who buy those foods.

Even if they have no children, adults are also influenced by such advertisements. In a study about adults' exposure to unhealthy food and beverage marketing, researchers found that "television was the most prevalent location of marketing exposure...followed by digital marketing"^[8]. Similarly, just as children may ask their parents to buy sweets, adults who are highly exposed to unhealthy food and beverage marketing are likely to buy sweets for their children. Different age groups' food choices will influence each other, contributing to an unhealthy American population.

Some advertisements make the food appealing, while some intentionally make it look healthy. Sugary drinks are "the single largest source of calories and added sugar in the U.S. diet." Therefore, some businesses try to convince consumers that the drinks are calorie-free. In 2013, Coca-Cola initiated an anti-obesity advertisement that admitted the harm of sweetened soda and promoted its calorie-free beverages. However, it is still possible that the findings of the study a company refers to look favorable to its claim because it is funded by the company. Therefore, it may be misleading and lure customers to purchase such seemingly healthy drinks and still consume an unhealthy level of sugar unconsciously.

4. Primary research

This study utilized a survey to learn more about 52 participants and their sugar intake behaviors, challenges, and perceptions of sugar, which was the focus of the primary research and survey distribution that targeted friends and the Twitter community.

The scope of the project was a perfect match because the survey targeted the 25–45-year age group. The most common age group (25–35) accounted for 75% of participants, while those aged 25–30 (9.6%) and 31–35 (9.6%) formed smaller groups. 71.2% of respondents were male versus 26.9% female. By education, the large majority were well-educated, with 40.4% holding a master's degree and 34.6% a bachelor's. These demographics suggest that they are an informed audience who can consider health-related behaviors.

4.1. Sugar in food is a necessary source of energy

Participants rated their knowledge of health risks posed by high and low sugar consumption on a scale from 1 to 5. For high risks related to excessive sugar use, the mean score was 3.54 with a median of 4, suggesting moderate to high awareness. There was relatively low awareness of insufficient sugar risks (mean 2.63, median 2).

4.2. Sugar consumption behaviors

The frequency of sugary food or beverage consumption was categorized as follows: 19.2% eat sweet foods several times a day; 31.9% eat them a few days a week; 5% eat sugary foods infrequently.

Only 15.4% of people actively track their sugar consumption. 69.2% considered their diets to be "balanced" in sugar content, even though they appeared to be sticking to extremely simple carbohydrates, suggesting either they were unaware or things were going unseen.

4.3. Obstacles facing sugar reduction

The survey found several significant challenges: 55.8% stated that lack of motivation was a significant barrier; 48.1% said they had trouble finding low-sugar products; 26.9% said they were expensive or had high prices.

These results indicate both behavioral and structural barriers, emphasizing relevant domains for intervention.

4.4. External factors behind sugar consumption

Social and cultural factors driving sugar consumption: 65.4% said they were moderately to very influenced by advertising (mean: 3.64; median: 4); 42.3% said that social gatherings usually mean they eat more sugar.

These findings highlight the opportunities for targeted behavior change, which may be driven in part by a better understanding of the marketing and social environments that shape dietary decisions.

4.5. Proposed solutions

Participants offered practical strategies for managing sugar consumption: 73.1% requested clearer labeling on food packaging; 51.9% favored having access to more healthful food choices that cost less; 50% stressed the need for educational resources to inform about sugar levels and health consequences.

These responses map onto consumer requirements of transparency, affordability, and accessible knowledge, reinforcing the efficacy of targeted interventions.

The survey highlights important opportunities to influence consumer behavior regarding sugar consumption. An alarming lack of awareness surrounding the dangers of inadequate sugar intake further highlights the necessity for effective educational campaigns promoting sugar management. Several of the identified challenges, including the cost and access to low-sugar products, were grounded in structural barriers, underscoring the need for interventions at the level of the market itself and partnerships with food producers to make healthier options available and affordable.

Social and cultural factors contribute as well; 65.4% of respondents said advertising affects their decision-making, and many consume increased amounts of sugar during social events. These findings suggest opportunities for utilizing advertising and social dynamics to encourage behavior normalization of healthier consumption patterns.

To address the common challenges faced by event participants when consuming BBQ in the social setting and to address the needs of participants for clearer labeling, more affordable options, and education, consumers will be empowered to make informed choices, adopt healthier habits, and mitigate health risks related to imbalanced sugar intake. This method allows for long-term health gains.

5. Recommendations

To help people in the U.S. ages 25–45 reduce their sugar intake, the study has come up with some recommendations focused on education, small reminders, technology, and community involvement. These suggestions can make it easier for people to overcome common problems when trying to change their eating habits. The goal is to help people adjust a few simple habits that can reduce excess sugar intake while retaining a sense of well-being in their lives. It is easy to enjoy a healthy life by incorporating sugar control into daily life rather than seeing it as a burden.

The first idea is a software application that allows users to develop a customized nutrition plan. As a part of this program, the creators would explain to the users the consequences of over as well as under consumption of sugar and the nutrition that some extreme diets can provide to the body. First of all, they need to understand that eliminating sugar intake does not mean eliminating all carbohydrate intake but substituting mundane added sugar with required carbohydrates. To explain these ideas to the users of these programs, such websites and applications can incorporate catch phrases like “an excessive sugar intake can cause a person to age much faster.” This will allow people to visualize this program and, therefore, want to engage with it. For example, the study

designed software that people can use to customize the plan that works best for them. Through this plan, they can learn about the amount of sugar they are consuming each day, and the software will also remind them if they are consuming too much or too little.

A second idea is to use behavioral cues to encourage people to make healthier decisions, for example, by encouraging people to eat products that have less sugar. Low-sugar or naturally sweetened products may be carefully placed at grocery stores and restaurants to make it easier for people to pick such items. Labels such as “Smart Sugar Choices” can also assist the consumers to pick up healthy alternatives. There can also be wish or discounts in the purchase of healthier goods as an added desire for customers to better their selection.

Social media is also a great way to reach out to people. Such networks as Instagram, TikTok, or YouTube can be a way to go further and share new short recipes, encouraging stories and exciting challenges for people on how to reduce the amount of sugar they consume. These campaigns can also become more effective when done with health influencers. For instance, instead of reaching for sweets, one can decide to have fresh fruit, which is a much healthier way of satisfying a sugar craving. Such social media posts can show that even small changes in what people eat can have an impact on their lives. People have to be cautioned that the anti-sugar program is not designed to stress the recipient, but to give them this obviously useful idea and then educate them about what healthy ways suit them better in this respect.

Additionally, it would also be beneficial to self-management to consider what role technology could play with these changes. A special application could be developed that would allow consumers to control their intake of sugar, plan their meals, and receive messages tailored to them based on those eating habits. The introduction of features that enhance the user experience, such as badges and streaks, may maintain user interest and reduce burnout associated with the task. In addition, the study suggests paying attention to the way food products are labeled. The labels should indicate the grams of sugar present in a given product and indicate the percentage that this amount is relative to the recommended daily intake. This would provide clarity on what people consume and prevent false advertisement. With all these strategies combined, users can be supported to limit their sugar intake more effectively and sustainably. These ideas will not only assist in making healthier decisions on food but will also help reduce the chances of developing chronic diseases such as obesity and diabetes. This promotes self-efficacy through better tools, education, and community so that people can achieve eating and health goals.

6. Limitations

The method of distributing the questionnaire in lifestyle-related communities on Twitter itself involves several limitations that might question the validity and generalization of this study. The participants, by belonging to lifestyle-related communities, are thus already interested in health, wellness, or diet-related topics, leading to selection bias and a sample not representative of the broader 25–45 age group in the U.S. This approach also limits demographic representation, as it excludes people who are not active on Twitter or do not engage in such communities, potentially underrepresenting groups from lower socioeconomic backgrounds, rural areas, or those who are less digitally active. Moreover, while the survey targeted U.S.-based users, it does not ensure even geographical distribution, possibly missing regional dietary and socioeconomic variations.

Although these suggested remedies have shown some potential for reducing excessive sugar intake, some of their limitations might seriously impact the viability of the strategies. First, these strategies may not fit all socioeconomic and cultural backgrounds, especially those who struggle to access digital platforms, let alone those

with food insecurity. Second, much of the secondary data relies on NHANES and USDA reports, which may not accurately reflect recent changes in consumer behavior or subpopulations, and self-reported dietary data is prone to certain biases.

On the other side, significant economic barriers are to be found. For instance, programs involving subsidies for low-sugar products and meal kit company partnerships will necessitate large investments and find resistance among food industry partners. Moreover, behavioral change is complex: strong preferences for sweet tastes and aggressive marketing of foods may well work against education and labeling efforts. The proposed use of digital tools, such as personalized nutrition apps, is highly dependent on sustained user engagement and accessibility, which could exclude people with limited digital literacy or access to technology.

Regulatory challenges, such as introducing simplified labeling, must be implemented and accepted by food manufacturers, which may show some resistance. Lastly, although these recommendations can easily lead to temporary awareness and changes in behavior, their long-term feasibility and scalability are not assured. Hence, they require continuous adaptation, funding, and monitoring to ensure that real impact is created. Future research should fill these gaps to make the proposed interventions more inclusive and effective.

Disclosure statement

The author declares no conflict of interest.

References

- [1] U.S. Centers for Disease Control and Prevention, 2024, National Diabetes Statistics Report. <https://www.cdc.gov/diabetes/php/data-research/index.html>
- [2] Amoutzopoulos B, Steer T, Roberts C, et al., 2020, Free and Added Sugar Consumption and Adherence to Guidelines: The UK National Diet and Nutrition Survey (2014/15–2015/16). *Nutrients*, 12(2): 393.
- [3] Shahbandeh M, 2024, Sugar consumption in the United States from 2010/2011 to 2024/2025 (in million metric tons). <https://www.statista.com/statistics/249692/us-sugar-consumption/>
- [4] U.S. Department of Agriculture, Agricultural Research Service, 2023, Food Patterns Equivalents Intakes from Food: Mean Amounts Consumed per Individual, by Family Income as % of Poverty Level and Age, What We Eat in America, NHANES 2017–March 2020 Prepandemic.
- [5] Van Horn L, Carson JAS, Appel LJ, et al., 2016, Recommended Dietary Pattern to Achieve Adherence to the American Heart Association/American College of Cardiology (AHA/ACC) Guidelines: A Scientific Statement from the American Heart Association. *Circulation*, 134(22): 505–529.
- [6] Dietary Guidelines for Americans, 2020, Dietary Guidelines for Americans, 2020–2025, 9th Edition.
- [7] World Health Organization, 2024, Marketing of Unhealthy Foods and Drinks.
- [8] Nieto C, Jauregui A, Contreras-Manzano A, et al., 2022, Adults' Exposure to Unhealthy Food and Beverage Marketing: A Multi-country Study in Australia, Canada, Mexico, the United Kingdom, and the United States. *The Journal of Nutrition*, 152(Suppl 1): 25–34.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

The Role and Challenges of Environmental and Resource Protection Law in Addressing Climate Change

Yu Gao*

Hainan University, Haikou 570228, China

*Corresponding author: Yu Gao, 22210301000056@hainanu.edu.cn

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: With the increasingly serious problem of climate change, environmental and resource protection law plays an increasingly important role in dealing with climate change. This paper first analyzes the basic framework of environmental and resource protection law under the background of global climate change and clarifies its important functions in slowing down greenhouse gas emissions, promoting green development, and promoting sustainable resource utilization. Through a systematic review of relevant domestic and foreign laws and regulations, it is found that China's existing environmental and resource protection law has made some progress in addressing climate change, but it still faces many challenges in policy implementation, law application, and public participation. Specific problems include the conflict between the application of climate change and traditional environmental protection laws, the lag of relevant legislation, and the inadequacy of cross-sectoral coordination mechanisms. To address these challenges, the paper proposes to strengthen the coordination of law and policy, promote independent legislation of climate change law, improve legal monitoring and enforcement mechanisms, and enhance public participation. The research shows that only by improving the relevant legal framework can the government effectively promote the legal protection system of China's response to climate change and contribute to global climate governance.

Keywords: Environmental and resource protection law; Climate change; Legal challenges; Public participation; Global climate governance

Online publication: April 3, 2025

1. Introduction

Climate change is an increasingly serious problem, which has a significant impact on ecological, economic and social life, and has become a major global challenge. In this regard, environmental and resource protection law, as a key tool to mitigate the problem, promote green development, and sustainable use of resources, must meet new challenges. However, many countries, especially China, face implementation problems, limited legal

scope, and inadequate coordination mechanisms. Scholars have proposed solutions, including special legislation, strengthening legal supervision, and public participation. However, how to increase the coordination of laws and policies and solve the cross-departmental coordination still needs in-depth research. Therefore, this paper focuses on the role and challenge of environmental protection law in coping with climate change, puts forward suggestions to improve China's legal system of coping with climate change, and hopes to contribute legal support to strengthen China's position in global climate governance.

2. Overview of environmental and resource protection law

2.1. Basic concept and development process of environmental and resource protection law

As an important branch of environmental law, environmental and resource protection law has attracted wide attention worldwide in recent years ^[1]. Its basic concepts mainly include the rational use and protection of natural resources, the maintenance of the ecological environment, and the support for the sustainable development of mankind. This legal framework aims to protect and improve the environment through legislative means, prevent pollution and other environmental hazards, safeguard human health, and promote the sustainable use of natural resources. Since the middle of the 20th century, with the acceleration of the global industrialization process and the prominence of environmental problems, countries have generally begun to build and improve the legal system of environmental and resource protection. The 1970s of the last century is regarded as the founding period of modern environmental law, and the successive promulgation of various international environmental treaties and regulations marked a new stage in the development of environmental and resource protection law. In the 21st century, the law on environmental and resource protection has been further refined and enriched, covering such areas as climate change, biodiversity, and pollution prevention and control, and gradually forming a legal and normative system that emphasizes both protection and development. This legal framework has played an irreplaceable role in promoting international cooperation, coordinating national policies, and contributing to global ecological governance.

2.2. Legal framework in the context of global climate change

The extensive impact of global climate change on human society and the ecosystem has prompted the international community to gradually form a set of legal frameworks to deal with climate issues. This framework, with the United Nations Framework Convention on Climate Change (UNFCCC) at its core, aims to mitigate greenhouse gas emissions and adapt to the effects of climate change through international cooperation. Important agreements within the framework, such as the Kyoto Protocol and the Paris Agreement, have established detailed emission reduction targets and long-term global warming limit targets, respectively, and stressed the importance of countries' intended contributions. The international climate legal framework also focuses on supporting the financial and technological needs of developing countries to achieve equitable and sustainable development ^[2]. To maximize the effectiveness of implementation, other international organizations and multilateral environmental agreements also play a coordinating and complementary role under this framework to promote legal and policy coherence among countries.

2.3. Main functions and objectives of environmental and resource protection law

The main functions of environmental and resource protection law include the prevention and control of environmental pollution, the protection of ecosystems and biodiversity, the rational use and protection of natural

resources, and the optimization of the human living environment ^[3]. Its goal is to promote the harmonious development of the environment and the economy and ensure the sustainable progress of society. Through legal means, the environmental and resource protection law is committed to reducing environmental damage, preventing the misuse of resources, promoting cleaner production and green technology innovation, enhancing public awareness and participation in environmental protection, and realizing the construction of ecological civilization and the modernization of the environmental governance system. The legal framework provides an important institutional guarantee and action guide for the global response to climate change.

3. The role of environmental and resource protection laws in addressing climate change

3.1. Legal measures to mitigate greenhouse gas emissions

The Environmental and Resource Protection Act plays a key role in mitigating greenhouse gas emissions. As an important legal tool to deal with climate change, its main focus is to force the reduction of major greenhouse gas emissions through legislation. Such legal measures include the setting of emission standards, the implementation of carbon emissions trading systems, and the combination of incentives and penalties. Emission standards are set to provide safe thresholds for greenhouse gas emissions from industries and ensure that industrial activities are carried out at sustainable levels ^[4]. As a market-oriented means, the carbon emission trading system promotes enterprises to achieve emission reduction targets at the lowest cost and stimulates enterprises' willingness to innovate in environmental protection through the trading of carbon credits. For different economic entities, the law also sets a variety of economic incentives to encourage the use of clean energy and energy efficiency. These statutory measures not only help control greenhouse gas emissions but also provide legal protection for the transition to a low-carbon economy and promote the development of industries in a green and sustainable direction. The effective implementation of these legal means is directly related to the mitigation of climate change and the effectiveness of global environmental governance.

3.2. Legal guarantee for promoting green development

Green development, as an important strategy to deal with climate change, depends on strong legal protection. The Environmental and Resource Protection Law encourages enterprises and society to transition to a low-carbon economy through mechanisms such as technical standards, industrial policies, and tax incentives. These laws provide incentives for green technology innovation and the development and use of renewable energy sources to reduce dependence on fossil fuels. By establishing a market access system for environmental protection industries, the law ensures efficient and sustainable use of resources and promotes the transition of consumption patterns to green products ^[5]. The Environmental and Resource Protection Law also effectively regulates land use and urban planning, prevents ecological damage, and provides institutional support for the construction of ecological civilization. These legal measures not only help to enhance the competitiveness of the green economy but also provide a legal guarantee for the coordinated development of the economy, society, and environment to promote the realization of global climate governance goals.

3.3. Legal support for sustainable resource use

Environmental and resource protection laws provide critical legal support in promoting sustainable resource use. The formulation of relevant laws and regulations to regulate the development, use, and regeneration of resources

effectively reduces the risk of resource waste and over-exploitation. The legal framework requires strict resource management policies to promote the development and use of clean energy to reduce dependence on non-renewable resources. The law also encourages and regulates ecological compensation mechanisms to maintain the integrity and sustainability of the ecosystem ^[6]. The implementation of regulations is not only committed to protecting natural resources but also to promoting the recycling of resources, supporting technological innovation and industrial transformation, and ultimately achieving a win-win situation of economic and environmental benefits, providing a strong guarantee for tackling climate change.

4. Comparison of the current situation of domestic and foreign environmental and resource protection laws in response to climate change

4.1. International legal framework and practice of climate change

The international legal framework on climate change mainly consists of a series of multilateral treaties and agreements, with the United Nations Framework Convention on Climate Change and the Paris Agreement as the core. The United Nations Framework Convention on Climate Change lays the foundation for the global response to climate change, with the goal of stabilizing greenhouse gas concentrations in the atmosphere ^[7]. The Paris Agreement defines the long-term goal of keeping global temperature rise below 2 degrees Celsius and working to limit it to 1.5 degrees Celsius, with countries developing and updating their nationally determined Contributions (NDCS). International legal practice emphasizes the common but differentiated responsibilities of States concerning mitigation, adaptation, and financial support.

4.2. Progress of China's environmental and resource protection law in addressing climate change

In recent years, China has made a series of important steps in addressing climate change by using the environmental and resource protection law. Through the gradual improvement of the relevant legal framework, a series of targeted policies and measures have been implemented. The revision and implementation of environmental protection laws and regulations, such as the Air Pollution Prevention and Control Law and the Water Pollution Prevention and Control Law, have played a driving role in the control of greenhouse gas emissions and the optimization of the ecological environment ^[8]. The Environmental Protection Law clearly puts forward the promotion of green development and low-carbon transformation, which provides a legal guarantee for tackling climate change. The state has stepped up efforts in the field of energy structure adjustment, supported the development and utilization of clean energy through the Renewable Energy Law and other legislation, and effectively promoted the reduction of carbon emission intensity.

4.3. Differences and experiences between China and foreign countries

There are significant differences in environmental and resource protection laws between China and foreign countries in dealing with climate change. Internationally, most countries have established a special climate change legislation system, emphasizing coordinated global governance and clear powers and responsibilities. In contrast, China's legal system mainly deals with climate change indirectly through relevant environmental laws and lacks an independent climate legal framework ^[9]. International experience has shown that comprehensive legislation and effective implementation are crucial to combating climate change. Drawing on international experience, China should focus on improving relevant legislation, strengthening enforcement, and strengthening international

cooperation to enhance the contribution of its laws in climate change governance.

5. Challenges faced by China's environmental and resource protection law

5.1. Conflict between law application and climate change

In response to climate change, environmental and resource protection law faces a significant conflict between the application of law and the needs of climate change. Traditional environmental protection laws mainly focus on local and regional pollution issues, and the targeted provisions mainly focus on pollution control and natural resource management ^[10]. As a global challenge, climate change has a wide and complex impact, which requires transnational and cross-sectoral cooperation and coordination. In particular, existing legal mechanisms are inadequate to address the scale of greenhouse gas emissions and their long-term effects.

5.2. Difficulties and delays in policy implementation

China's environmental and resource protection law has difficulties and lags in the implementation of climate change policies, which are mainly manifested by regional differences in policy implementation effects, unreasonable resource allocation, and insufficient coordination among departments. Policies related to climate change often involve multiple fields and sectors, but the lack of a unified coordination mechanism, cross-functional or unclear responsibilities between departments has affected the efficiency of policy implementation. Some local governments have insufficient enforcement of environmental and resource protection laws, and there is a phenomenon that economic development is more important than environmental protection. Especially in economically underdeveloped areas, environmental protection policies are often weakened or circumvented due to local interests ^[11].

5.3. Deficiencies of public participation and cross-field coordination mechanisms

The inadequacies of public participation and cross-disciplinary coordination mechanisms pose significant challenges to the effectiveness of China's environmental and resource protection law in addressing climate change. The degree of public participation is limited, legal awareness and environmental awareness still need to be strengthened, and the actual influence of the public in the decision-making process is insufficient ^[12]. The lack of an effective cross-field coordination mechanism leads to poor information among departments, disjointed policy implementation, and low resource utilization efficiency. Unclear division of responsibilities and sector-driven interests weaken the enforcement of laws on complex climate issues, and more coordinated mechanisms are urgently needed to improve the overall response.

6. Legal challenges and improvement suggestions in addressing climate change

6.1. Strengthen the coordination of laws and policies

Strengthening the coordination of environmental and resource protection laws and policies is an important direction to address the legal challenges of climate change. In the existing legal system, the issue of climate change often involves the intersection of policies and laws in multiple departments and fields, and the fragmentation of the existing system and the lack of a coordination mechanism between departments have limited the efficiency of policy implementation. This problem is particularly prominent in greenhouse gas emission reduction policies, energy transition planning, and natural resource management ^[13]. A collaborative governance framework of law

and policy should be constructed with integrated thinking to avoid the disconnection between legal provisions and policy objectives.

6.2. Promote independent legislation on climate change law

Promoting independent legislation on climate change law is a key way to address the legal challenges of climate change. Although the existing environmental and resource protection law covers the issue of climate change to some extent, its wide scope of application and traditional environmental protection objectives limit its effectiveness. The establishment of an independent climate change law can be more focused on greenhouse gas emission reduction and adaptation strategies to ensure that the law is precise and targeted. Independent legislation can also help streamline the distribution of legal powers and responsibilities and eliminate conflicts between regulations in the existing legal framework ^[14]. The new law should incorporate a future-oriented mechanism to address the rapidly changing global climate situation, improve policy flexibility and foresight, and provide clear legal guidance and compliance paths for governments and businesses at all levels.

6.3. Improve the legal supervision and enforcement mechanism

Improving the legal supervision and enforcement mechanism is the key to enhancing the ability of the environmental and resource protection law to address climate change. In the process of implementation, the existing legal supervision system often faces problems such as lax law enforcement and insufficient supervision, which affect the effectiveness of the law ^[15]. To strengthen law enforcement, it is necessary to establish an independent and authoritative legal supervision body, increase the severity of penalties for environmental violations, and raise the cost of violations. Cross-regional and cross-departmental law enforcement coordination should be strengthened to ensure consistency and comprehensiveness of policy implementation. Through the introduction of modern technological means to improve the transparency and efficiency of law enforcement, to provide a solid legal guarantee for tackling climate change.

7. Conclusion and prospect

7.1. Summarize the role and challenges of environmental and resource protection law

Environmental and resource protection law plays a key role in addressing climate change, including mitigating greenhouse gas emissions, promoting green development, and supporting sustainable resource use. By building a systematic legal framework, such laws provide a strong legal basis and guarantee for the formulation and implementation of various climate policies. In the process of global environmental governance, these laws and regulations have formed guidelines for action at the national and regional levels, promoted international exchanges and cooperation, and jointly addressed the challenges brought about by climate change.

Despite some positive progress, the Environmental and Resource Protection Law still faces many challenges in its implementation. Conflicts between the application of the law and climate change occur from time to time, because existing laws are mainly based on traditional environmental protection, which is difficult to fully cover the emerging field of climate change. There are also difficulties in the implementation of laws and policies, especially at the local level, where the intensity and speed of implementation often lag behind rapidly changing environmental needs. Further complicating matters is the lack of public participation and inadequate cross-cutting coordination mechanisms that impede the implementation of laws and effective responses to climate change.

7.2. Legal contribution to promoting global climate governance

The law has an indispensable role to play in the global response to climate change. Environmental and resource protection law is not only the embodiment of domestic policy but also can be an effective tool to promote global climate governance. Through the implementation of strict environmental laws and regulations, the international community can promote the joint mitigation of greenhouse gas emissions, including strengthening the legal responsibility of countries in climate agreements and improving the enforcement of international environmental agreements. This legalized binding mechanism provides countries with a clear framework for action to prevent shirking their responsibilities and contribute to the achievement of global climate goals.

The Environmental and Resource Protection Law provides legislative support for green technology and renewable energy and provides a legal guarantee for transnational technology transfer and innovation cooperation. This support can help to break down technical barriers and reduce the cost of acquiring green technologies, thereby accelerating their adoption worldwide. Through foreign environmental legislation and agreements, the government will promote the formation of a community of interests for sustainable development among countries and enhance the awareness of cooperation and synergy in global climate governance.

8. Conclusion

This study explores the role and challenges of environmental and resource protection laws in addressing climate change, with a particular focus on greenhouse gas mitigation, green development, and sustainable resource use. Assess the performance of the legal system on climate change by collating domestic and international laws. The study found that although China has made some progress in climate governance, there are still problems such as lagging legislation, conflicts of laws, insufficient cross-field coordination, and difficult implementation. Four suggestions were put forward for improvement: enhancing the coordination of environmental protection law and climate policy, promoting independent legislation on climate change law, improving legal supervision and enforcement mechanisms, and increasing public participation and transparency in implementation. However, there are still limitations in this study, such as the need for in-depth empirical research on the effect of law enforcement and learning from international experience. In the future, the implementation effect of the environmental law system should be evaluated in combination with practice, and interdisciplinary research should be strengthened to optimize China's climate rule of law system to better provide legal protection for global climate governance.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Liu WY, 2022, Challenges and Responses: Protection of the Great Wall under the Influence of Climate Change. *Natural and Cultural Heritage Research*, 7(4): 24–34.
- [2] Huang Y, Cui HH, 2011, Addressing the Challenge of Climate Change through Education. *Environmental Education*, 2021(7): 48–51.
- [3] Gong YJ, 2023, The New Challenge of Global Cultural Heritage Protection under Climate Change. *Chinese Philanthropists*, 2023(4): 121–125.

- [4] Journal Editorial Department, 2022, Jointly Addressing the Challenge of Climate Change. Disaster Reduction in China, 2022(4): 1.
- [5] Wang ML, Zhang JJ, 2022, Actively Responding to the Risks and Challenges of Climate Change. Financial Expo, 2022(20): 48–49.
- [6] Wu KJ, 2023, Legislation on Climate Change in Environmental Law System. Society by Law, 2023(6): 13–26.
- [7] Wu SB, 2012, Theoretical Construction of Property Rights System of Atmospheric Resources. Academic Exchange, 2012(10): 67–70.
- [8] Sun YH, 2024, Attributes of Environmental and Resource Protection Law. Journal of Southwest University of Political Science and Law, 26(5): 17–24.
- [9] Huang N, 2017, Research on the Reform of Environmental and Resource Protection Law Teaching. Journal of Higher Education, 2017(19): 135–137.
- [10] Zhang FL, 2012, On the Legal Construction of Environmental Protection and Resource Protection. Beauty & Times City, 2012(9): 35.
- [11] Luo ZY, 2022, Exploration on Ideological and Political Teaching Reform of “Environmental and Resource Protection Law” Course. Lucheng Journal, 2022(2): 53–58 + 96.
- [12] Yang HG, 2014, Exploration and Practice of “Environmental and Resource Protection Law” Course Teaching Reform. Law and Society, 2014(34): 223–224.
- [13] Rooi G, 2017, Analysis of Environmental and Resource Protection Law in the Context of “The Belt and Road”. Journal of Jiamusi Vocational College, 2017(10):153.
- [14] Yang YL, 2001, Strengthening the Legal Construction of Environmental and Resource Protection to Maintain Sustainable Economic Development. Proceedings on Environmental Protection for Sustainable Development in the 21st Century. Wuhan University Press, Hubei, 366–372.
- [15] Li AN, Hu CD, 2003, Review of Environmental and Resource Protection Law Studies. Times Law, 1(2): 112–120.

Publisher’s note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Training Strategies for Agricultural Product Online Live Streaming Sales Anchors

Wanru Zhu, Ramlan Bin Jantan*

Faculty of Art, Sustainability & Creative Industry, Universiti Pendidikan Sultan Idris, Tanjong Malim 35900, Perak, Malaysia

*Corresponding author: Ramlan Bin Jantan, ramlan@fskik.upsi.edu.my

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Under the wave of digitalization and the popularization of the Internet, the online live broadcast of agricultural products has gradually emerged and become a new driving force to promote the sale of agricultural products. To cultivate professional livestreaming of agricultural products, this paper puts forward a series of training strategies, aiming at improving the professionalism, practical ability, and market acumen of livestreaming of agricultural products, to promote the sustainable and healthy development of agricultural products e-commerce industry, and help rural revitalization and farmers' income increase. The online live broadcast anchors of agricultural products should be combined with the actual situation of their own live broadcast types. In daily training, the e-commerce anchors also need to have innovative thinking and learning abilities and be able to constantly try new live broadcast forms and content, as well as quickly learn new knowledge and skills. At the same time, they also need to have good psychological quality and coping ability, be able to flexibly respond to various emergencies in the process of live broadcasting, and maintain a professional image.

Keywords: Agricultural products; Network broadcast; New media; Anchors

Online publication: April 3, 2025

1. Introduction

Starting from 2022, with the increasingly standardized development of the e-commerce live streaming industry and the drive of new technologies such as 5G, augmented reality (AR), and artificial intelligence (AI), the field of live streaming has continued to innovate and develop, constantly exploring new business models and fields, and entering automotive, real estate, agriculture, and other fields, showing greater business potential and space for innovation.

According to the Special Research Report on the Development of China's Rural Digital Economy in 2024, the online retail sales of agricultural products in China in 2023 will reach 590 billion yuan, an increase of 11.0%. In 2023, rural online retail sales will reach 2,490 billion yuan, a year-on-year increase of 14.7%, and it is expected that its online retail sales will reach 2,871.1 billion yuan in 2025. In recent years, the growth momentum of China's

rural development has been obvious. Under a series of measures such as accelerating the improvement of rural logistics facilities and service shortcomings, rural e-commerce has developed vigorously and achieved remarkable results in the docking of agricultural production and marketing and agricultural transformation and upgrading.

In recent years, the development momentum of agricultural live broadcast has been strong, as one of the specific measures to implement the targeted poverty alleviation policy, radio and television stations, and online audiovisual platforms through “public service advertisement”, “short video”, “program +” and “live broadcast +” and other models to help poor areas to achieve product transformation, value transformation, sales transformation, expand the influence of product brands in poor areas, improve visibility.

At the same time as increasing the sales of agricultural products, the online live broadcast with goods is also chaotic. Some black anchors, false propaganda, fake traffic, selling fake products, etc., all make consumers feel discouraged when watching new live anchors, so it is difficult to produce trust. To better establish a long-term cooperative relationship, the key lies in the integrity of the farmer anchor management. Based on the current status of agricultural products, this paper gives some guidance and suggestions so that major online anchors can enhance service awareness and jointly maintain the long-term interests of both sides.

2. Preparation before live broadcast

2.1. The necessity of text preparation

2.1.1. Copywriting should be based on facts

The language expression of the e-commerce anchor in the live broadcast is related to the effect of the live broadcast with goods. Before the broadcast, the live broadcast team often sets the theme first, screens the products sold on the day, writes the script, and determines the process. The main broadcaster of agricultural products should prepare a detailed introduction script for each agricultural product, including the name, origin, characteristics, advantages and use methods of the product. Make sure that the knowledge of the product is in-depth and can be clearly and vividly communicated to the audience.

To have a more accurate and in-depth understanding of the products, it is suggested that merchants organize anchors to visit the production base of agricultural products, interact with farmers, and personally experience the planting, picking, and other processes of agricultural products. Such field experience activities can not only enable anchors to have a more comprehensive understanding of agricultural products, but also bring consumers a more real experience in the live broadcast.

2.1.2. Make clear the key information of products

The audio language expression of e-commerce anchors is not a simple correspondence between text and speech but a vivid, intuitive, and true reflection of the goods with goods. Anchors to convert the text into a voice language with appeal and appeal, must deeply understand, be familiar with the text content, and clear all links and processes, from the efficiency, the requirements of rapid, skilled, the quality, to have an accurate grasp of the text, especially some of the numbers, nouns, origin, welfare, price, to avoid making mistakes.

2.2. Preparation methods before live broadcast

2.2.1. Divide the text levels and clarify the live broadcast process

After the text is determined, the anchor should understand and clarify the content of each section of the live broadcast, further organize the natural paragraphs, and do a good job of merging and dividing. In terms of merging,

paragraphs with close internal connections are classified into one level. In terms of division, it is the division of the internal levels of a paragraph. Analyzing the script in this way will make the program process clearer and help the anchors of agricultural products express themselves methodically and clearly.

The live broadcast process is roughly divided into the opening link, product introduction link, interactive link, preferential information release link, and the end link. Anchors should make clear all the links in the preparation process.

2.2.2. Ensure the accuracy of voice

Many streamers think that e-commerce anchors are not professional hosts, so it does not matter if they mispronounce words. But this is wrong. E-commerce live broadcasting is not only a platform for commodity display and sales but also an important link for audience interaction, building trust, and brand image, while misreading characters may have a bad impact on the brand, cause dissatisfaction on the brand side, and may also send wrong information. Therefore, in the process of live broadcasting, attention should be paid to the standardized expression of voice.

2.2.3. Prepare the background information of the product

There is a wide variety of agricultural products, each with its own unique growing environment, planting methods, nutritional value, and other characteristics. When livestreaming with goods, the brand may also ask the anchor to tell stories related to the product, such as the brand story, the producer's anecdotes in the production process, the user's experience in the use process, the history of the product, the particularity of the product, the price comparison of the product, etc. Being familiar with the background information related to the product can also help the anchor better answer the audience's questions and concerns. During the live broadcast, if the anchor can answer these questions accurately, it can increase the trust and satisfaction of the audience and improve the interactive participation of the live broadcast.

2.2.4. Express the purpose clearly

Be clear about the audience's needs. Start by understanding who the audience group is, what they care about, and what their needs and expectations are for the product. Through market research and data analysis, the anchors can more accurately grasp the needs of the audience.

First, set the target of the live broadcast. A clear goal can be set before the live stream begins. How many sales do the anchors want to achieve through this live broadcast, increase in brand awareness, increase the number of fans, etc. Setting clear goals helps anchors stay focused during the livestreaming process and can evaluate the effect of the livestreaming in real time.

Second, clearly communicate the purpose. In the process of live broadcasting, the anchor should clearly convey their purpose. The anchor can briefly introduce the theme and purpose of the live broadcast to the audience at the beginning of the live broadcast so that the audience can have an overall understanding of the live broadcast. At the same time, in the process of live broadcast, it is necessary to constantly emphasize the purpose of the live broadcast, which can make the expression and attitude more detailed and accurate but also enhance the sense of communication so that the audience can stay focused.

3. Expression skills during live broadcasting

3.1. Object sense

E-commerce anchors should communicate with users, who cannot speak their own words, avoid speaking to the air, as the user is the anchor communication object. In the process of live broadcasting, anchors should clearly perceive the existence of the audience, and interact and express themselves according to the needs and interests of the audience.

First of all, the anchor should timely understand the audience's needs and feedback and understand their concerns and expectations for agricultural products. Through the data of the audience's bullet screen, comments, and purchasing behavior, the anchor can perceive the audience's interests and preferences, to adjust the live broadcast content and methods to better serve the audience ^[1].

Secondly, e-commerce anchors need to establish a positive interaction and communication relationship with the audience. They can build closer ties and cultivate intimate relationships with the audience by sharing their usage tips and experiences as well as engaging in interesting interactive games. This kind of interaction and communication can enhance audience engagement and stickiness and improve the conversion rate and sales effect of live broadcasts.

3.2. Accent

In expression, words or phrases are stressed according to the purpose of the statement, thought, and emotion. In the process of live broadcasting, e-commerce anchors without professional training will have flat voice tones, lack cadence, have less prominent sentence purpose, and have incomplete logical relationships. From the perspective of the audience, it is difficult to grasp the key information of the live broadcast, and it is easy to sound distracted and boring. Therefore, anchors accurately determine the stress when carrying goods in the live broadcast, which can make the meaning clearer and accurate, the purpose of the sentences more clear, the logical relationship more organized, and the emotional color more vivid.

The types of stress can be divided into juxtaposed stress, contrastive stress, echoing stress, progressive stress, watershed stress, and emphatic stress ^[2]. There are also three different ways of expressing stress: high and low, fast and slow, stopping and connecting, imaginary and real. It should be noted that the use of stress should be moderate; avoid excessive use of high and low sounds or loud and small sounds so that the listener is not uncomfortable.

3.3. Tone

Tone is the sound form of a sentence governed by the state of thought and emotional movement. The proper sound form can accurately reflect the movement of thoughts and feelings. The e-commerce anchor should impress and infect users through language when introducing products and recording drainage videos.

3.3.1. Positive and enthusiastic tone

E-commerce anchors need to maintain a warm and positive tone to stimulate viewers' desire to buy. For example, when introducing a popular agricultural product, the anchor tone can add some excitement: "Everyone look at this product, the sales are very good, it is really popular!" This kind of tone is warm and generous and has a certain appeal.

3.3.2. A cordial and friendly tone

During live broadcasts, a cordial and friendly tone can help e-commerce anchors build an intimate connection with their viewers. Anchors can interact with the audience with warm words, such as: “Dear audience friends, hello! Today I have brought you a very great product, I hope you like it!” This tone can bring you closer to your audience and increase intimacy ^[3].

3.3.3. A funny and humorous tone

In the live broadcast, proper humor can bring a relaxed and cheerful atmosphere, which can relieve the tension in the live broadcast room and keep the audience in a good mood to watch the live broadcast. Therefore, the e-commerce anchors can say some interesting things about the products, or funny stories. In some e-commerce live broadcast pictures, it is often seen that anchors fight wits and prices with merchants to benefit the audience. Such interactive design, as well as exaggerated tone actions, can deepen the audience’s impression of anchors and stimulate audience consumption.

The tone style of the anchor can be adjusted according to the live content and the reaction of the audience, and it remains flexible and changeable. In addition, anchors should pay attention to avoid exaggerating the tone to praise the quality of products so as not to make the audience resist.

4. E-commerce anchors need to have the basic ability

4.1. Innovative way of thinking

The way of thinking is very important in the impromptu oral expression of e-commerce anchors. In the highly competitive field of live e-commerce broadcasting, innovative thinking is a necessary ability for e-commerce anchors. Anchors need to constantly try new live broadcast forms, interactive ways, and marketing strategies to bring freshness and appeal to the audience.

4.1.1. Focus on content innovation

In the process of live broadcasting, anchors can choose unique themes, introduce fresh and interesting interactive segments, or adopt novel ways to introduce products. By offering different content, anchors can create a unique style of live streaming, thereby standing out in the highly competitive e-commerce live streaming market.

4.1.2. Technological innovation

With the development of science and technology, e-commerce anchors need to pay attention to and use the latest technological tools to improve the live streaming experience. For example, the use of virtual reality (VR) or augmented reality (AR) technology can give viewers a more intuitive understanding of the details of the product; Using artificial intelligence (AI) technology, intelligent recommendations can be made to improve shopping efficiency; Big data and algorithms can be used to more accurately understand the needs and interests of the audience, to provide personalized services.

4.1.3. Marketing strategy innovation

E-commerce anchors need to constantly explore new marketing strategies to improve conversion rates and sales. For example, it is possible to stimulate the audience’s desire to buy by holding limited-time discounts, full reduction activities, and giveaway sweepstakes.

4.2. The ability to improvise

Adaptability is one of the most important abilities of e-commerce anchors. In the process of live broadcasting, there may be various unexpected situations, such as technical problems, audience questions, product problems, etc., which require anchors to have good language organization and expression skills, rich product knowledge and experience, strong psychological endurance and adaptability, to maintain the smooth progress of live broadcasting and the satisfaction of viewers.

At the same time, anchors also need to have the ability to quickly adapt to new environments and new situations and be able to flexibly respond to the changing market environment and audience needs ^[4]. During the live broadcast, it is necessary to pay close attention to the data of the live broadcast room, such as the number of viewers, interaction rate, conversion rate, etc., to understand the live broadcast effect and adjust the live broadcast strategy according to the data.

4.3. Grasp the purchasing psychology of users

E-commerce anchors must understand the purchasing psychology of users in the process of livestreaming goods. Only by fully understanding and mastering the user's purchase psychology can we better put the words to the user's heart, and ultimately promote the placing of orders and increase sales.

4.3.1. The pursuit of affordable psychology

Most consumers want to be able to get good-quality products at low prices. Therefore, e-commerce anchors can meet users' affordable psychology through coupons, limited-time discounts and other promotional methods, prompting them to place orders.

4.3.2. The psychology of pursuing quality

Some users value the quality of goods more than the price. When recommending goods, anchors can highlight the brand, material, craft and other quality characteristics of the goods to meet the quality pursuit of users.

4.3.3. Herd mentality

Many users are influenced by others when making a purchase, especially when seeing a lot of people buying or reviewing it well. E-commerce anchors can take advantage of this psychology to show the hot sale of goods, user evaluations, etc., to increase users' confidence in buying.

4.3.4. The psychology of pursuing freshness

Users tend to be more interested in new and unique products. E-commerce anchors can recommend some new, strange, and creative goods to meet users' needs for freshness.

5. Advice on professional quality

5.1. Continuous learning and self-improvement

Agricultural product anchors need to have a deep understanding of the agricultural products they promote, including their growing environment, planting technology, nutritional value, market conditions, etc. Only by fully understanding the products can they deliver accurate and persuasive information to consumers.

The market for agricultural products is constantly changing, with new planting techniques and marketing

methods emerging one after another. Anchors of agricultural products need to maintain a continuous learning attitude and constantly improve their professionalism and market sensitivity.

5.2. Team cooperation

E-commerce anchors need to work closely with team members to complete live broadcast tasks together. Anchors need to communicate closely with the selection team, operation team, technical support team, etc., to ensure the smooth progress of live broadcasting. At the same time, anchors also need to work with team members to analyze live broadcast data and sum up experiences and lessons to continuously improve the live broadcast effect ^[5].

5.3. Establish a good cooperative relationship

Anchors of agricultural products can establish cooperative relationships with suppliers of agricultural products, agricultural experts, etc., to jointly promote agricultural products. By cooperating with professionals, they can improve their professionalism while also providing more valuable information to the audience.

6. Conclusion

In the digital era, live delivery of agricultural products has become a new model to connect farmers and consumers and promote the sale of agricultural products. To cultivate excellent livestreaming of agricultural products, anchors should not only pay attention to the training of basic knowledge but also improve their livestreaming skills.

In addition, related departments need to provide practical opportunities for livestreaming and pay attention to professional development and industry dynamics to ensure that anchors can keep up with market changes and provide valuable information for consumers. By formulating and implementing scientific and effective training strategies, the department can cultivate more high-quality and professional live streamers of agricultural products, and contribute to promoting the modernization and digital transformation of the agricultural industry.

Disclosure statement

The author declares no conflict of interest.

References

- [1] School of Broadcasting and Hosting Arts, Communication University of China, 2015, Foundation of Broadcasting and Hosting Creation. Communication University of China Press, Beijing, 83.
- [2] Li XY, Wu JJ, 2023, E-commerce Anchor Expression Training Course. Communication University of China Press, Beijing, 134.
- [3] He YH, 2015, On the Affinity of Program Host. Western Radio and Television, 2015(13): 135.
- [4] Yang TT, 2016, Control of Improvising Language Skills by Broadcast Hosts. New Media Research, 2016(19): 172–173.
- [5] Song YH, 2021, Research on Integrated Communication Strategy of Live Delivery of Agricultural Products, thesis, Hebei University.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

High-Speed Bandwidth Acquisition System Based on Intermediate Frequency Signal Processing

Ziming Yin*, Yunyu Wei, Kuo Wang

Xi'an Electronic Engineering Research Institute, Xi'an 710100, Shaanxi, China

*Corresponding author: Ziming Yin, changkong0309@sina.com

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: In the high-speed bandwidth acquisition and playback system, due to the current hardware conditions, it is impossible to directly sample the signal at the RF end. Therefore, first complete the down-conversion in the RF module, reduce the signal to the intermediate frequency, and then realize the digitization of the intermediate frequency signal. In response to this problem, a field programmable logic array chip (FPGA) and AD9680 were selected to process the intermediate frequency signal. Use AD9680 to collect the mid-band pass signal with a center frequency of 750 MHz and a bandwidth of 400 MHz as a signal source for test verification, and then pass through a parallel multiphase digital down-conversion module to achieve spectrum shifting. It is verified by testing that the design can normally process the intermediate frequency signal, and the out-of-band suppression reaches 60 dB, which meets the design requirements, has high stability, and has high application value in engineering applications.

Keywords: Software radio; IF signal; Digital down-conversion; FPGA; AD9680

Online publication: April 3, 2025

1. Introduction

With the rapid development of modern digital communication systems, the amount of data that systems need to process is constantly increasing, and the demand for data is also growing ^[1]. Currently, high-speed signal transmission systems receive and transmit signals that have been modulated into radio frequency (RF) signals. According to the current level of integrated circuit development, it is not feasible to directly sample RF signals. A more mature solution is the digital intermediate frequency (IF) reception technology ^[2]. First, an analog RF down-conversion circuit is used to convert the RF signal into an analog IF signal, which is then digitized.

The digital signal processing performed in the digital IF section generally takes two forms: implementation using a dedicated signal processor (DSP) or using a Field-Programmable Gate Array (FPGA) ^[3]. Developing with a DSP is very convenient and can reduce the development process. It is generally believed that to achieve good signal filtering effects, 100 operations are needed per sampling point. However, DSPs execute instructions

in a single cycle, and when the data sampling frequency is high, the data transfer rate will also be high, making it difficult for DSPs to handle. On the other hand, FPGAs are very suitable for processing data with high transfer rates. They have abundant internal logic resources available for use, short internal delays, and parallel processing capabilities. When paired with high-frequency system clocks, they can achieve very high data processing speeds.

2. Design theory analysis

2.1. Bandpass sampling theorem

If researchers want to sample a baseband signal with a spectrum of $(0, f_H)$, according to the Nyquist sampling theorem, the sampling rate f_s must be at least twice that of f_H . However, for the wideband signal required by this system (with a spectral range of $f_L - f_H$), if researchers still adopt a sampling rate greater than twice the highest frequency, it will waste a lot of unnecessary resources. As can be seen from the sampling theorem, the periodic extension of the sampled signal, if the chosen sampling frequency is inappropriate, will cause the extended spectrum to overlap with the original signal spectrum, making it difficult to recover the original signal. On both sides of the frequency band (f_L, f_H) , there are extension components $(-f_H + mf_s, -f_L + mf_s)$ and $(-f_H + (m+1)f_s - f_L + (m+1)f_L)$ generated by sampling^[4]. To avoid spectral aliasing, the condition in equation (1) must be satisfied.

$$\begin{cases} -f_H + mf_s \leq f_L \\ -f_H + (m+1)f_s \geq f_H \end{cases} \quad (1)$$

Where m is an integer greater than or equal to 0. By synthesizing equation (1), the following can be obtained:

$$\frac{2f_H}{(m+1)} \leq f_s \leq \frac{2f_L}{m} \quad (0 \leq m \leq N-1) \quad (2)$$

where N is the largest positive integer not exceeding f_H/B . According to the bandpass sampling theorem, when the signal being sampled is a high-frequency bandpass signal, the sampling frequency can be significantly reduced. However, applying the bandpass sampling theorem requires a prerequisite: the useful signal being sampled must reside within a single frequency band. If it appears in other frequency bands, it may lead to signal aliasing.

2.2. Parallel down-conversion filter structure

In modern digital communication systems, digital down-conversion (DDC) is a widely applied technology. Its primary purpose is to shift the signal spectrum downward to the desired frequency. Traditional digital down-conversion consists of three modules: the NCO (Numerically Controlled Oscillator), the mixing module, and the filter bank module^[5]. However, the traditional digital down-conversion operates in a serial structure, which can impose a significant clock burden when the ADC sampling rate is too high, thereby affecting the stability of the entire system. When the AD sampling frequency is excessively high, a polyphase-structured digital down-conversion technique is generally employed for down-conversion operations, as illustrated in **Figure 1**. In this structure, data is input in parallel, and both the NCO and the filter bank are also structured in parallel. This approach meets the down-conversion requirements for high-speed ADC data acquisition without increasing the clock frequency.

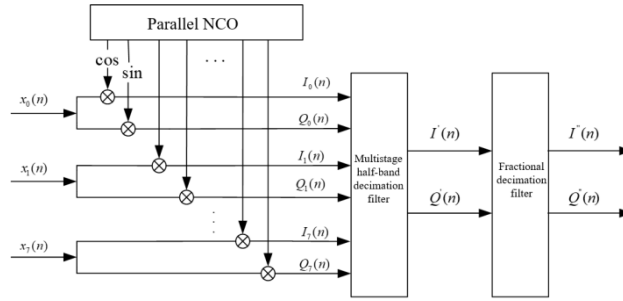


Figure 1. Parallel multi-phase digital down-conversion structure diagram

3. FPGA implementation of AD9680 acquisition

3.1. ADC device selection

The ADC device of this design requires that the number of quantization bits is not less than 14 bits, and the bandwidth of the signal is up to 400 MHz. The selection of ADC devices is carefully measured from three aspects: quantization bits, sampling frequency, and analog input bandwidth.

The signal collected in this design is divided into two types. The acquisition requires two channels. One collects a fixed 750 MHz medium frequency band communication signal, and the other collects a frequency of 1 M – 1 GHz. Among them, the 750 MHz center frequency signal has a maximum bandwidth of 400 MHz; the maximum bandwidth in the frequency range of 1 M – 1 GHz is 375 MHz, and the frequency range is 625 M – 1000 MHz. Moreover, the higher the sampling frequency, the better the suppression effect of the collected signal on the spectrum aliasing, and the maximum sampling rate needs to be greater than 1 GHz. By comparison, ADI's dual-channel analog-to-digital converter AD9680, whose maximum sampling frequency can reach 1.25 GHz, supports JESD204 B coded output and can be used for up to 2 GHz broadband analog signal sampling. Built-in on-chip buffers and sample-and-hold circuits are specifically designed for low power consumption, small size, and ease of use. The AD9680 core adopts a multi-stage differential pipeline structure, integrates output error correction logic, and uses an integrated reference power supply to simplify the design. Each ADC in the AD9680 integrates two DDCs, and the DDC module can complete filtering, down-conversion, extraction, and complex real number conversion. At the same time, the AD9680 also has AG, which can simplify the design of the receiver. It also has a flexible power-down option, which can significantly reduce power consumption when conditions permit. The above characteristics can be configured by three-wire SPI. **Figure 2** is the function block diagram of AD9680.

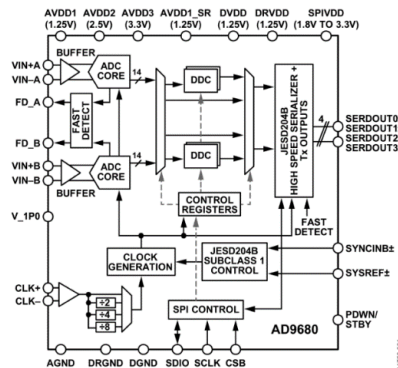


Figure 2. Functional block diagram for AD9680

3.2. AD9680 configuration and FPGA design

The AD9680 chip uses a three-wire SPI interface to read from and write to its internal registers. During the configuration process, the main tasks involve digital processing and JESD204B output settings.

The AD9680 is a dual-channel device, but its two channels are not used simultaneously. Therefore, the number of converters M is set to 1, the JESD204B word N' is set to 16, and an appropriate number of link lanes L is chosen as 4. Based on these parameters, the calculated lane rate for the AD9680 is 5 Gbps. The number of samples per frame parameter SS is typically set to an integer, often 1. In this design, to improve data transmission efficiency, the parameter SS is set to 2. After calculation, the number of bytes per frame parameter F for the AD9680 is determined to be 1, resulting in the JESD204B parameter LMFSLMFS for the acquisition link being 4112.

The AD9680 supports JESD204B Subclass 1, and during register configuration, the JESD204B link parameters within the chip need to be set. The chip manual also provides a quick configuration for register 0x570 based on the link parameters. When $M=1$, $N'=16$, and $LMFS=4112$, the value of register 0x570 must be set to 0x80. The default JESD204B lane rate for the AD9680 is 6.25 to 12.5 Gbps, but the calculated lane rate is 5 Gbps, so register 0x56E needs to be modified. Registers 0x5B2 to 0x5B6 control the mapping between JESD204B logical lanes and physical lanes, and the appropriate mapping is selected in coordination with the hardware circuit design. **Figure 3** shows the main flowchart of the AD9680 configuration program.

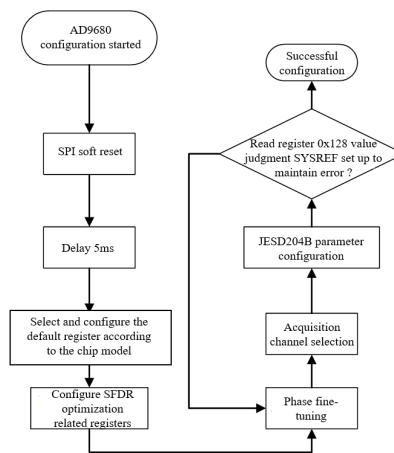


Figure 3. AD9680 configuration flow chart

Determine the registers and related parameters that AD9680 needs to configure, write the Verilog program, and after Vivado synthesis, the RTL diagram is shown in **Figure 4** below.

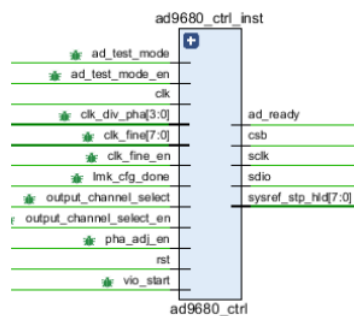


Figure 4. AD9680 configuration RTL diagram

4. Logical implementation of parallel polyphase down-conversion

4.1. Parallel link number conversion

The intermediate frequency signal collected by AD9680 is divided into four channels after JESD204 B demapping. If it is combined into one way to do down conversion, the clock frequency will become higher, and the FPGA chip will also be difficult to achieve this frequency. Therefore, the researchers choose to use resource exchange speed and parallel processing to complete digital down conversion.

When the demapping of the collected data is divided into 4 channels, to reduce the consumption of FPGA on-chip resources, 4 channels of signals need to be converted into 6 channels of signals. **Figure 5** is the RTL diagram of 4-way to 6-way.

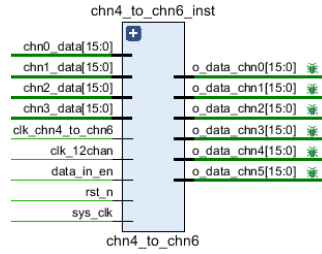


Figure 5. Parallel 4-way to 6-way RTL diagram

4.2. Parallel NCO implementation

If the researchers know $\cos(2\pi f_c T_s * 6k)$, $\sin(2\pi f_c T_s * 6k)$, $\cos(\Delta\phi)$, and $\sin(\Delta\phi)$, they can use the trigonometric formula to derive the expressions of the remaining paths.

In Simulink, the rotation module is designed according to the triangle formula, which consists of four multipliers, one adder, and one subtractor. Two NCO modules are designed to generate the first signal and phase difference. Then the signal is input to the previous phase rotation module, and the second signal output can be combined. The structure is shown in **Figure 6** ($\theta_0 = 2\pi f_c T_s * 6k$).

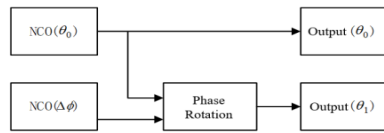


Figure 6. Simulink two NCO outputs

In the logic design, because there are multipliers and adders in the phase rotation module, there will be two clock delays between the input and output data. To ensure the last 6 data phases are similar, other signals can be obtained, and the top RTL diagram of the parallel NCO generation module is shown in **Figure 7**.

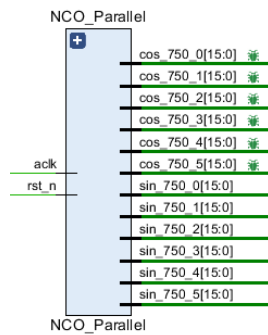


Figure 7. NCO generates the top-level RTL diagram of the module

4.3. Parallel FIR design

The filter structure of I and Q is exactly the same. The first is to use Simulink to design the required filter. In order to meet the out-of-band suppression of 60 dB and minimize resource consumption, 65 order filters are selected here to generate corresponding 66 filter coefficients. Then MATLAB divides the coefficients into 6 groups with 6 steps, 11 coefficients in each group.

Since the FIR IP core provided in Vivado will occupy more DSP resources, this design chooses to write FIR modules by itself. The parallel 6-channel I, Q signals are multiplied by the parallel carrier 6-channel I, Q signals as the input of the FIR module. The input signal is beaten, and then the FIR output signal of each channel is obtained by multiplying and adding with each channel coefficient. The Simulink construction of each FIR sub-module is shown in **Figure 8**, and the top-level RTL diagram of the parallel FIR module is shown in **Figure 9**.

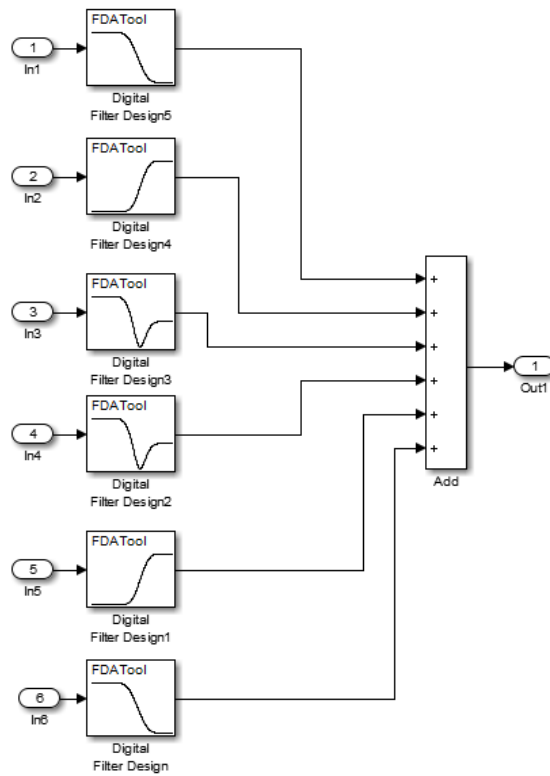


Figure 8. Simulink diagram of FIR submodule

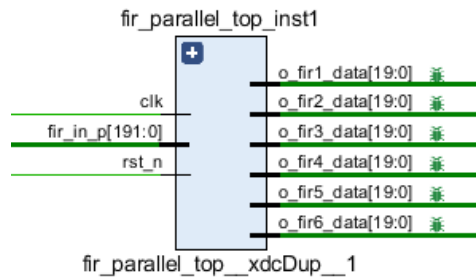


Figure 9. RTL diagram of FIR top-level module

5. Test verification

After the four 16-bit signals collected by the AD9680 are converted into six 16-bit parallel signals, they are multiplied by the six 16-bit of the parallel NCO module, and the obtained six data are sent to the parallel FIR module for filtering. The filtered data is intercepted to obtain six parallel FIR output data.

The FIR input data and output data are exported and analyzed in MATLAB. The sampling rate is 1GHz, and the spectrum diagram is shown in **Figure 10** and **Figure 11**, respectively. By comparing the spectrum of **Figure 10** and **Figure 11**, it can be seen that the filtering effect of the filter is better, and the out-of-band suppression reaches 60 dB, which meets the design requirements of this time. The abscissa is frequency / MHz, and the ordinate is amplitude / dB.

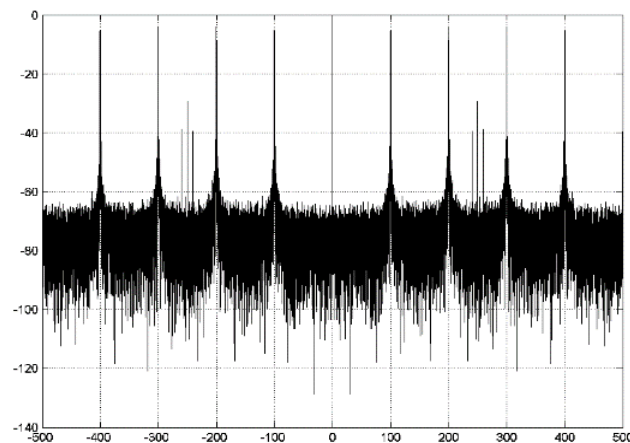


Figure 10. FIR input spectrogram

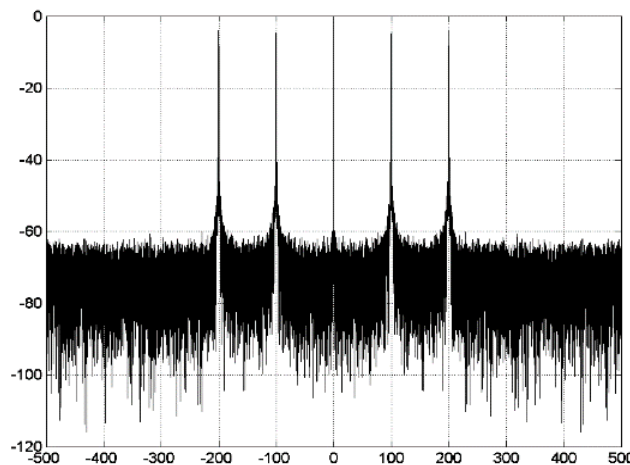


Figure 11. FIR output spectrogram

6. Conclusion

In this paper, an intermediate frequency signal processing based on FPGA and AD9680 is designed and successfully implemented. After testing and verification, this design can meet the parallel filtering of the band communication signal with a bandwidth of 400M and a center frequency of 750M, and achieve the design

requirement of 60dB out-of-band suppression. Compared with the traditional serial structure, this design has the characteristics of reducing clock frequency, improving system stability, and fast processing speed. The structure used in this design provides a more useful solution for intermediate frequency signal processing and has a high application value.

Disclosure statement

The authors declare no conflict of interest.

Author contributions

Study idea conceptualization: Ziming Yin

Experimentation: Ziming Yin, Yunyu Wei

Data analysis and paper writing: Ziming Yin, Kuo Wang

References

- [1] He S, 2020, Research on Key Technologies of Broadband Signal High-speed Acquisition and Transmission System, thesis, North University of China.
- [2] Li ZJ, 2019, Development of PXIe Intermediate Frequency Digitizer, thesis, Harbin Institute of Technology.
- [3] Zhao YL, 2008, Design and Implementation of Signal Acquisition and Processing System based on FPGA, thesis, Nanjing University of Science and Technology.
- [4] Peng DL, Wang X, Chen XH, et al., 2013, Hardware Circuit Design of High-speed Data Acquisition System based on Band-pass Sampling Theorem. *Instrumentation Technology and Sensors*, 2013(5): 72–74.
- [5] Wu NX, 2020, Research on FPGA-based High-speed and High-precision ADC/DAC Data Deep Storage and Digital Frequency Conversion System, thesis, University of Chinese Academy of Sciences (School of Artificial Intelligence, Chinese Academy of Sciences).

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Building Long-term Mechanisms for Medical Students to Find Work in Their Hometowns within the Framework of Rural Revitalization

Wenxuan Xu, Jingyu Yang, Xinru Zhang, Jiaye Chen, Chunyan Jiang*

Wenzhou Medical University, Wenzhou 325035, Zhejiang, China

*Corresponding author: Chunyan Jiang, 939917161@qq.com

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: As urbanization has increased, the supply-demand gap for rural medical care has expanded, making rural revival harder. This study used the Theory of Planned Behavior (TPB) and the Benefit-Risk Theory model to identify attitudes, subjective norms, perceived behavioral control, perceived benefits, and perceived risks as influencing medical students' willingness to return home for work. For the survey questionnaire, eight hypotheses were proposed. The study's analysis of 528 valid questionnaires found that most medical students dislike going back to their hometowns for work, that improving rural conditions can encourage them to return, and that some who are willing to do so are not interested in healthcare. These data support all eight theories. After investigating medical students' unwillingness to return home for employment, the study found that the government, medical institutions, the education sector, and medical students all affect the five elements. This study offers specific solutions to encourage medical students to return to their hometowns to revitalize rural healthcare.

Keywords: Rural revitalization; Medical students; Employment; Structural equation model; Long-term mechanism

Online publication: April 3, 2025

1. Background and importance

Currently, the supply of medical services in large rural areas has long been marginalized due to the uneven economic development of urban and rural areas. This has led to the uneven allocation of medical resources between urban and rural areas, and there is an urgent need to strengthen and develop the medical and healthcare team ^[1]. Most medical students would rather remain in big cities above the county level, big hospitals, or big businesses due to societal attitudes, traditional family ideas, and other issues, including poor rural infrastructure building and inadequate employment policy subsidies ^[2]. The countryside has raised its demands for medical and healthcare professionals as well as medical service levels as a result of the extensive promotion of the rural

revitalization plan. Young medical students can contribute fresh medical ideas and service models for rural revival as they are the future of the medical industry's precursors.

To build a theoretical model of the factors influencing medical students' willingness to return to their hometowns, this study combines the Theory of Planned Behavior (TPB) and the Benefit-Risk Analysis (BRA) model. It then analyzes the factors influencing medical students' willingness to return to their hometowns and offers workable solutions and recommendations to deal with the reality of medical students' reluctance to return to their hometowns in search of employment. In addition to expanding the knowledge of medical students' employment decision-making behavior and enhancing the understanding of college students' employment decisions when they return to their hometowns, this will offer a strong theoretical foundation for the development of relevant policies as well as a fresh theoretical viewpoint on how people make career decisions ^[3].

2. Analysis of variables affecting medical students' decision to return

2.1. Developing a theoretical framework

Five factors influenced medical students' inclination to return to their hometowns for work in this study, which was based on the Theory of Planned Behavior (TPB) and Benefit-Risk Analysis (BRA) model. The particular model is displayed in **Figure 1** ^[4].

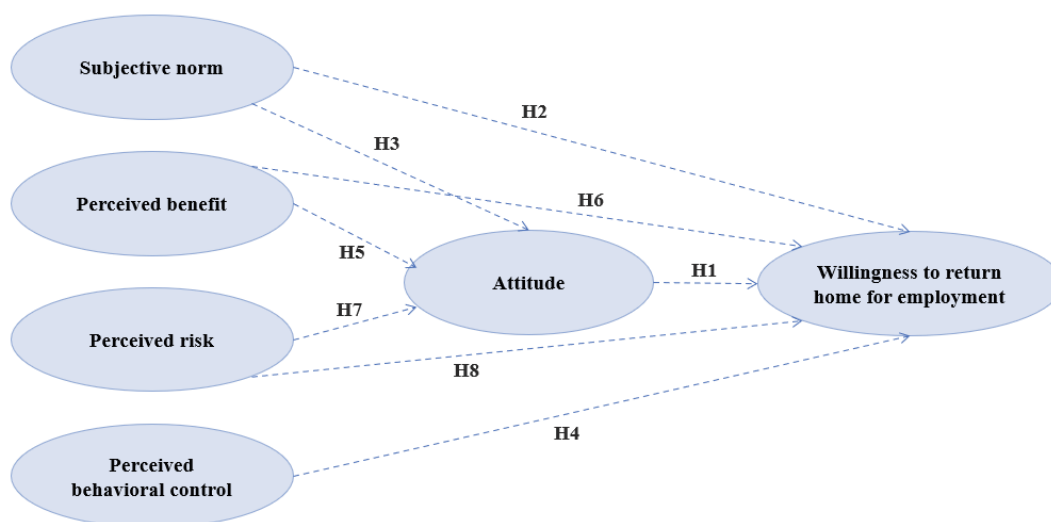


Figure 1. Theoretical model of factors influencing medical students' willingness to return home for employment

Medical students' attitudes toward rural jobs have a direct impact on their desire to work in rural areas. The expectations and assessments that medical students experience from friends, family, teachers, the school, the local government, and others when deciding whether to return to rural work are referred to as subjective norms. The medical students' self-assurance and resourcefulness in determining whether they can effectively return to rural employment and adjust to the new setting is known as perceived behavioral control. The term "perceived benefits" describes how medical students view the social recognition, exercise opportunities, national favoring policies, and self-worth realization that come with working in their hometowns. Contrarily, perceived hazards are the unknowns, difficulties, and demands that medical students think they would encounter while practicing in rural areas. These mostly include a challenging work environment, reduced pay, and societal and familial obligations ^[5].

Based on this, eight hypotheses are proposed: H1: Medical students' attitudes have a significant positive effect on the willingness to return to the countryside for employment; H2: Subjective norms have a significant positive effect on medical students' willingness to return to the countryside for employment; H3: Subjective norms have a significant positive effect on medical students' attitudes to return to the countryside for employment; H4: Perceived behavioral control has a significant positive effect on medical students' willingness to return to the countryside for employment; and H5: Perceived benefit have a significant positive effect on medical students' return to the countryside for employment attitude; H6: Perceived benefit has a significant positive effect on medical students' willingness to return home; H7: Perceived risk has a significant negative effect on medical students' attitude to return home; H8: Perceived risk has a significant negative effect on medical students' willingness to return home.

2.2. Basic data about survey participants

2.2.1. Information sources

To understand the primary determinants influencing the employment of medical students returning to their hometowns, the study team visited rural medical colleges in July 2024. Based on their findings, they created a questionnaire. The study team disseminated the surveys in 11 prefecture-level cities in Zhejiang Province using the Questionnaire Star platform. A total of 558 questionnaires were recovered, 528 of which were legitimate, yielding a valid questionnaire recovery percentage of 94.2%. The samples' primary attributes were as follows: 371 women (70.27%), 157 men (29.73%), 406 undergraduates (76.9%), 103 postgraduates (19.5%), 19 specializations (3.6%), 465 Han Chinese (88.07%), and 63 members of ethnic minorities (11.93%)^[6].

2.2.2. Methods of research

After conducting literature research and field visits to gather and analyze opinions from both domestic and international sources regarding medical students' willingness to return to their hometowns for employment, as well as the factors that influence these opinions, the questionnaire was scientifically designed and assessed by experts and scholars. The questionnaire's primary contents are: (1) the medical students' personal information, such as their education, grade, gender, family location, whether they are the only child, etc.; and (2) their willingness to return to their hometowns for work and the factors that influence that willingness, such as the intended place of employment and the reasons for it, their opinions of rural healthcare institutions, the expected salary of rural work, and the extent to which relevant talent revitalization initiatives have an impact.

2.3. Status of willingness to return home for employment

2.3.1. Most medical students have unfavorable attitudes about going back to their hometowns to work

According to the results of the questionnaire, only 25 (4.73%) of the medical students thought that the countryside would be the best place to work after graduation, while 376 (71.27%) thought that the city would be the best place to work. This suggests that most medical students had a negative attitude toward going back to the countryside for work and were unwilling to accept the countryside as the location for achieving their career goals.

2.3.2. Improving rural areas can encourage medical students to go back to their hometowns

According to the results of the questionnaire, 359 (67.9%) of medical students are only willing to work in the city, suggesting that most medical talent is not very driven to take part in rural revitalization and is not eager to return to their hometowns for employment. The fact that 424 (80.30%) medical students agreed with the statement, "I

will choose to return to my hometown to work in the countryside if there is a good opportunity”, suggests that this status quo can be altered as long as favorable internal and external conditions for medical students’ career needs are met.

2.3.3. Some medical students are hesitant to pursue a career in medicine because they want to go home

According to the results of the questionnaire, 26 (15.38%) medical students decided to return home for work but were not interested in working in the healthcare sector. The primary reasons for this were the following: poor employment prospects (30%), fewer jobs (33%), low job pay (33%), and high work pressure in rural medical jobs (40%). Together, these elements have an impact on medical students’ career choices; they do not exist separately.

The aforementioned analysis of the current situation reveals that: on the one hand, medical students’ career choices exhibit a diversified trend, with some students choosing to change careers and pursue other fields instead of focusing solely on the medical industry; on the other hand, medical students’ employment intention is skewed toward the city, and they are more willing to work in the medical industry in an urban setting than in a rural one.

2.4. Modeling affecting factors using structural equations

A structural equation model was created using Stata to evaluate the eight hypotheses while accounting for attitude’s role as a latent and mediating variable. The established structural equation model’s three key indicators satisfy the requirements and have a strong model fit. As shown in **Table 1**, all eight study hypotheses were valid.

Table 1. Hypothesis testing results

Paths	Path factor standardization	Z-value	Speculation	Test findings
Attitude → Willingness to return home for employment	0.464	11.45***	H1	Support
Subjective norm → Willingness to return home for employment	0.155	3.50***	H2	Support
Subjective norm → attitude	0.601	18.29***	H3	Support
Perceived behavioral control → Willingness to return home for employment	0.114	2.87**	H4	Support
Perceived benefit → Attitude	0.269	7.39***	H5	Support
Perceived benefit → Willingness to return home for employment	0.192	4.62***	H6	Support
Perceived risk → attitude	-0.108	4.23***	H7	Support
Perceived risk → willingness to return home for employment	-0.105	4.21***	H8	Support

Note: *** denotes $P < 0.001$, ** denotes $P < 0.01$, * denotes $P < 0.05$.

3. Analyzing the reasons affecting the return of medical students to their homes for employment

3.1. The reasoning for the five elements

The five main factors—attitudes, subjective norms, perceived behavioral control, perceived benefits, perceived risks, and the constant presence of medical students, education departments, medical institutions, and the government—all have an impact on medical students’ willingness to return to their hometowns for employment.

Medical students’ perspectives are reflected in their interest in and awareness of going back to work. The

level of support that medical students receive from their friends, family, schools, the government, and other sources for returning to work is the source of subjective norms. Medical students' views and desire to return to rural jobs are influenced by both perceived hazards and perceived rewards. Perceived behaviors influence medical students' capacity to adjust to their rural living and working circumstances, as well as their confidence in the medical knowledge and communication skills necessary for rural practice.

3.2. Reasons for reluctance to return home for employment

When it comes to attitudes, medical students have negative ideas about working in rural areas; when it comes to subjective norms, there is a lack of social recognition for rural doctors and fewer rural internships offered by schools; when it comes to perceived behavioral control, returning medical students have low confidence in their ability to adjust to rural life, and there is a lack of communication and experience sharing between medical students and rural doctors; when it comes to perceived benefits, rural medical institutions offer fewer opportunities for promotion, and the policies and benefits that returning students enjoy are not properly implemented; when it comes to perceived risks, the rural working conditions are subpar and the task of understaffing is difficult. Regarding perceived benefits, rural medical organizations offer fewer opportunities for advancement, and policies and benefits for returning medical students are not in place. Regarding perceived risks, rural working conditions are subpar, there is a shortage of personnel, the workload is demanding, and the patient groups they treat are of low quality.

Three explanations have been summed up as follows: First, the idea of medical students choosing their careers is firmly established and orthodox. The development potential and need for primary healthcare facilities are frequently overlooked by medical students, who are more likely to select large cities with three hospitals. Second, there is not enough government policy support and direction. The issue of the unequal distribution of medical resources between urban and rural regions is made worse by the lack of government support and the poor infrastructure in rural areas, which make it less appealing for medical students to return home for work. Third, there is no connection between the hiring and employment processes. There is a gap between the supply of graduates and the demand for recruitment as a result of the information asymmetry between universities and medical institutes.

4. Long-term mechanism to promote the return of medical students to their homes for employment

4.1. Universities rethink hiring young medical staff based on native emotions

Helping medical students make confident career choices. Colleges should offer "Career Planning and Employment Guidance for College Students" to help medical students make career decisions.

Improve medical students' rural internships ^[7]. Schools should create strong alliances with rural medical schools, boost internship bases, and give more opportunities for medical students to visit the countryside and learn about people's lives.

Create a medical skill database. Medical talent introduction is more successful, and medical students have more career advancement alternatives when basic data, professional experience, and skills are carefully acquired and organized.

4.2. Rural medical schools create a talent development platform to modernize medical education

Facilitate rural physician-medical student contact. To ensure full and timely information exchange, improve the online and offline communication system, and regularly design and coordinate engaging online and offline communication events, including teleseminars, learning site visits, case-sharing sessions, etc.

Provide remote medical care. Internet and communication technology can alter medical consultation administration and service delivery by enabling remote diagnosis and treatment, condition tracking, real-time doctor-patient contact, and other services. Use extended functions like training and continuing education to improve rural medical institutions' diagnosis and treatment quality and service capacity, recognize the interdependence of urban and rural medical resources, and offer medical students returning home new educational and employment opportunities^[8].

Excellent medical skills. Rural medical institutions should partner with medical schools to offer focused training, select rural-focused students, and provide financial aid and career development support.

4.3. The government optimizes rural services to complement policy

Make living situations better. Boost the development of infrastructure, maintain the strengthening of the rural communication infrastructure's supply power, streamline the network design, and hasten the industrial chain's digital transformation^[9]. To satisfy the higher-level living requirements of rural physicians, strengthen the social insurance subsidy program, and improve the social insurance treatment of these professionals^[10].

Financing innovation and scientific research. To encourage medical talent to return to their hometowns for work, the government boosts the amount of financial aid available to offer a firm basis for medical students to do so.

Increase rural physicians' social recognition. Make broad use of new media platforms like social media and conventional media like radio, television, and newspapers to spread the word about the accomplishments of excellent rural physicians.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Sun J, Liu YT, Sun HL, 2023, Study on the Dilemma and Countermeasures of Medical Students Returning to their Hometowns for Employment under the Background of Rural Revitalization. *Intelligent Agriculture Guide*, 3(20): 106–109. <https://doi.org/10.20028/j.zhnydk.2023.20.025>
- [2] Du YM, Xie J, Liang XY, et al., 2023, Study on Medical Students' Willingness to Return to their Hometowns for Employment and Countermeasures in the Context of Rural Revitalization: Taking a Medical University in Hebei as an Example. *Modern Medicine*, 51(S1): 124–129.
- [3] Wu X, 2021, Research on Rural Higher Vocational Students' Willingness to Return to their Hometowns for Employment under the Background of Rural Revitalization, thesis, Sichuan Agricultural University. <https://doi.org/10.27345/d.cnki.gsnyu.2021.000105>
- [4] Zhang HX, 2023, Research on the Influencing Factors of College Students' Rural Employment Willingness in the Context of Rural Revitalization Strategy. *China Light Industry Education*, 26(6): 41–51.

- [5] Johnson G, Foster K, Blinkhorn A, et al., 2020, Rural Clinical School Dental Graduates' Views on Rural and Metropolitan Employment. *European Journal of Dental Education*, 24(4): 741–752. <https://doi.org/10.1111/eje.12564>
- [6] Zheng YF, Wang ZY, Huang ZF, 2023, The Current Situation and Countermeasures of Medical Students Returning to their Hometowns for Employment in the Post-epidemic Period: An Example of 1,078 Medical Graduates from 90 Counties and Districts in Zhejiang Province. *Journal of Wenzhou Medical University*, 53(1): 84–87.
- [7] Seaman CE, Green E, Freire K, 2022, Effect of Rural Clinical Placements on Intention to Practice and Employment in Rural Australia: A Systematic Review. *International Journal of Environmental Research and Public Health*, 19(9): 5363. <https://doi.org/10.3390/ijerph19095363>
- [8] Zhuang W, 2011, Building a Telemedicine Service System and Integrating High-quality Resources to Benefit the Countryside: GE Healthcare Tele-Med Helps Beihang Third Hospital to Implement Telemedicine. *China Hospital Chief Executive*, 2011(18): 78–79.
- [9] Yang DP, 2022, Practical Paths and Countermeasures of Digital Enabling Rural Revitalization to Achieve Common Wealth. *China Soft Science*, 2022(S1): 71–75.
- [10] Sun YB, 2018, Exploration of Social Integration Problems of Rural Nationality College Students Returning to their Hometowns for Employment and Entrepreneurship under the Strategy of Rural Revitalization. *Agricultural Economy*, 2018(7): 110–112.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

The Impact of Rural Population Aging on the Development of Green Agricultural Technology: A Spatial Perspective Study

Yijuan Xu¹, Zhenping Xu^{2*}

¹Jingzhou Institute of Technology, Jingzhou 434000, Hubei, China

²School of Computer Science of Yangtze University, Jingzhou 434000, Hubei, China

**Corresponding author:* Zhenping Xu, xzp18@yangtzeu.edu.cn

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Promoting the green development of agriculture is an essential path toward modernizing agriculture in China, while the regional aging of the rural population structure poses new challenges to green agricultural development. Based on the spatial error model (SEM) and the perspective of human capital level, this paper uses the SBM-ML index method to construct the level of green agricultural development and empirically analyzes the impact of rural population aging on green agricultural development. The study finds that both an increase in the proportion of the rural elderly population and an increase in the old-age dependency ratio restrain green agricultural development. Additionally, the aging of the rural population has a negative impact on the level of rural human capital. Robustness analysis using replacement weight matrices confirms the reliability of the paper's conclusions. Therefore, efforts are needed to enhance rural education levels, provide more training opportunities for rural elderly individuals, and promote the dissemination of green agricultural technologies to facilitate rural green development.

Keywords: Green agricultural total factor productivity; Rural population aging; Spatial error model; Human capital level

Online publication: April 3, 2025

1. Introduction

In recent years, the issue of population aging in China has become increasingly prominent. According to data from the seventh national census, the population aged 60 and above has reached 264.02 million, with 190.64 million people aged 65 and above, accounting for 13.5% of the total population. In rural areas, the proportion of individuals aged 60 and above has risen to 20.04%, and those aged 65 and above account for 13.82% (Data source: Comprehensive Research Report on Rural Revitalization in China 2021). The aging population structure in China, especially in rural areas, poses unprecedented challenges to agricultural production methods, which has become a pressing issue for China's agricultural development.

The impact of changes in the rural population structure on agricultural development in China primarily focuses on the following aspects.

The aging rural population in China affects agricultural production in both positive and negative ways. While it decreases grain output and hinders labor-intensive agriculture, it can also promote mechanization and large-scale farming ^[1–3]. Scholars have explored the impact of aging on agricultural efficiency, with some suggesting that elderly farmers' traditional knowledge supports green agriculture, while others argue that aging hinders the adoption of green technologies and lowers productivity ^[4–5]. Bao noted that aging reduces the labor supply, weakening production efficiency ^[6]. Physical limitations further hinder new method adoption, increasing environmental strain ^[7]. Cooperation between older and younger farmers may mitigate some negative effects ^[8]. Theoretical views also vary: Hou highlighted the value of elderly farmers' ecological knowledge for sustainable farming, while Zhang argued that aging reduces human capital quality, hindering modernization ^[9–10]. Gao noted barriers in adopting new technologies, and Li suggested family farming models could combine elderly experience with youth innovation to support green development ^[11–12].

Rural population aging in China impacts green agricultural development both positively and negatively. Aging reduces labor's ability to adopt new technologies, lowering productivity and quality. The outflow of young workers to cities further diminishes the rural labor force, which hinders green agriculture progress. This study explores the spatial effects of aging on agriculture and the role of human capital in this process.

2. Model specification and variable selection

2.1. Model specification

This paper primarily analyzes the impact of the rural population aging on green agricultural development in China. Considering the main factors influencing green agricultural development, the following baseline model is constructed:

$$gtfp_{it} = \alpha_0 + \alpha_1 old_{it} + \alpha_2 var_{it} + \varepsilon_{it} \quad (1)$$

The dependent variable $gtfp_{it}$ represents green agricultural development. The core explanatory variable old_{it} represents population aging, and var_{it} represents other control variables, which mainly include urbanization level (urb), industrial structure (ind), disaster-affected crop area (dis), planting structure (stru), agricultural infrastructure (infra), and rural social retail sales (sale). ε_{it} denotes the random disturbance term.

Considering that the agricultural population aging in one region may impact agricultural development in surrounding areas, neglecting spatial correlation may lead to inconsistent parameter estimates in empirical analysis. The spatial error model (SEM) introduces a spatial weight matrix W and a spatial error autocorrelation coefficient λ_2 , constructing a spatial autocorrelation structure in the error term. Thus, SEM can explain the relationship between the explanatory variables and the dependent variable and reveal hidden spatial dependency patterns in the data. Therefore, this paper constructs a spatial error model (SEM) for empirical analysis. The SEM considers only the spatial lag of the error term, and its expression is:

$$gtfp_{it} = \beta_0 + \beta_1 old_{it} + \beta_2 var_{it} + \lambda W \varepsilon_{it} + u_{it} \quad (2)$$

Where $\lambda W \varepsilon_{it}$ represents the spatial lag of the error term, λ denotes the spatial error autocorrelation coefficient.

A larger λ indicates a stronger spatial correlation induced by the spatial error terms.

Moreover, to examine whether rural population aging affects green agricultural development through its influence on agricultural human capital levels, this study constructs the following model:

$$hc_{it} = \gamma_0 + \gamma_1 old_{it} + \gamma_2 var_{it} + \lambda W\varepsilon_{it} + u_{it} \quad (3)$$

2.2. Variable Selection

Dependent Variable: Green agricultural Development (*gtfp*). This study measures green agricultural development using the Malmquist-Luenberger (ML) index to assess green agricultural total factor productivity. This variable describes changes in agricultural production efficiency and environmental sustainability. An increase in *gtfp_{it}* indicates that while enhancing agricultural economic growth, environmental damage has been reduced, thereby alleviating environmental resource pressures, increasing primary sector income, and achieving coordinated and sustainable development between agriculture and ecology.

First, input variables are defined as follows. (1) Agricultural labor input is measured by the number of people employed in the primary sector; (2) Land input is represented by the sown area; (3) Machinery input is quantified by the total power of agricultural machinery; (4) Fertilizer input is assessed by the effective quantity of fertilizer applied; (5) Irrigation input is indicated by the area with effective irrigation.

The output variables are as follows: (1) Desirable output is primarily measured by the total value of agricultural, forestry, animal husbandry, and fishery products adjusted to constant prices; (2) Undesirable output is represented by agricultural carbon emissions as a proxy variable for undesirable outputs.

Core explanatory variables: Rural population aging (*old1*) is measured by the proportion of elderly individuals aged 65 and above within the rural population. This study also employs the elderly dependency ratio (*old2*) for robustness checks. Mechanism variable: Human capital level (*lnhc*). Control variables: Urbanization level (*urb*); Industrial structure (*ind*); Crop disaster area (*dis*); Cropping structure (*stru*); Agricultural infrastructure (*lninfra*); Rural social retail sales (*lnsale*).

2.3. Variable selection and data sources

Due to data availability, this study selects panel data from 30 provinces and municipalities in China (excluding Hong Kong, Macau, Taiwan region, and Tibet) for the period 2007–2020 as the research sample. Minor missing data is addressed using interpolation methods. Data sources include the China Statistical Yearbook, China Rural Statistical Yearbook, China Population and Employment Statistical Yearbook, and the EPS database. The impact of heteroscedasticity is mitigated by taking the natural logarithm of some variables. Descriptive statistics for each variable are presented in **Table 1**.

3. Empirical analysis

3.1. Spatial correlation analysis

Before conducting the spatial econometric analysis, it is necessary to test the spatial autocorrelation of the explained variable. This study employs the Local Moran's I index to examine the spatial autocorrelation of green agricultural total factor productivity. The Moran's I index ranges between -1 and 1; a positive value indicates a positive spatial correlation in green agricultural total factor productivity, a negative value indicates a negative spatial autocorrelation, and a value of 0 indicates no correlation. For spatial autocorrelation and empirical analysis,

this study uses a 0-1 adjacency matrix and a distance inverse matrix for robustness checks. Combining formulas (1) and (2), the spatial autocorrelation test of green agricultural development levels across 30 provinces and municipalities in China (excluding Hong Kong, Macau, Taiwan region, and Tibet) is performed using Stata 15.0. The results are presented in **Table 2**.

Table 1. Descriptive statistics of variables

Variable	Obs	Mean	Std.Dev.	Min	Max
gtfp	420	1.085	0.198	0.339	2.949
old1	420	0.115	0.0364	0.0502	0.261
old2	420	16.57	5.981	7.050	44.56
lnhc	420	2.036	0.0848	1.743	2.293
lninfra	420	7.260	1.026	4.693	8.729
lnsale	420	8.382	1.020	5.291	10.36
dis	420	0.186	0.141	0.00592	0.695
urb	420	0.563	0.134	0.282	0.896
ind	420	0.446	0.087	0.158	0.615
stru	420	0.348	0.135	0.029	0.672

Table 2. Spatial autocorrelation analysis of green agricultural total factor productivity (2010–2020)

Variables	Year	Moran'sI
gtfp	2010	-0.017
gtfp	2011	0.03*
gtfp	2012	0.046*
gtfp	2013	0.195*
gtfp	2014	0.012
gtfp	2015	-0.011
gtfp	2016	0.180***
gtfp	2017	0.004
gtfp	2018	0.05
gtfp	2019	-0.021
gtfp	2020	0.056*

Notes: * $P < 0.1$, ** $P < 0.05$, *** $P < 0.01$

As shown in **Table 2**, between 2010 and 2020, half of the years strongly reject the null hypothesis of “no spatial autocorrelation” at the 1%, 5%, and 10% significance levels, and more than half of the years have positive Moran's I indices. Additionally, previous research indicates that global autocorrelation has significant limitations, so anomalous spatial correlation levels in a few years do not negate the existence of spatial correlation. Therefore, there is spatial autocorrelation in agricultural green total factor productivity, and it is necessary to employ spatial econometrics for subsequent empirical analysis.

3.2. Spatial model selection: First item

First, the spatial econometric model is selected using the Lagrange Multiplier (LM) test, which indicates that the spatial error model is more statistically significant than the spatial lag model, leading to its selection for empirical analysis. Second, the Hausman test reveals a significant P -value at the 1% level under the 0-1 spatial weight matrix, prompting the use of fixed effects. Third, the LR test shows that the P -values are not significant, supporting the hypothesis that the SDM model degenerates into the SEM model, which further confirms the suitability of the spatial error model. Finally, the time and regional fixed effects model provides the highest maximum likelihood value, thus, the spatial error model with both time and regional fixed effects is employed for the econometric analysis.

3.3. Benchmark regression analysis

Table 3 presents the regression analysis of the impact of rural population aging on green agricultural development from 2010 to 2020. Column (1) shows the effect of population aging on green agricultural development without control variables. It can be observed that the coefficient for rural population aging is negative but not significant. Column (2) gradually introduces control variables, and the coefficient for rural population aging remains negative but is still not significant. In Column (3) of **Table 3**, after including the spatial weight matrix and both time and regional fixed effects, the impact of rural population aging on green agricultural total factor productivity is negative and significant at the 10% level. As discussed earlier, incorporating the spatial matrix makes the regression results more reliable. Therefore, as the degree of population aging increases, green agricultural total factor productivity is suppressed, indicating that the rising proportion of elderly people in the rural population has a negative impact on green agricultural development.

Table 3. Regression results of rural population aging on green agricultural development (2010–2020)

	(1)	(2)	(3)
old1	-0.400 (-1.51)	-0.813 (-1.22)	-1.419* (-1.87)
dis		0.003 (0.03)	0.050 (0.59)
urb		0.022*** (4.27)	0.019*** (3.51)
ind		0.001 (0.39)	-0.001 (-0.40)
stru		0.003 (1.11)	0.004 (1.14)
lninfra		-0.288*** (-2.81)	-0.273*** (-2.69)
lnsale		-0.219*** (-3.86)	-0.185** (-2.44)
_cons	1.131*** (35.40)	3.687*** (4.53)	

Table 3 (Continued)

	(1)	(2)	(3)
Spatial			
lambda			-0.580*** (-3.14)
Variance			
sigma2_e			0.028*** (14.31)
Time			YES
Area			YES
N	420	420	420

Note: The figures in parentheses represent the standard errors of the regression coefficients. * $P < 0.1$, ** $P < 0.05$, *** $P < 0.01$

3.4. Robustness checks

This study employs two methods to conduct robustness checks to ensure the reliability of the empirical results. The first method involves replacing the core explanatory variable, with rural population aging being measured by the rural elderly dependency ratio (old2). The second method uses the inverse distance matrix to replace the 0-1 adjacency matrix for spatial econometric analysis. The results are presented in **Table 4**. According to Columns (1) and (2) of **Table 4**, the elderly dependency ratio has a negative impact on both green agricultural development and rural human capital levels. In Columns (3) and (4) of **Table 4**, the use of the inverse distance matrix for spatial econometric analysis still shows a negative impact of rural population aging on green agricultural development and rural human capital levels. Therefore, the results of this study are robust.

Table 4. Robustness checks

	(1)	(2)	(3)	(4)
Dependent Variable	gtfp	lnhc	Gtgp (Inverse Distance Matrix)	Lnhc (Inverse Distance Matrix)
Main				
old2	-0.009* (-1.94)	-0.004*** (-8.56)		
old1			-1.674** (-2.22)	-0.638*** (-7.89)
Spatial				
lambda	-0.578*** (-3.13)	-0.415** (-2.40)	-0.776*** (-3.47)	-0.806*** (-3.60)
Variance				
sigma2_e	0.028*** (14.31)	0.000*** (14.40)	0.028*** (14.23)	0.000*** (14.22)
Time	YES	YES	YES	YES
Region	YES	YES	YES	YES
N	420	420	420	420

Note: The figures in parentheses represent the standard errors of the regression coefficients. * $P < 0.1$, ** $P < 0.05$, *** $P < 0.01$.

4. Summary and recommendations

The authors should discuss the results and how they can be interpreted from the perspective of previous studies and the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

4.1. Research conclusions

The results of this study indicate that rural aging negatively affects both green agricultural productivity and human capital levels, with the reduction of human capital being the key mechanism. Robustness checks confirm that the elderly dependency ratio also suppresses both green agricultural development and human capital. This research contributes to the current literature by exploring how aging influences green agricultural development, a perspective that has rarely been addressed in existing studies.

4.2. Managerial implications

To address the rural population aging and promote green agricultural development, several measures can be taken. First, enhance rural education by increasing investments in infrastructure and establishing training programs on green agricultural technologies to equip farmers with necessary skills. Second, promote green agricultural technologies through pilot demonstration projects, elderly-friendly farming models, and diverse dissemination channels like digital platforms and traditional media. Third, improve elderly farmers' practical skills by organizing on-site expert guidance and developing flexible employment arrangements to match their capabilities. Lastly, guide rational resource allocation through tailored regional development plans and incentives for young talent to work in aging rural areas, improving local economies and balancing labor distribution.

Funding

The 2019 Ministry of Education industry-university cooperation collaborative education project “Research on the Construction of Economics and Management Professional Data Analysis Laboratory” (Project number: 201902077020)

Disclosure statement

The authors declare no conflict of interest.

Author contributions

Study idea conceptualization: Yijuan Xu

Experimentation: Zhenping Xu

Data analysis and paper writing: Yijuan Xu

References

- [1] Liu J, Du S, Fu Z, 2021, The Impact of Rural Population Aging on Farmers' Cleaner Production Behavior: Evidence from Five Provinces of the North China Plain. *Sustainability*, 13(21): 12199.

- [2] Liu J, Fang Y, Wang G, et al. The Aging of Farmers and its Challenges for Labor-intensive Agriculture in China: A Perspective on Farmland Transfer Plans for Farmers' Retirement. *Journal of Rural Studies*, 2023(100): 103013.
- [3] Liao L, Long H, Gao X, et al., 2019, Effects of Land Use Transitions and Rural Aging on Agricultural Production in China's Farming Area: A Perspective from Changing Labor Employing Quantity in the Planting Industry. *Land Use Policy*, 2019(88): 104152.
- [4] Shi C, Li L, Chiu YH, et al., 2022, Spatial Differentiation of Agricultural Water Resource Utilization Efficiency in the Yangtze River Economic Belt under Changing Environment. *Journal of Cleaner Production*, 2022(346): 131200.
- [5] Du JG, Li B, Yang H, 2023, The Impact of Agricultural Human Capital on Green Agricultural Total Factor Productivity under the Aging Population. *China Population Resources and Environment*, 33(9): 215–228.
- [6] Bao XX, 2022, Analysis of the Impact and Strategies of the Aging of the Rural Population and the Loss of the Young Population on the Agricultural Economy. *Science and Technology Information*, 20(4): 254–256. <https://doi.org/10.16661/j.cnki.1672-3791.2112-5042-8134>
- [7] Cheng AH, Zhao F, He LH, 2017, Research on the Aging of Rural Population in Ethnic Minority Areas and its Development Trends — Empirical Analysis Based on Inter-provincial Panel Data from 2000 to 2015. *Ethnic Studies*, 2017(4): 39–49 +124.
- [8] Liu Y, Lu C, Chen X, 2023, Dynamic Analysis of Green Agricultural Development Efficiency in China: Spatiotemporal Evolution and Influencing Factors. *Journal of Arid Land*, 15(2): 127–144.
- [9] Hou C, Chen H, Long R, 2022, Coupling and Coordination of China's Economy, Ecological Environment and Health from a Green Production Perspective. *International Journal of Environmental Science and Technology*, 19(5): 4087–4106.
- [10] Zhang H, Li J, Quan T, 2023, Strengthening or Weakening: The Impact of an Aging Rural Workforce on Agricultural Economic Resilience in China. *Agriculture*, 13(7): 1436.
- [11] Gao Y, Zhao D, Yu L, et al., 2020, Influence of a New Agricultural Technology Extension Mode on Farmers' Technology Adoption Behavior in China. *Journal of Rural Studies*, 2020(76): 173–183.
- [12] Li Q, Ding CL, 2019, Environmental Regulation, Spatial Spillover and Industrial Upgrading—An Example from the Yangtze River Economic Belt. *Journal of Chongqing University (Social Science Edition)*, 25(1): 17–28.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Exploring College Students' Well-Being and Its Influencing Factors

Li Xu*

Zhejiang Tourism and Health College, Zhoushan 316111, China

*Corresponding author: Li Xu, zlj_xl@163.com

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: This study investigated the major factors impacting college students' well-being. The findings demonstrated that while academic stress had a detrimental effect on well-being, peer support and student-teacher relationships significantly enhanced it. The effect of major satisfaction was not statistically significant. Future education administration should focus on helping students build healthy interpersonal networks to support their overall development.

Keywords: Academic stress; Major satisfaction; Student-teacher relationships; Peer support; Well-being

Online publication: April 3, 2025

1. Introduction

A common approach to evaluating the effectiveness of an educational system or institution is to analyze the impact of institutional interventions on students' academic achievement. However, recent research trends have expanded beyond the traditional focus on knowledge and skill acquisition to encompass broader aspects, such as students' well-being within the academic environment ^[1]. Given its extensive benefits, promoting students' well-being has become a critical priority for educational systems worldwide. Also, students' well-being is not only a key facilitator of effective learning but also a crucial outcome of 21st-century education ^[2].

As students' well-being gains prominence in educational policy and practice, various initiatives aimed at assessing and monitoring this aspect have emerged ^[3]. However, mental health and well-being concerns remain prevalent in higher education, with many students experiencing high levels of stress, poor overall health, and psychological distress, including symptoms of depression and anxiety ^[4]. The growing prevalence of mental health challenges poses a significant issue for both students and higher education institutions, as poor mental health can negatively impact academic performance and overall well-being.

The well-being of vocational college students warrants particular attention. As future skilled professionals contributing to national development, their personal and academic growth is of great importance. In China, many vocational college students face academic pressure from parents, teachers, and peers due to their inability to gain

admission to academic university. This pressure can lead to decreased motivation for learning and an increased risk of mental health issues. Therefore, this study uses a higher vocational college in Zhejiang as a case study to examine the factors influencing students' well-being and to identify effective measures for enhancing their overall educational experience and satisfaction.

2. Literature review and proposed hypothesis

2.1. Students' well-being

Well-being is a multifaceted concept that has been explored across various disciplines, leading to multiple definitions. A common approach to defining well-being is through the lens of health, as reflected in the World Health Organization's (WHO) definition: "Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity." This perspective suggests that well-being extends beyond mere health and is not limited to specific contexts or roles, such as workplace or students' well-being, but rather represents a fundamental aspect of human life ^[5-6]. Emotion factors also play a crucial role in well-being, with positive emotions such as enjoyment, relief, and happiness, along with the absence of anxiety, being essential components ^[7]. Additionally, the multidimensional well-being framework provides a comprehensive approach, highlighting the importance of positive interpersonal relationships, personal development, environmental mastery, self-acceptance, and having a sense of purpose in life as key elements in sustaining well-being ^[8].

2.2. Academic stress and students' well-being

Academic stress refers to the adverse reactions students experience due to pressures in their academic environment ^[9]. Academic challenges are considered the primary source of stress among college students ^[10]. Academic stress is the demands related to academics that strain or exceed a student's perceived internal or external resources. She further explains that academic stress reflects an individual's perception of academic frustration, conflict, pressure, and anxiety ^[11]. Several factors have been identified in the literature as contributors to academic stress in college students, including academic workload, attending lectures, exams, school schedules, a lack of educational resources, and subject-related projects ^[12-13]. Students experiencing academic stress may exhibit symptoms such as sadness, anxiety, intolerance, irritability, difficulty concentrating, and even social withdrawal ^[14]. Moreover, a significant relationship between academic stress and mental health ^[15]. Similarly, a strong correlation between academic stress and both physical and mental health, further highlighting its broad impact on students' well-being ^[16].

H1: Academic Stress has a significant impact on students' well-being in higher vocational colleges.

2.3. Student-teacher relationships and students' well-being

Student-teacher relationships are a multifaceted concept shaped by various factors, both professional and interpersonal ^[17]. They categorize these aspects into two dimensions: "affective" and "supportive." The affective dimension refers to the interpersonal or emotional connection that develops between students and teachers, reflecting the level of affiliation (e.g., warm, caring, trusting relationships) ^[18]. In contrast, the supportive dimension represents the professional relationship, where students and teachers collaboratively contribute to a positive learning and teaching environment. Research on student-teacher relationships from the perspective of attachment theory suggests that such relationships play a crucial role in fostering student's academic success and well-being. Teachers who act as a "secure base", that is, being accessible, accommodating, and responsive to students' needs — enhance their student's competence, commitment, and motivation to learn ^[19-21]. When

considering various external factors, teachers' behavior has been found to affect students' well-being. For instance, supportive teacher behavior is linked to students' school well-being ^[22].

H2: Student-teacher relationships have a significant impact on students' well-being in higher vocational colleges.

2.4. Peer Support and students' well-being

Peer support plays a crucial role in adolescent life, particularly within the school environment. It involves trust and intimacy among friends and acquaintances, providing both social and academic motivation while fostering feelings of care and acceptance ^[23–24]. Acceptance, support, and consideration from peers contribute to increased self-confidence and greater school satisfaction among adolescents ^[25]. Peer support is a mutual process in which individuals with shared traits, experiences, or challenges offer one another empathy, assistance, and motivation ^[26]. Furthermore, research suggests that when parental social support is considered, perceived social support from friends plays an even more significant role in promoting healthy social, emotional, and overall adjustment to university ^[27]. In recent years, peer support has gained increasing attention in academic literature, with studies highlighting its function as a protective factor for mental health, well-being, and overall quality of life ^[28].

H3: Peer support has a significant impact on students' well-being in higher vocational colleges.

2.5. Major choice and students' well-being

Major satisfaction plays a crucial role in students' academic experiences and long-term career development. The process of career development is lifelong, involving various academic and professional transitions in pursuit of career goals. Among these transitions, selecting a college major is a key decision, as it shapes students' academic journeys and future career paths. A chosen major can influence numerous educational and post-educational outcomes, including academic achievements, challenges, job opportunities, study persistence, and overall academic satisfaction ^[29]. Additionally, major selection has broader implications for financial returns and social standing. However, dissatisfaction with one's major can have negative psychological consequences. Students who are unhappy with their major may experience decreased motivation and heightened anxiety related to college life ^[30]. Given its profound impact on students' academic engagement, emotional well-being, and future career prospects, major satisfaction is an essential factor influencing students' well-being.

H4: Major choice has a significant impact on students' well-being in higher vocational colleges.

3. Methodology

The researchers clarified the purpose of the questionnaire and distributed it to the students. The researchers also informed them that the collected questionnaires would be used for research purposes and treated with confidentiality. Then a total of 143 students from six different majors volunteered for the survey. The data indicated that the participation rate among female students was significantly higher than that of male students, at 76.92%. Additionally, the participation rate of freshmen exceeded that of sophomores, reaching 62.94%.

The data were used to conduct appropriate quantitative research with the statistical tool Jamovi to confirm the validity of the four preceding hypotheses and identify the factors influencing students' well-being.

4. Research findings and discussion

Utilizing the findings of the linear regression analysis, the study elaborated on the connection between students' well-being and factors such as academic stress, the teacher-student relationship, major satisfaction, and peer support.

4.1. Overall model fit

The study indicated 73.6% of the variance in the college students' well-being, according to $R^2 = 0.736$ and adjusted $R^2 = 0.728$. This indicated that the model had excellent explanatory power.

4.2. Variable regression coefficient analysis

The data in **Table 1** showed that academic stress had a negative and significant effect on well-being ($P=0.044$), with a regression coefficient of -0.17373, meaning that students who experienced more academic stress were less likely to feel a sense of well-being. Therefore, H1 was supported.

Table1. The multiple linear regression results on students' well-being ($n=143$)

Variables	Estimate	SE	<i>t</i>	<i>P</i>	Stand. estimate
Academic stress	-0.17373	0.0854	-2.03	0.044	-0.0938
Student-teacher relationships	0.36523	0.0610	5.99	<.001	0.3307
Major satisfaction	0.09178	0.0873	1.05	0.295	0.0524
Peer support	0.69372	0.0602	11.53	<.001	0.6128

With a regression coefficient of 0.36523 and a standardized regression coefficient of 0.3307, the student-teacher relationships had a positive and highly significant ($P<.001$) impact on well-being. This suggested that the more positive the relationship between a teacher and a student, the higher the students' well-being. Moreover, this variable had a relatively strong effect on well-being. Therefore, H2 was supported.

Major satisfaction did not appear to be a primary factor influencing college students' well-being, as evidenced by the lack of a significant relationship between major satisfaction and well-being ($P=0.295$). Therefore, H3 was not supported.

The impact of peer support on well-being was positive and highly significant ($P<.001$), with a regression coefficient of 0.69372 and a standardized regression coefficient of 0.6128, indicating that peer support had the greatest impact on well-being. In other words, students who received more peer support were more likely to experience a higher level of well-being. Therefore, H4 was supported.

5. Implications

This study demonstrates that while a variety of factors affect college students' well-being, peer support and student-teacher interaction are particularly important. Regression analysis results demonstrate that student-teacher relationships significantly improve students' well-being ($P<.001$), suggesting that students who interact well with their teachers are more likely to experience higher well-being. Likewise, peer support had the greatest regression coefficient ($\beta= 0.6128$, $P<.001$), suggesting that the most important factor in fostering students' well-being is support among peers.

On the other hand, the influence of academic pressure on well-being is negative and significant ($P=0.044$), indicating that students experiencing greater pressure are likely to have lower well-being. Therefore, in the process of boosting students' well-being, colleges should focus on mental health support, optimization of student-teacher interactions, and the establishment of peer mutual help systems.

Even though this study found no significant relationship between major satisfaction and well-being ($P=0.295$), this does not imply that major choice is unimportant; rather, it may indicate that interpersonal relationships have a greater influence on well-being than major choice. Thus, in addition to focusing on the quality of instruction, the college should consider how to foster a more positive environment for interpersonal interactions in course design and management. Some strategies include enhancing student-teacher communication, planning team projects, and offering psychological counseling resources to maximize the student experience.

6. Conclusions

This study examined the effects of peer support, major satisfaction, student-teacher relationships, and academic stress on college students' well-being through empirical analysis. The findings suggest that colleges and educators should place greater emphasis on interpersonal factors, particularly fostering positive student-teacher relationships and peer support, to enhance students' well-being.

Beyond providing mental health care, improving the learning environment, and reducing unnecessary academic stress, future education management and policymaking should focus on helping students build strong interpersonal networks to further support their well-being.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Joing I, Vors O, Potdevin F, 2020, The Subjective Well-being of Students in Different Parts of the School Premises in French Middle Schools. *Child Indicators Research*, 13(4): 1469–1487.
- [2] Govorova E, Benitez I, Muniz J, 2020, How Schools Affect Student Well-Being: A Cross-Cultural Approach in 35 OECD Countries. *Frontiers in Psychology*, 2020(11): 431.
- [3] Svane D, Evans N, Carter MA, 2019, Wicked Wellbeing: Examining the Disconnect between the Rhetoric and Reality of Wellbeing Interventions in Schools. *Australian Journal of Education*, 63(2): 209–231.
- [4] Linden B, Stuart H, 2020, Post-secondary Stress and Mental Well-being: A Scoping Review of the Academic Literature. *Canadian Journal of Community Mental Health*, 39(1): 1–32.
- [5] Galvin K, Todres L, 2011, Kinds of Well-being: A Conceptual Framework that Provides Direction for Caring. *International Journal of Qualitative Studies on Health and Well-Being*, 6(4): 10362.
- [6] Todres L, Galvin K, 2010, “Dwelling-mobility”: An Existential Theory of Well-being. *International Journal of Qualitative Studies on Health and Well-Being*, 5(3): 5444.
- [7] Hascher T, 2012, Well-Being and Learning in School, in *Encyclopedia of the Sciences of Learning*. Springer, Boston, 3453–3456.
- [8] Ryff CD, 1989, Happiness is Everything, or is it? Explorations on the Meaning of Psychological Well-being. *Journal*

of Personality and Social Psychology, 57(6): 1069–1081.

- [9] Lee M, Larson R, 2000, The Korean “Examination Hell”: Long Hours of Studying, Distress, and Depression. *Journal of Youth and Adolescence*, 29(2): 249–271.
- [10] Chawla K, Sachdeva V, 2018, Domains of Stress and Coping Strategies used by 1st year Medical Students. *National Journal of Physiology Pharmacy and Pharmacology*, 2018(8): 366–369.
- [11] Bisht AR, 1980, A Study of Stress in Relation to School Climate and Academic Achievement (Age Group 13–17), thesis, Kumaon University.
- [12] Agolla JE, Ongori H, 2009, An Assessment of Academic Stress among Undergraduate Students: The Case of University of Botswana. *Educational Research and Review*, 4(2): 63–70.
- [13] Conner J, Pope D, Galloway M, 2010, Success with Less Stress. *Health and Learning*, 67(4): 54–58.
- [14] Beiter R, Nash R, McCrady M, et al., 2015, The Prevalence and Correlates of Depression, Anxiety, and Stress in a Sample of College Students. *Journal of Affective Disorders*, 2015(173): 90–96.
- [15] Subramani C, Kadiravan S, 2017, Academic Stress and Mental Health among High School Students. *Indian Journal of Applied Research*, 7(5): 404–406.
- [16] Travis J, Kaszycki A, Geden M, et al., 2020, Some Stress is Good Stress: The Challenge-Hindrance Framework, Academic Self-efficacy, and Academic Outcomes. *Journal of Educational Psychology*, 112(8): 1632–1643.
- [17] Hagenauer G, Volet SE, 2014, Teacher-Student Relationship at University: An Important yet Under-researched Field. *Oxford Review of Education*, 40(3): 370–388.
- [18] Newberry M, Davis HA, 2008, The Role of Elementary Teachers’ Conceptions of Closeness to Students on their Differential Behavior in the Classroom. *Teaching and Teacher Education*, 2008(24): 1965–1985.
- [19] Baker JA, 2006, Contributions of Teacher-child Relationships to Positive School Adjustment during Elementary School. *Journal of School Psychology*, 44(3): 211–229.
- [20] Gastaldi FGM, Longobardi C, Quaglia R, et al., 2015, Parent-teacher Meetings as a Unit of Analysis for Parent-teacher Interactions. *Culture & Psychology*, 21(1): 95–110.
- [21] Quaglia R, Gastaldi FGM, Prino LE, et al., 2013, The Pupil-teacher Relationship and Gender Differences in Primary School. *The Open Psychology Journal*, 6(1): 69–75.
- [22] Suldo SM, Friedrich T, White J, et al., 2009, Teacher Support and Adolescents’ Subjective Well-Being: A Mixed-Methods Investigation. *School Psychology Review* 38(1): 67–85.
- [23] Hamm JV, Faircloth BS, 2005, The Role of Friendship in Adolescents’ Sense of School Belonging. *New Directions for Child and Adolescent Development*, 2005(107): 61–78.
- [24] Reschly AL, Huebner ES, Appleton JJ, et al., 2008, Engagement as Flourishing: the Contribution of Positive Emotions and Coping to Adolescents’ Engagement at School and with Learning. *Psychology in the Schools*, 45(5): 419–431.
- [25] Deci EL, Ryan RM, 2000, The “What” and “Why” of Goal Pursuits: Human Needs and the Self-Determination of Behavior. *Psychological Inquiry*, 11(4): 227–268.
- [26] Penney D, 2018, Defining “Peer Support”: Implications for Policy, Practice, and Research, accessed August 19, 2021. www.ahpnet.com/AHPNet/media/AHPNetMediaLibrary/White%20Papers/DPenney_Defining_peer_support_2018_Final.pdf
- [27] Alsubaie MM, Stain HJ, Webster LAD, et al., 2019, “The Role of Sources of Social Support on Depression and Quality of Life for University Students. *International Journal of Adolescence and Youth*, 24(4): 484–496.
- [28] Brunsting NC, Zachry C, Liu J, et al., 2021, Sources of Perceived Social Support, Social-emotional Experiences, and

Psychological Well-being of International Student. *The Journal of Experimental Education*, 89(1): 95–111.

- [29] Al-Rfou AN, 2013, Factors that Influence the Choice of Business Major Evidence from Jordan. *Journal of Business and Management*, 8(2): 104–108.
- [30] Kim J, Cho E, 2018, Analysis of Factors Affecting Major Satisfaction. *International Journal of Advanced Culture Technology*, 6(2): 72–79.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Competitiveness of the Tourism Industry in Guizhou Province

Lu Gan*

School of Business Administration, Guizhou University of Finance and Economics, Guiyang, China

*Corresponding author: Lu Gan, 348938059@qq.com

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Guizhou Province has become an important tourist destination for domestic and foreign tourists because of its unique karst landscape, colorful folklore, and suitable weather. In the face of fierce competition in the domestic and international tourism markets, this paper proposes a series of countermeasures to enhance the competitiveness of Guizhou's tourism industry, including optimizing the socio-economy, improving the competitiveness of resources, exploring the potential to improve the socio-economic benefits, and making use of the natural advantages to create an "ecological" Guizhou, and so on. These measures aim to promote the leapfrog of Guizhou's tourism industry and enhance its competitiveness in the tourism market through policy guidance, capital investment, talent training, digital transformation, ecological protection, and cultural heritage.

Keywords: Tourism; Competitiveness

Online publication: April 3, 2025

1. Introduction

Against the background of globalization and regional economic integration, tourism, as an important part of the national economy, plays an irreplaceable role in promoting regional economic growth, cultural exchanges, and international cooperation ^[1]. Guizhou Province, as a bright pearl in Southwest China, has become a desired destination for many people at home and abroad due to its unique karst landscape, colorful folklore, and suitable weather. However, in the face of fierce competition in the domestic and international tourism market, how to enhance the competitiveness of Guizhou Province's tourism industry is an issue worth studying. Guizhou Province is rich in tourism resources and is blessed with natural landscapes and human heritage. From the spectacular Huangguoshu Waterfalls to the mysterious Zunyi Conference site, from the colorful minority customs to the long history and culture, these valuable tourism resources provide a solid foundation for the tourism industry in Guizhou Province ^[2]. However, the utilization of tourism resources, the innovative design of tourism products, the enhancement of tourism services, and the formulation of tourism marketing strategies still need to be further

optimized and improved. The purpose of this paper is to explore the key factors affecting the competitiveness of the tourism industry in Guizhou Province by delving into the current situation of the tourism industry in Guizhou Province, and on this basis, to propose strategies to enhance the competitiveness of the tourism industry in Guizhou Province ^[3].

2. Status of the tourism industry in Guizhou Province

2.1. Red tourism resources in Guizhou Province

Guizhou Province is rich in red tourism resources. According to the results of the great census of tourism resources in 2016 and the supplementary results of resource census in 2022 of the Guizhou Provincial department of culture and tourism, there are a total of 1,384 red tourism resource sites in the province, which are widely distributed in 88 provincial municipalities, but the overall level is low ^[4-5]. The distribution of red tourism resources shows obvious agglomeration, especially in the already red tourism resources, and this agglomeration difference is more significant. These core areas are mainly distributed in places of strategic importance during the Red Army's Long March, such as Yanhe, Dejiang, and Yanjiang connecting areas, Honghuagang, Huichuan, and Baozhou connecting areas, as well as Liping districts and counties ^[6]. The developed sources of red tourism are mainly concentrated in 3 first-level core areas, 2 second-level core areas, and 9 core areas, showing the "Y" shape of "multiple cores, small pieces and discrete points" and the "core-edge" spatial structure ^[7]. Among them, the density of developed sources of red tourism in Guizhou Province is high in the north and low in the south, showing the spatial distribution characteristics of "more in the north and less in the south, dense in the north and sparse in the south." These resources are affected by the five dimensions of resources, nature, society, economy, and tourism level, in which market demand, road network density, consumption level, forest coverage, and total tourism income have a decisive role in the spatial distribution of red tourism resources. These red tourism resources are of great significance in promoting the comprehensive economic and social development of the old revolutionary areas, protecting and utilizing the red resources, giving full play to the function of revolutionary education, and promoting the spirit of patriotism ^[8]. Guizhou also enhances the connection between red resources and real life, for example, through the organic combination of these red resources and the teaching of university courses on ideology and politics, to help students establish a correct world view, outlook on life and values, and promote their healthy growth.

2.2. Tourism resources of intangible cultural heritage in Guizhou Province

The intangible cultural heritage in Guizhou Province has distinctive national and regional characteristics and is rich in cultural heritage resources. These heritages reflect the living history, customs, psychological characteristics, and close connection with nature and society of each ethnic group and are the embodiment of local life ^[9]. The inheritance and promotion of intangible cultural heritage in Guizhou Province requires its historical continuity and the maintenance of its fundamental cultural identity. In the process of promotion, it is necessary to pay attention to its dissemination in different directions and levels, as well as to promote exchanges between different ethnic groups, ensuring that the culture retains its original charm while also undergoing continuous innovation ^[10]. The bearers of intangible cultural heritage play a central role in preserving and transmitting cultural heritage, connecting the past with the present and with innovation, ensuring that the essence of the skills is preserved, and revitalizing the culture. Guizhou Province has adopted a variety of approaches to the transmission of ICH,

including direct folk transmission, preservation through the use of digital means, integration into the education system, and the active participation of institutions ^[11]. Folk transmission encompasses family, group, and community forms of transmission, while digital transmission involves detailed field research, recording, archiving and integration through modern technology, and the promotion and preservation of this cultural heritage through online platforms.

3. Progress in research related to the competitiveness of the tourism industry

3.1. Definition of competitiveness in the tourism industry

Competitiveness remains important for the success of a company, regardless of the industry ^[12]. This principle applies to the tourism industry even if tourism is not a physical product. Poon, as the first tourism researcher to conduct a study on tourism competitiveness, identified four key principles in terms of competitive success, firstly tourism, secondly tourism, thirdly radical innovations, and fourthly strengthening the strategic position of the traveler. According to Athiyaman and Robertson, the competitive advantage to be available requires the application of energy and resources to strategic planning and the results of decisions and actions based on specific research findings. Tourism destinations should understand the meaning of competitiveness based on the universal definition of competitiveness and understand the competitiveness model and factors. Abreu-Novais et al. stated that research on competitiveness of the tourism industry in progressively, identifying the factors that contribute to the competitiveness of the tourism industry. Although there are various definitions in the tourism literature, Crouch and Ritchie's definition has been recognized by scholars, which describes the competitiveness of the tourism industry as "the ability of tourism expenditures to increasingly attract tourists while providing them with satisfying and memorable experiences, and to do so profitably while enhancing the well-being of the destination's inhabitants and preserving the natural capital of the destination for future generations."

3.2. Competitiveness is recognized as a key factor for success within the tourism industry

3.2.1. Measuring competitiveness in the tourism industry

In a service-intensive industry such as tourism, a model that provides a clear understanding of how to improve the competitiveness of a destination is undoubtedly important. Poon proposed competitive strategies that apply to the tourism industry and a model that incorporates these strategies. In a study done by Zengeni, he states that the measurement of competitiveness of the tourism industry can be done with published secondary data. Among them, quantitative data is often used because it tends to be more precise and accurate, and two types of qualitative data or "soft measures" can be found in the tourism literature. First, competitiveness is measured by survey data on tourists' opinions and perceptions, and the second is based on an empirical assessment of some subjective indicators of tourism competitiveness, which are surveyed and reported on key tourism-related indicators such as the TTCI (Tourism and Travel Competitiveness Index). The Tourism Competitiveness Report (2019) indicates what factors are required for tourism, which will further improve the measurement of tourism competitiveness ^[12]. These factors are determined by the Tourism Competitiveness Index (TCI), which is derived from the World Economic Forum's Executive Opinion Survey and then measured on a scale of 1–7, where 7 indicates the best result.

3.2.2. Factors for the competitiveness of Guizhou's tourism industry

Rich resource endowment: Guizhou is endowed with unique natural scenery and a cool climate, as well as rich

ethnic culture and historical relics. These original natural landscapes and colorful ethnic cultures provide a solid foundation for tourism. It also has rich animal resources, which are divided into livestock and poultry resources and wildlife (including rare animals) resources. Guizhou has 45 kinds of breeding livestock and poultry. Rich natural resources bring beautiful natural landscapes to Guizhou, with famous tourist attractions such as Fanjing Mountain, Qianling Mountain, and Huangguoshu Waterfall. Distinctive ethnic and cultural characteristics: Guizhou is a multi-ethnic province, represented by the cultures of Miao, Dong, Bouyei, Shui, and other ethnic minorities, with rich ethnic customs and unique cultures, which provide diversification and differentiation of tourism products ^[13]. Outstanding climate tourism resources: The cool climate and fresh air in summer make Guizhou a place for summer vacation and leisure, with obvious climate tourism advantages. Guizhou has a warm and humid climate, which is suitable for living. Guizhou has good air and little temperature change. It is warm in winter and cool in summer. The average temperature in summer is about 24°C. The average temperature of Liupanshui, known as the “cool capital of China”, is as low as 19.8°C. The average annual relative humidity is above 70%. The intensity of ultraviolet rays is low. The forest coverage rate of the province is about 40%. Policy support: Guizhou province promotes tourism through a series of policies and measures, such as the Guizhou Province Tourism Management Regulations, for the standardized management of the tourism industry and market order to provide legal protection. Gradual improvement of infrastructure: With the improvement of transportation infrastructure, such as the construction of highways and rapid railroads, the accessibility of Guizhou province has been improved, which promotes tourism ^[14].

4. Countermeasures to enhance the competitiveness of Guizhou Province’s tourism industry

In Xu Qun’s analysis, four factors were analyzed: economic environment factor, socio-economic benefit factor, international tourism operation factor, and natural environment factor. Through principal component analysis, the tourism competitiveness of 31 provinces (municipalities) and autonomous regions in China is comprehensively ranked, and the current situation of tourism competitiveness in Guizhou province is analyzed and compared with other provinces. Based on the results of the empirical analysis, suggestions are made for the competitiveness of the tourism industry in Guizhou Province as follows.

4.1. Optimize the socio-economic environment

Adopt guiding economic development policies to attract capital flow to the tourism industry and make up for the lack of capital. At the same time, increase investment in infrastructure, including transportation, communication, and energy, to lay a solid foundation for the development of the tourism industry. It is necessary to make full use of long-term systems and policies that encourage rural tourism. Ensure the supply of land and incorporate it into the annual and land-use master plan for rural tourism projects. Rural collective economic organizations can use their property or property associated with other units and individuals for the construction of parking lots for hospitality, accommodation, catering, tourism, and other service-oriented facilities following relevant plans. Support the creation of pilot projects to improve the layout of rural construction land, connect urban and rural construction land, and provide infrastructure for tourism.

4.2. Improve resource competitiveness

Emphasize the cultivation and development of tourism talents, improve the mechanism for cultivating tourism

talents, increase investment in tourism education, attract and retain talents, and form human resource advantages. A tourism sector can grow and develop, and the tourism experience can be enhanced and innovated, all thanks to the development and promotion of the digital economy ^[15]. Culture and tourism authorities should do a good job in the top-level design of digital tourism, set up enough special funds to encourage enterprises to carry out digital tourism projects, product development, and digital tourism construction, and encourage the development of digital platforms. A combined mode of industry-university-research can be adopted to jointly cultivate digital talents in the tourism industry, education, culture, and tourism authorities. This model relies on excellent practice programs to strengthen practice management and coordination of digital tourism talents. Cultural and tourism authorities should guide the digitization of popular destinations and help top companies implement their digital tourism plans. Guizhou's unique tourism resources should be promoted to tourists through technology, with a focus on tapping the growth potential of smart tourism investment enterprises in attracting investment.

4.3. Utilizing natural advantages to create an “ecological” Guizhou

Give full play to the characteristics of Guizhou's rich plant species, optimize the natural environment, and promote the competitiveness of the tourism industry. Relying on Guizhou's unique natural environment and biodiversity, develop eco-tourism products, such as excursions to nature reserves, ecological hiking, bird-watching activities, etc., to attract tourists interested in nature and ecology. Utilizing the natural scenery, idyllic life, and agricultural resources of the countryside, develop rural tourism and provide activities such as farmhouse, agricultural experience, and rural leisure so that tourists can experience the tranquility and nature of the countryside. Design diversified thematic tourism routes, such as world natural heritage tours, ethnic and cultural village tours, and ancient town style tours, to meet the interests and needs of different tourists ^[16]. Provide customized tourism services, designing exclusive tourism plans and itineraries according to the individual needs of tourists to enhance the personalization and satisfaction of tourism services.

Funding

Student scientific research project of Guizhou University of Finance and Economics: Research on product pricing decisions considering return risk in live supply chain (Project number: 2024ZXS010)

Disclosure statement

The author declares no conflict of interest.

References

- [1] Athiyaman A, Robertson RW, 1995, The Interface of Tourism and Strategy Research. *Tourism Management*, 16(6): 447–453.
- [2] Audretsch DB, Eichler GM, Schwarz EJ, 2022, Emerging Needs of Social Innovators and Social Innovation Ecosystems. *International Entrepreneurship and Management Journal*, 2022(18): 217–254.
- [3] Crouch GI, Ritchie JRB, 1999, Tourism, Competitiveness, and Societal Prosperity. *Journal of Business Research*, 44(3): 137–152.
- [4] Frank KI, Reiss SA, 2014, The Rural Planning Perspective at an Opportune Time. *Journal of Planning Literature*,

29(4): 386–402.

- [5] Guo K, Gu Y, 2022, The Construction of Smart Tourism City and Digital Marketing of Cultural Tourism Industry under Network Propaganda Strategy. *Security and Communication Networks*, 2022(1): 1–12.
- [6] Poon A, 1993, *Tourism, Technology and Competitive Strategies*. CAB. International, New York.
- [7] Poux F, Valembois Q, Mattes C, et al., 2020, Initial User-centered Design of a Virtual Reality Heritage System: Applications for Digital Tourism. *Remote Sensing*, 12(16): 2583.
- [8] Ritchie JRB, Crouch GI, 2003, *The Competitive Destination: A Tourism Perspective*. CABI Publishing, Wallingford.
- [9] Wu YC, Lin SW, Wang YH, 2020, Cultural Tourism and Temples: Content construction and Interactivity Design. *Tourism Management*, 2020(76): 103972.
- [10] Sun XL, Song YD, Zhu LT, et al., 2024, Spatial Differentiation Pattern and Influencing Factors of Red Tourism Resources in Guizhou Province. *Economic Geography*, 44(4): 220–230.
- [11] Yao SJ, 2023, Inheritance and Dissemination of Intangible Cultural Heritage in Guizhou Province. *Guizhou Ethnicities Research*, 44(6): 129–132.
- [12] Zhou CW, 2022, An Analysis of the Path for Integrating Red Tourism Resources in Guizhou Province with Curriculum-based Ideological and Political Education Reform. *Tourism Overview*, 2022(21): 46–48.
- [13] Pan GF, 2022, Study on the Strategic Path of Digital Humanities Development of National Intangible Cultural Heritage in Guizhou Province. *Guizhou Ethnic Studies*, 43(3): 83–88.
- [14] Wu HY, Xie X, Liu R, 2022, Study on Intangible Cultural Heritage protection and Tourism Development from a Cultural Perspective: A Case Study of Danzhai County, Guizhou Province. *Tourism Review*, 2022(4): 48–51.
- [15] Xu Q, Zhang ZD, 2012, Empirical Analysis of Tourism Industry Competitiveness in Guizhou Province. *Reform and Opening Up*, 2012(14): 187–189 + 191.
- [16] Shi Z, 2010, *Research on Deepening Development of Tourism in Guizhou Province*, thesis, Guizhou University of Finance and Economics.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Research on the Cultivation Path of “Craftsman Spirit” in the Course Teaching of Chinese Arts and Crafts History

Yanhua Jiang*

School of Design and Art, Hunan Applied Technology University, Changde 415100, Hunan, China

*Corresponding author: Yanhua Jiang, 13657428271@163.com

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: The course teaching of Chinese arts and crafts history plays an important role in cultivating students' craftsman spirit. However, in the practical teaching of application-oriented colleges and universities, there exists a marginalized phenomenon of cultivating a craftsman spirit, which deviates from the training goal of application-oriented talents. By analyzing the internal connection between the teaching content design of Chinese arts and crafts history course and the opportunities for cultivating craftsman spirit, this paper proposes that in the process of cultivating craftsman spirit, it is necessary to construct the cultivation of craftsman spirit in inheritance and innovation, the cultivation of craftsman spirit in moral spirit's role in the consciousness space of technology and art, and the cultivation of craftsman spirit in the awareness and grasp of the world.

Keywords: Craftsman spirit; Arts and crafts; Course teaching; Cultivation path

Online publication: April 3, 2025

1. Introduction

Carrying forward the craftsman spirit and inheriting the excellent Chinese culture, today's society needs a large number of high-quality applied talents and skilled craftsmen as the requirement of the times^[1]. In the teaching of applied undergraduate colleges and universities, how to better cultivate students with a “craftsman spirit” is an important issue facing the new era. The course of the history of Chinese Arts and Crafts is a course to cultivate the theoretical quality of professionals with a craftsman spirit in the new era. It should be carried out according to the professional personnel training program and teaching syllabus to cultivate talents with innovative spirit and ability. Through the establishment of the “craftsman spirit” teaching mode, improve the traditional history teaching moral cultivation model. In the specific teaching process, the humanistic connotation, moral responsibility, and innovative spirit of the craftsman spirit are run through it, providing new teaching ideas and models for the

cultivation of the craftsman spirit ^[2].

2. The dilemma of cultivating a “craftsman spirit” in the course teaching of Chinese arts and crafts history

In applied colleges and universities, the teaching of the history of Chinese arts and crafts is often based on the clues of the development of historical traditions. The classical arts and craft works and historical facts of various periods are taught in different categories, and the knowledge of historical theory is taught. This is caused by the old tradition of history teaching, historical tradition, and the conditions of teachers themselves ^[3]. The cultivation of the craftsman spirit is more about the explanation of historical knowledge and historical analysis, and teachers have not formed a unified understanding of the craftsman spirit.

2.1. The teaching of Chinese arts and crafts history lacks the cultivation of the craftsman spirit

The teaching of the history of Chinese arts and crafts in application-oriented undergraduate colleges emphasizes the teaching of historical theory knowledge and lacks research and development on the teaching content of craftsman spirit, which is a constraint on how to better cultivate craftsman spirit talents ^[4]. It ignores the practical and applied characteristics of vocational education in application-oriented undergraduate colleges and universities and fails to integrate the cultivation of historical theory knowledge and skills with the cultivation of a craftsman spirit, which cannot meet the needs of application-oriented personnel training. At present, the textbooks about the history of Chinese arts and crafts on the market are out of application and practice, which brings great difficulties and constraints to teachers' teaching and students' learning.

Therefore, the teaching of the history of Chinese arts and crafts rarely involves the cultivation of the craftsman spirit in applied undergraduate colleges ^[5]. The teaching plan and corresponding teaching content do not incorporate the spirit of Chinese craftsman, the textbooks do not have corresponding cases to analyze and interpret the spirit of craftsman, and teachers rarely analyze the history and works of Chinese arts and crafts from the perspective of the spirit of craftsman. There is a serious disconnect between the course content and the cultivation of craftsman spirit. Although some teachers have analyzed the craftsman spirit, they still stay at the point level and have not formed a systematic teaching content and a perfect teaching mode. As a result, the cultivation of the craftsman spirit is marginalized in the course teaching of Chinese arts and crafts history ^[6].

2.2. The understanding of the craftsman spirit is not comprehensive and profound

The education and teaching of application-oriented undergraduate vocational colleges pay more attention to the cultivation of students' application and practice ability, comprehensive problem-solving ability, and innovative thinking. Therefore, teachers need to master vocational skills and inherit and innovate the craftsman spirit. However, the craftsman spirit embodied in the teaching content of the history of Chinese arts and crafts course—dedication, excellence, dedication, pursuit of excellence, and innovative spirit of the professional quality has not been deeply interpreted ^[7]. In the course of teaching, the teachers did not have a deep grasp of practical ability and skill level, did not understand the teaching content of the history of arts and crafts in combination with the spirit of craftsman, and did not form a high recognition of the spirit of craftsman. In addition, the teachers' limited knowledge and busy teaching and scientific research did not do in-depth research on the content of cultivating the spirit of craftsman in the course. Therefore, it is difficult to achieve the ideal effect of cultivating an artisan spirit.

2.3. The teaching content lacks the interpretation of the connotation of the craftsman spirit in Chinese arts and crafts

Judging from the overall teaching situation of Chinese arts and crafts history, the serious shortage of outstanding teachers is an important factor troubling the improvement of teaching quality. In the specific teaching process, from the teaching design and analysis of each art and crafts work to the cultivation of craftsman spirit, “learning” and “using” are disjointed. Teachers interpret the historical theory and theoretical knowledge they have understood and mastered, and conduct teaching and analysis from the perspectives of historical development, color, shape and form of arts and crafts works^[8]. The design and production of arts and crafts works, as well as the craftsman spirit connotation contained in the works, are often ignored. As a result, there is a serious deviation between the teaching of the history of Chinese arts and crafts and the cultivation of the craftsman spirit. In this teaching situation, the course teaching of Chinese arts and crafts history cannot understand the cognitive mode of craftsman spirit and the angle of grasping the world, the understanding of aesthetic structure in works stays in the category of fine arts, and the understanding of moral responsibility, inheritance and innovation contained in the craftsman spirit cannot be profound. Naturally, the understanding of the craftsman spirit embodied in love and dedication, innovation, excellence, and hard study stays on the surface^[9]. As a result, the teaching of the history of Chinese arts and crafts has gradually become a pure theoretical research course, which runs contrary to the training of applied talents, let alone the cultivation of the craftsman spirit.

3. The cultivation path of “Craftsman spirit” in the course teaching of Chinese arts and crafts history

Application-oriented colleges and universities in the new era conform to the requirements of the times and train application-oriented innovative talents to serve China’s modernization. In the process of Chinese arts and crafts history education and teaching, students should be guided to become applied talents with original thinking, original design, and original quality^[10].

3.1. Construct the teaching content of inheriting and innovating artisan spirit cultivation

Throughout the history of Chinese arts and crafts, it is the embodiment of the best culture of the Chinese nation, and the craftsman spirit has been perfectly interpreted in the works of arts and crafts. The inheritance and innovation of the craftsman spirit in the new era is the main content of constructing the professional spirit and value^[11]. By teaching the history of Chinese arts and crafts, students are guided to understand that the craftsman spirit is the source and inevitable choice of cultural self-confidence. Combined with the historical background of social development and the contemporary Chinese spirit of the times, it is necessary to understand the connotation of contemporary Chinese craftsman spirit.

3.1.1. Teachers can deeply understand the connotation of the craftsman spirit through the appreciation of Chinese arts and crafts

In the teaching process of appreciation of Chinese arts and crafts works, each excellent work needs to be analyzed and explained step by step. Firstly, from the perspective of production technology, the craftsman’s spiritual pursuit of fine carving, excellence, inheritance, and innovation is analyzed^[12]. Secondly, the spiritual pursuit and ideal pursuit of “things carry Tao” reflected in the works are part of Chinese traditional culture. Finally, the craftsman spirit embodied in the works is the fullest expression of professional dedication. Through the above three steps of

teaching, students can fully understand the connotation of the traditional craftsman spirit in Chinese arts and crafts works and lay a foundation for future students to understand the connotation of the Chinese craftsman spirit in the new era.

The cultivation of the craftsman spirit in applied colleges and universities must effectively link the teaching of the craftsman spirit with the background of the times. The craftsman spirit is an important content of cultural development and inheritance, and the craftsman spirit in the new era must first have the unity of ingenuity, craftsmanship, and craftsman ethics. The first is to understand that craftsmanship guides today's college students from the perspective of the development of various periods in the history of Chinese arts and crafts^[13]. To become an applied talent with the characteristics of the new era, they must be prepared as a craftsman and have the ability and character to focus on one thing. To understand craftsmanship, it is necessary to understand that every excellent work of art and craft contains superb skills. Teachers need to guide students to study traditional culture hard and master the ability of inheritance and innovation, to better practice the spirit of craftsmanship. The craftsman virtue is sublimated into a Chinese cultural spirit through the interaction between craftsmen, which is the craftsman spirit in the new era after inheritance and innovation. Second, in the appreciation process of Chinese arts and crafts, teachers should guide students not only to analyze and interpret from the aspects of history and culture, shape and color, form and content, but also to explore the spiritual pursuit embodied by artists in their works of arts and crafts, which is perfectly combined with professional behavior. In today's fast-paced operation and over-emphasis on the pursuit of interests, it is particularly important to guide college students to fully understand that the spirit of craftsmanship is a spiritual quality that can be developed in professional behavior, rather than just a means of making a living. Thirdly, the content of the artisan spiritual home embodied in arts and crafts works of various periods should not be ignored. Students should be guided not only to understand excellent arts and crafts works from the economic perspective, which can improve personal income and social status, but also to understand people's love for work, life, career, and society embodied in the craftsman spirit^[14].

3.1.2. Deeply understand the construction content of innovative thinking in Chinese arts and crafts works

In the teaching of Chinese arts and crafts, teachers should first vigorously promote the artisan spirit of "respecting skills and promoting virtue", which is reflected in both modern manufacturing industry and working life. Therefore, guiding students to grasp superb works from work and life itself has this moral attribute. Secondly, teachers' explanation of the craftsman spirit of "excellence" and "focus on excellence" is a key to guiding students to understand tradition and innovation. Excellent Chinese arts and crafts always reflect the characteristics of excellence, which is the craftsman's respect for tradition and norms, through the detailed appreciation of art works in various periods to grasp the craftsman's excellence, the craftsman's focus on excellence itself is a kind of innovation, which not only reflects the deep understanding of tradition but also the transcendence of tradition. Thirdly, in the whole process of learning the history of Chinese arts and crafts, teachers should analyze the craftsman spirit of "respecting teachers and valuing education" and "seeking truth and dedication" from the perspective of emotional identification. Through the love of Chinese arts and crafts and the occupation they are engaged in, they sublimate to the height of the integration of teachers and Taoism. Fourth, from the perspective of ideological and political education to interpret Chinese arts and crafts, innovation is the embodiment of a country and a nation's spiritual temperament, "seeking truth and dedication" is the expression of cultural confidence. In the process of pursuing truth and practice, being willing to contribute is an important manifestation of the

responsibility of contemporary college students ^[15]. They must pursue innovation in seeking truth and pragmatism and find cultural self-confidence in being willing to contribute.

3.2. Construct the teaching content of the moral spirit as a craftsman

From the perspective of Chinese ethics and culture, the connotation of the “moral spirit” of Chinese culture, which puts morality first, is taught to students, which is the professional standard that Chinese craftsmen must follow and also the basis for the generation of the craftsman spirit. Chinese artisans spread the word with their skills and follow “the way of the people, the way of no intention and the way of no self”, which is the embodiment of the Chinese people’s understanding of nature and pursuit of civilization. Teachers need to analyze and study the “craftsmanship” and “craftsmanship” embodied in the works of arts and crafts, and finally explain the “Tao” embodied by the craftsmen through the creation of craft works. The specific teaching methods are as follows. First of all, the similar craft works in various periods are classified, their technical processes are analyzed, and the basic position of technology in craft production is deeply studied. Second, it tells the relationship between technology and art in the works so that students can understand that art is a skill that is developed based on art, and art is the embodiment of the combination of Tao and art. Grasp the craftsman spirit of “technology to carry Tao” in the mutual relationship between technology and skill ^[16]. Third, explain the mutual relationship between technology and Tao in similar arts and crafts works in various periods with the view of historical materialism, so that students can understand that the craftsman spirit of “technology to carry Tao” is the carrier of people. The craftsman embodies the spiritual connotation of “Tao” in the process of respecting nature and maintaining the harmonious coexistence between man and nature.

3.3. The teaching content of constructing the craftsman spirit of craftsman thinking

The Chinese unique thinking mode and code of conduct contained in Chinese arts and crafts reflect the craftsman spirit of craftsman thinking. Excellent works of arts and crafts not only have superb technology and exquisite skills but also reflect the work attitude of rigor, responsibility, meticulousness, and focus, as well as the work concept of excellence, which reflects the sense of identity, responsibility, and mission of the profession. In teaching, teachers need to analyze and explain the works to make an in-depth analysis of the craftsman’s way of understanding and grasping the world to find the inner connection between the craftsman thinking and the works so that students can understand the spirit of the craftsman thinking reflected in the works.

In the process of cultivating students’ ingenuity thinking, it is mainly analyzed and explained from three perspectives. Firstly, the paper analyzes the abstract thinking embodied in the works of Chinese artisans. From the viewpoint of historical materialism, the paper finds the root and basis of the creative thought of each type of different works in each period, and the expression of the constant view of the cycle of all things in the works, and conveys the understanding of abstract thinking in the spirit of Chinese artisans and craftsmen through a balanced and neutral expression. Secondly, by understanding the spirit expressed in the overall cognition of the world in the works, this spirit is materialized into the creation process of specific arts and crafts works, which not only retains the concreteness of things but also has the unique thinking mode of Chinese people to grasp the world and life. Finally, students must maintain a pure and creative heart and pursue the ideal of freedom and perfection to achieve a high state of unique originality of thinking.

4. Conclusion

Chinese arts and crafts history education and teaching is one of the important courses to cultivate students' craftsman spirit. In the teaching process, teachers need to study the combination of Chinese arts and crafts history curriculum content and craftsman spirit cultivation and reconstruct the teaching content of craftsman spirit cultivation. In the three aspects of inheritance and innovation, moral responsibility, and originality thinking, the teaching content reform should improve the shortcomings of craftsman spirit cultivation in the teaching of Chinese arts and crafts history. Through the cultivation of the craftsman spirit in education and teaching, students are helped to establish correct career ideals, cultivate their rigorous study and hard work attitude, as well as the spirit of inheritance and innovation.

Funding

This paper is the research result of the general project of teaching reform research of Hunan Institute of Applied Technology in 2022, "Teaching Research on Cultivating College Students' Craftsman Spirit in the New Era Based on Chinese Arts and Crafts History Course." Project number: HYJGYB202220

Disclosure statement

The author declares no conflict of interest.

References

- [1] Du S, Zhang JF, 2019, The Causes of the Lack of "Craftsman Spirit" in Vocational School Students and its Cultivation Strategies. *Western Quality Education*, 6(9): 6–8.
- [2] Zhu J, 2024, Research on the Cultivation Path of Vocational Students' Craftsman Spirit in Digital Age. *Science and Education Guide*, 12(9): 86–88.
- [3] Sun JF, 2023, Value Implication, Practical Dilemma and Practical Path of Integrating Artisan Spirit into Talent Training in Higher Vocational Colleges from the Perspective of Virtue and Cultivating People. *Education and Occupation*, 11(22): 100–105.
- [4] Zhang LL, 2021, A Study on the Training Mode of Work-study Combined Talents in Technical Colleges from the Perspective of Craftsman Spirit, thesis, Guangxi Normal University.
- [5] Liu XP, Liu YJ, Li M, 2024, The Cultivation Path of Craftsmanship Spirit in Undergraduate Vocational Education under the Background of the Three-Teaching Reform. *Journal of Yueyang Vocational and Technical College*, 12(6): 41–44.
- [6] Zhou X, 2025, Ways to Cultivate Artisan Spirit in Higher Vocational Colleges Based on Internal Drive. *Modern Business Trade Industry*, 2(2): 116–118.
- [7] He LJ, Qian YP, He Y, 2024, Cultivation of Vocational Students' Craftsman Spirit Based on Modern Apprenticeship. *Education and Occupation*, 2(3): 98–102.
- [8] Xi WQ, 2017, Mining and Cultivating "Craftsman Spirit" in Modern Teaching. *Curriculum and Teaching*, 8(8): 82–85.
- [9] Guo AY, Liu TS, Shuai W, 2019, Research on the Strategies of Carrying Forward the Spirit of Craftsman and Improving the Professional Quality of Students in Vocational Colleges. *Science and Technology Wind*, 12(34): 19–

21.

- [10] Song JH, 2017, Optimization of CNC Course Design and Training of Students' Craftsman Spirit. *China New Communications*, 19(5): 134.
- [11] Gu JC, 2018, Vigorously Carry forward Craftsman Spirit and Improve Students' Professional Quality: A Case study of Training students' Craftsman Spirit in Technical Colleges. *Occupation*, 2018(33): 26–27.
- [12] Tan WC, 2022, A Study on Cultivating Artisan Spirit in Technical Colleges from the Perspective of Positive Psychology: A Case Study of Jiangxi Electronic Information Technician College. *Education and Teaching Forum*, 2022(30): 46–49.
- [13] Avram A, 2000, *History of Western Art Education*, translated by Jing Li, Chang Ningsheng. Sichuan People's Publishing House, Chengdu, 92–145.
- [14] Shi ZY, 2004, *Introduction to Educational Philosophy*. Beijing Normal University Press, Beijing, 112.
- [15] American Association for the Advancement of Science, 2005, *The Design of Science Literacy*, translated by China Association for Science and Technology. Science Popularization Press, Beijing, 39.
- [16] Cheng HD, Chen F, 2024, Research on the Cultivation Path of “Craftsman Spirit” for New Quality Laborers. *Engineering Research*, 10(37): 1–12.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Research on the Development and Design of Quanzhou Tourist Souvenirs

Wangming Hu¹, Jiangwei Lu^{2*}

¹College of Cultural Communication, Liming Vocational University, Quanzhou 362000, Fujian, China

²College of Fine Arts and Design, Quanzhou Normal University, Quanzhou 362000, Fujian, China

*Corresponding author: Jiangwei Lu, lujiangwei87@126.com

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: *Objective:* For the better development of Quanzhou's tourist souvenir market, to inject fresh blood into Quanzhou's souvenir market, to meet the needs of consumers, and to promote Quanzhou culture to the world. *Methods:* From the perspective of Quanzhou regional culture, an objective analysis of the Quanzhou souvenir market and the existing problems of the souvenirs was performed. Then, the design principles of Quanzhou tourist souvenirs were put forward, and the culture of Quanzhou was integrated into the design of the souvenirs. From the landscape architecture, food culture, religious culture, intangible cultural heritage, representative historical figures, and other aspects, analyze its basic characteristics, extract cultural elements, develop and design tourism souvenirs with strong Quanzhou characteristics, and promote the unique culture of Quanzhou to the world. *Results:* The study provided design reference and theoretical guidance for the design of Quanzhou tourist souvenirs.

Keywords: Tourism; Souvenir; Quanzhou culture; Design; Heritage

Online publication: April 3, 2025

1. Introduction

With the improvement of people's living standards and the growth of the national economy, the tourism industry has developed and perfected at a high speed in recent years, and the development and design of tourist souvenirs is an important part of the development of tourism. Located on the southeast coast of Fujian Province, Quanzhou has a long history, a prosperous population, and a developed economy. It is recognized by UNESCO as the starting point of the Maritime Silk Road and was selected as the first "East Asian Cultural Capital" in 2013^[1]. There are many scenic spots in Quanzhou, with many "the best" in China. It has witnessed the thousand-year vicissitudes of Quanzhou civilization, contains rich historical and cultural relics, and occupies an important position in the traditional culture of southern Fujian^[2]. At present, Quanzhou is an expansive destination in the world. Quanzhou has become one of the destinations of domestic and foreign tourism lovers. According to relevant statistics, the number of tourists in Quanzhou in 2024 exceeded 100 million^[3]. At the same time, the tourism market of Quanzhou is short and

homogenized seriously, lacking modern creativity and practicality, and unable to fully reflect the deep historical and cultural heritage and local characteristics of Quanzhou. Therefore, the design and development of various tourist souvenirs with Quanzhou characteristics is a necessary condition for the vigorous development of Quanzhou tourism.

2. Quanzhou tourism souvenir development and design principles

2.1. Unique regional symbolism

Quanzhou is the birthplace of southern Fujian culture, which contains religion, architecture, language, folklore, immigration, and art, showing its unique and colorful characteristics ^[4]. Quanzhou has scenic spots such as the Laojun Rock of Qingyuan Mountain, the Qingjing Temple, the East-West Pagoda, the Kaiyuan Temple, Luoyang Bridge, and the South Shaolin Temple. For religion, there are Buddhism, Islam, Taoism, Mazu, Christianity, Catholicism, etc., with a long history and rich historical sites. In architecture, the combination of Chinese and Western style, ancient house, dovetail ridge, red tile slope roof. In terms of language, the Quanzhou dialect is the main carrier of Quanzhou culture. In history, the Quanzhou dialect used to be the representative of the southern Fujian dialect. For example, “Badu demon”, “frozen tail eagle”, and “Water Chaomu” are the immediate impressions. In the folk custom, Quanzhou has retained the cultural heritage of opera, there are Liyuan opera, Nanyin, North Guan, marionette, Gaojia opera, Dacheng opera, and other operas. In terms of food, there are noodle paste, Anhai frozen earth bamboo shoot, stone flower paste, Chongwu fish roll, and meat zongzi. There are also Huian women, Huian stone carving, Quanzhou lantern, and many more. Extracting and redesigning these elements and integrating them into the design and research of tourism products allow them to be more vivid in which can be more vivid to promoting Quanzhou culture to the world.

2.2. Having associative recall ability

By viewing this souvenir, tourists can associate it with Quanzhou architecture, food, language, and other related pictures, which plays a role in promoting the spread of Quanzhou culture. On the one hand, representation involves the complex relationship between the symbol itself, the intention, and the represented object; on the other hand, it is closely related to communication, dissemination, understanding, and interpretation in a specific context ^[5]. Indeed, if tourists can recall Quanzhou culture and even have the desire to explore it again through viewing the souvenirs in their hands, it is obvious that such product design is successful. Quanzhou tourist souvenirs are static and fixed, but they often express rich spiritual connotations with this frozen and immobile image so that the viewer can think of the emotion, plot, and future trend before and after the moment when viewing the souvenir ^[6]. Quanzhou tourist souvenirs in the performance must “live in static”, that is, choose a memorable moment, and this moment should be the most imaginative. There is no doubt that the design and development of such souvenirs are successful.

2.3. Advancing with the times

As a modern carrier of art, tourist souvenirs should not only reflect a strong artistic atmosphere but also have a keen sense of modern fashion so that consumers have a strong artistic resonance and increase consumers’ artistic identity for tourist souvenirs. Take Xiamen as an example. Xiamen is vigorously developing cultural and creative industries, among which the development of tourist souvenirs is a key link to promote the development of creative industries. Xiamen City holds relevant design competitions to allow more colleges, students, enterprises, designers, design companies, folk craftsmen, and craft artists to participate in the design of Xiamen creative tourism souvenirs, injecting fresh blood into Xiamen’s cultural and creative industries and thus promoting the

innovation of Xiamen tourist souvenirs. As a result, more and more tourist souvenirs with novel design styles and unique artistic modeling appear in the Xiamen tourism market ^[7]. For example, the unique Xiamen tourist map, in the form of “drifting slowly pass” to send a paper blessing postcard to the future self, with a unique artistic style of art works, so that consumers with different artistic tastes can get artistic satisfaction, can improve the public aesthetic, encourage designers to create more high-quality works, to achieve a virtuous cycle of tourism souvenir market. This is very worthy of reference for the innovation and development of tourism souvenirs, Quanzhou souvenir development should also keep up with the pace of innovation of the times, hold related design competitions, so that more colleges and universities, students, enterprises, designers, etc. can participate in the design of creative tourism souvenirs in Quanzhou, and stand out from the same tourist souvenirs. This can better promote the development and innovation of Quanzhou souvenirs.

3. Quanzhou tourism souvenir design symbol discussion

3.1. Landscape architectural elements

As a national historical and cultural city, Quanzhou has preserved many scenic and architectural wonders, such as the famous 18 scenic spots in Quanzhou — Qingyuan Mountain, Kaiyuan Temple, Chongwu Ancient City, Fuwen Temple, West Lake Park, Shenzhen-Hubay, Niumlin, Qingshui Rock, Tianhou Palace, Wuli Bridge, East Lake Park, Luoyang Bridge, Gold Coast, Xiangong Mountain, Cai’s ancient residence, Daixian Waterfall, Zheng Chenggong Historical Site, and Tumen Street. In the design of Quanzhou tourist souvenirs, the traditional scenic architectural elements should be combined with souvenirs. On the one hand, it can improve the uniqueness of souvenirs, and on the other hand, it can evoke tourists’ memories of Quanzhou tourism. However, the application of the elements of Quanzhou landscape architecture is not a simple copy of the shape, such as the common resin models on the market, as such souvenirs are low-end and lack some practical value, so it is difficult to arouse the desire of tourism enthusiasts to buy. The correct approach should be to refine and symbolize the form, shape, and color of the Quanzhou logo building and then productize it. In the process of productization, some design principles described above should be followed. **Figure 1** is the winning work of Quanzhou Tourism Commodity Cultural and Creative Design Competition, “Moisten the Silent”, organized by Quanzhou Cultural and Tourism Bureau and Quanzhou Ancient City Office in 2020. The work is designed to extract and design the ancient place of southern Fujian, and designs a modern tea set with distinctive Quanzhou cultural elements with Quanzhou Dehua ceramics as the carrier, which is a very excellent tourist companion gift.



Figure 1. Design of Quanzhou architectural elements tableware

3.2. Food elements

Quanzhou is located in the subtropical zone, the land is fertile with rich products, so Quanzhou snack has been very famous since ancient times. For example, there is a beef soup with strong tendons and bones that nourishes the spleen and stomach. There is a meat zongzi with non-greasy oil. There is sweet and refreshing peanut kernel soup that melts in the mouth. There are delicious, sweet, and smooth noodle pastes. There are fresh and sweet oyster omelets with endless aftertaste. The texture, color, and shape of these delicacies are transformed figuratively, combined with the function of tourism memorial products, which not only meets the practical function but also vividly and directly displays the local cultural characteristics, visually stimulating the user's desire for in-depth understanding.

3.3. Religious and cultural elements

Quanzhou, located on the southeast coast of Fujian Province, is an important port. Marco Polo called it "the largest port in the East", equal to the port of Pressure Mountain in Egypt. Missionaries from all over the world came here to preach. Many religious relics constitute a unique cultural landscape in Quanzhou, which is called the "Museum of World Religions." Its cultural value has become the common cultural wealth of Quanzhou people and even the Chinese nation. There are Taoism, Buddhism, Islam, Manichaeism, Nestorianism, Catholicism, Brahmanism, and so on. Combining religious and cultural elements with souvenirs, modern language can be used, such as abstract geometric language to evolve religious and cultural elements, making the original form more concise and more beautiful in modern form. It can also be used to extract the most typical elements of religious culture concisely when changing the original form, and then exaggerate, strengthen, modify, and recombine them on this basis.

3.4. Elements of intangible cultural heritage

Quanzhou has a long and profound culture. At present, Quanzhou has four intangible cultural heritage projects, and it is the only city in China with three categories of UNESCO intangible cultural heritage list and roster projects. At the same time, Quanzhou has 34 national intangible cultural heritage projects, 89 provincial intangible cultural heritage projects, and 224 municipal intangible cultural heritage projects^[8]. All kinds of "intangible cultural heritage" treasures, such as puppet heads, wood carvings, lanterns, paper carvings, Jincang embroidery, paper painting, porcelain carving, Nanyin, Gaojia opera, and so on, are dazzling. "Intangible cultural heritage" is not only a living culture but also a culture with a profound history. Therefore, the development and design of tourism souvenirs of Quanzhou's intangible cultural heritage should adopt a full range of materials. First of all, the historical process of the formation and development of intangible cultural heritage in relevant literature is deeply studied to grasp the essence of intangible cultural heritage treasures. Secondly, researchers should go deep into the masses to understand their understanding of intangible cultural heritage and extract the essential characteristics from the masses' understanding and cognition. Finally, interviews with practitioners are conducted to grasp their understanding and explore the scale of change. On this basis, the development and design of tourism souvenirs in Quanzhou are carried out. **Figure 2** is the winning work of the Quanzhou Tourism Commodity Cultural and Creative Design Building in 2020, which is inspired by the Quanzhou Gaojia Opera. The line of the performer's hat is taken as the handle of the comb, which has an interesting image and practical value. It is a good tourism commemorative gift.



Figure 2. Comb of Gaojia Opera

3.5. Elements representing historical figures

Figure visualization is a method of productization. Historical celebrities are often a concentrated withdrawal of one or several spiritual forces, representing a kind of person or a kind of value. Some of them are civil, military, and courageous. Some are fierce and strong, and their eyes are wide. Some are dignified and unyielding. The externalized images of these figures are admired and liked. In terms of character visualization in Quanzhou tourism souvenirs, some have their heads printed on items, clothing, and daily necessities. Taking Quanzhou heroes as prototypes, this paper analyzes the commonness and individuality of heroes, extracts the characteristics of characters, and uses serialization and differentiation in visual language to express the individual differences of different characters.

4. Conclusion

Tourism souvenirs are not only a memorable item in the process of tourism but also carry the memories and enjoyment of tourists' travel life. Whether the design of souvenirs is to display the original ecology or simply a two-dimensional design, it needs to use creative thinking and integrate with modern aesthetics. Adhering to tradition and innovation and creation are not contradictory binary opposites. Adhering to tradition shows tourists the original appearance of history, while innovation and creation bring novelty and interest to tourists. Successful souvenir design is often not just through one or a few design processes; only by thinking out of the box can the souvenir have a broader design space. Therefore, the development of Quanzhou tourist souvenirs can combine the souvenirs with Quanzhou culture through innovative ways, promote the inheritance and promotion of Quanzhou unique culture in the tourism consumption industry while promoting local tourism development, and enhance the influence of Quanzhou culture.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Li ZR, 2008, Research on the Development of Minnan Cultural Tourism in Nan'an. *Fujian Forum (Social Science Education Edition)*, 2008(52): 149–150.
- [2] Dong JQ, Zhang YC, Yang Y, et al., The Ancient Silk Road Stretches for a Thousand Years; The Close Ties of Kinship Reach Across Ten Thousand Miles. *People's Daily*, July 2, 2014, 6.
- [3] Quanzhou Net, 2025, More than 100 Million People! Main data released 2024 Quanzhou Tourism. <https://cj.sina.com.cn/articles/view/1984895831/764f1b57020016unq>
- [4] Zheng XM, Fu YQ, 2012, Composition, Product Type and Development Model of Cultural Tourism Resources in Southern Fujian. *Journal of Jimei University*, 2012(3): 27–28.
- [5] Kita JZ, 2012, Giving Design Soul: When Modern Design Meets Traditional Craft. Publishing House of Electronics Industry, Beijing.
- [6] Zhong FL, 2007, Folkloric Communication. Shanghai Culture Publishing House, Shanghai, 144.
- [7] Kang B, 2008, Creative Design and Development of Tourist Souvenirs in Xiamen. *Journal of Xiamen University of Technology*, 16(4): 6–10 + 85.
- [8] Yang YS, 2017, Celebrating the 19th National Congress of the Communist Party of China and Praising China's Cultural Heritage: Quanzhou is Full of Cultural Heritage — A Glimpse of Fujian's Intangible Cultural Heritage (Part 2). http://www.china.com.cn/v/zhuanti/2017-09/26/content_41650020.htm

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Investigation and Analysis of Psychological Pressure Status of Medical Postgraduates

Chen Xu, Sheng Wang*

School of Pharmacy, Fudan University, Shanghai 200032, China

*Corresponding author: Sheng Wang, shengwang@fudan.edu.cn

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: This study used the international 12-item general health questionnaire (GHQ-12) to survey 2578 postgraduates in three medical schools in Shanghai. The results show that the psychology of postgraduates in medical schools is generally “sub-healthy.” 55.4% of the participants are in a state of excessive psychological stress, and 38.2% of the participants have or are developing into mental illness. Compared with the data published by European scholars, the pressure on graduate students in medical schools in the country is greater, and the psychological “sub-health” is more serious. The above results all remind that schools must strengthen their attention to the mental health of graduate students in the medical school, take practical actions to help them complete their studies with a healthy attitude, and eventually grow into the pillars of socialism.

Keywords: Medical graduate students; Psychological pressure; Source

Online publication: April 3, 2025

1. Introduction

With the rapid development of society, the country’s requirements for the quantity and quality of talent cultivation are constantly increasing. Since China continuously expanded enrollment in universities in 1999, the scale of graduate education has maintained a rapid growth trend. According to statistics, there were 1.405 million graduate students in China in 2009, which increased to 1.848 million in 2011, and reached a new high in 2017, totaling 1.981 million people ^[1]. The healthy growth of young graduate students has always been the focus of education work in universities. To deeply study and implement the President of the CCP’s Thought on Socialism with Chinese Characteristics for a New Era and the spirit of the 19th National Congress of the Communist Party of China, and to further promote the effective implementation of the spirit of the National Conference on Ideological and Political Work in Colleges and Universities, all universities should integrate moral education with emotional education, actively advance mental health education, and cultivate a rational, calm, and positive mindset among graduate students.

Medical school graduate students are a unique subgroup within the broader graduate student population. On one hand, the curriculum design and professional pressures make them distinct from other graduate students. According to statistics, the academic and research pressures faced by medical graduate students are the most intense among all disciplines. They not only need to have a solid theoretical foundation in their coursework but also must master advanced professional skills in clinical practice and research. These factors contribute to a significantly higher learning pressure compared to students in other fields. On the other hand, the requirements for obtaining a degree for medical graduate students are relatively high. Medical graduate students, especially doctoral students, face more demanding graduation requirements than students in other basic disciplines, leading to a higher incidence of delayed graduations.

Due to the unique nature of medical graduate students, combined with increasingly fierce social competition, their mental health issues have become more prominent. In fact, some of them have developed serious psychological problems and negative tendencies. Therefore, conducting research on the psychological status of medical graduate students is crucial to providing a scientific basis for mental health education for medical students and to offering effective strategies for promoting their mental well-being.

2. Research objects and methods

2.1. Research objects

The research targets medical graduate students from three universities in Shanghai. The survey questionnaire was conducted using the “Wenjuanxing” platform.

To ensure the breadth and scope of the survey while eliminating differences between universities, before releasing the survey questionnaire, the research team restricted the number of participants, grades, and genders from each university.

According to statistics, a total of 2,578 medical graduate students participated in the survey, including 906 from University A, 832 from University B, and 840 from University C. Among them, there were 1,037 male students and 1,541 female students. The participants included 108 first-year master’s students, 297 second-year master’s students, 292 third-year master’s students, 305 first-year doctoral students, 307 second-year doctoral students, 321 third-year doctoral students, 291 fourth-year doctoral students (direct doctoral students), 291 fifth-year doctoral students (direct doctoral students), and 144 deferred graduate students (all doctoral students). **Table 1** shows the specific numbers and proportions.

Table 1. Status of students participating in the survey

	College A		College B		College C		Total
	Male	Female	Male	Female	Male	Female	
Master’s Year 1	46	62	40	61	39	60	308
Second year master’s degree	42	65	38	58	36	58	297
Master’s Year 3	44	63	35	57	37	56	292
First-year PhD student	41	67	42	63	48	52	313
Second year PhD	44	64	39	58	40	60	305
PhD Year 3	43	63	41	58	41	61	307

Fourth year PhD student	45	66	43	61	44	62	321
PhD Year 5	40	61	35	58	39	58	291
Postgraduate delay	20	30	17	28	18	31	144
Total	365	541	330	502	342	498	2578

3. Research method

This study primarily adopts the globally recognized general health questionnaire with twelve items (GHQ-12), combined with a stress cause analysis scale, to investigate the mental state and sources of stress among medical graduate students. Fortunately, during the progress of this research project, a similar study was publicly published by European scholars, who surveyed over 3,000 PhD students in Flanders, Belgium ^[2]. That study was also based on the GHQ-12 scale, and its findings can serve as valuable corroboration and reference for this research.

The statistical method employed in this study is primarily the Chi-square test, with the fitting formula being:

$$\chi^2 = \sum_{i=1}^k \frac{(f_i - np_i)^2}{np_i}$$

4. Survey results and analysis

4.1. Basic data analysis

To ensure that there is no bias in the data source of the medical graduate students participating in the survey, this study first conducted a statistical analysis of the gender and age of survey participants from different universities before analyzing the data.

4.1.1. No significant difference in gender distribution among universities

In the data collected for this study, the gender distribution among universities is shown in **Table 2**. After conducting a Chi-square test, it was found that $P > 0.05$, indicating no significant difference in gender distribution among the universities.

Table 2. Gender distribution in various universities

	Boys		Girl		Total	
	Number of people	Proportion (%)	Number of people	Proportion (%)	Number of people	Proportion (%)
College A	365	40.3	541	59.7	906	100
College B	330	39.7	502	60.3	832	100
College C	342	40.7	498	59.3	840	100

Note: $P > 0.05$

4.1.2. No significant difference in grade distribution among universities

In the data collected for this study, the grade distribution among universities, stratified by gender, is shown in **Table 3**. After conducting a Chi-square test, it was found that $P > 0.05$, indicating no significant difference in grade distribution among the universities.

Table 3. Distribution of grades in various universities

	Master's Year 1		Second year master's degree		Master's Year 3	
	Number of people	Proportion (%)	Number of people	Proportion (%)	Number of people	Proportion (%)
College A	108	11.9	107	11.8	107	11.8
College B	101	12.1	96	11.5	92	11.1
College C	99	11.8	94	11.2	93	11.1

	First-year PhD student		Second year PhD		PhD Year 3	
	Number of people	Proportion (%)	Number of people	Proportion (%)	Number of people	Proportion (%)
College A	108	11.9	108	11.9	106	11.7
College B	105	12.6	97	11.7	99	11.9
College C	100	11.9	100	11.9	102	12.1

	Fourth year PhD student		PhD Year 5		Postgraduate delay	
	Number of people	Proportion (%)	Number of people	Proportion (%)	Number of people	Proportion (%)
College A	111	12.3	101	11.1	50	5.5
College B	104	12.5	93	11.2	45	5.4
College C	106	12.6	97	11.5	49	5.8

Note: $P > 0.05$

4.2. Overall analysis of mental health status

According to international standards, the GHQ-12 scale consists of twelve indicators, namely, being in a state of chronic fatigue, feeling depressed and difficult to feel happy, suffering from insomnia due to excessive worrying, feeling unable to overcome difficulties, having no interest in life, complete loss of self-confidence, feeling a lack of social presence, being unable to concentrate, overthinking everything, feeling worthless, being unable to make decisions, and avoiding problems.

Among the 2,578 medical graduate students participating in the survey, the proportions of responses to the twelve indicators are shown in **Figure 1**. The top four indicators, in order, are chronic fatigue (71.0%), feeling depressed and difficult to feel happy (59.0%), being unable to concentrate (54.8%), and overthinking everything (50.5%), all of which exceed 50%. This means that among all the graduate students surveyed, more than half of them experience at least one of these four symptoms. Therefore, it can be seen that these symptoms are a common occurrence among medical graduate students.



Figure 1. Proportion chart of the twelve indicators

4.3. Impact of gender factors on the analysis of psychological status

Due to inherent personality differences between men and women and their varying self-perceptions in society, the psychological pressures they endure are also likely to differ ^[3]. The research team conducted a stratified analysis based on gender. As shown in **Figure 2**, there are no significant differences between men and women in the four indicators of “being in a state of chronic fatigue”, “feeling depressed and difficult to feel happy”, “being unable to concentrate”, and “feeling a lack of social presence.” However, notable differences are observed in the other indicators.

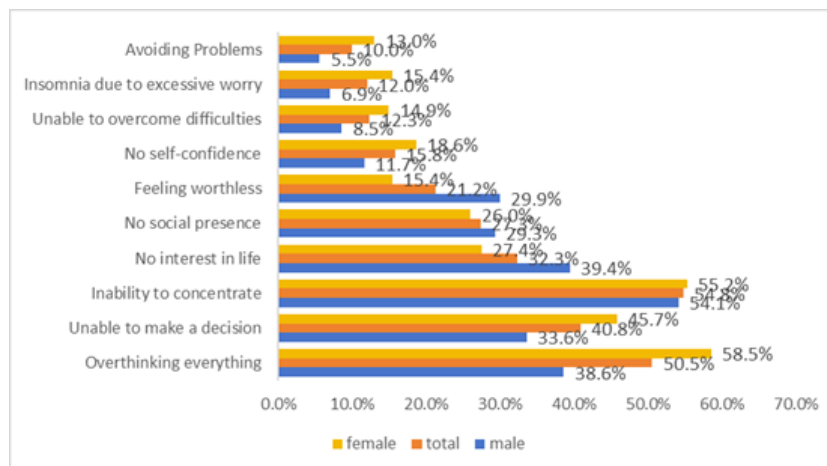


Figure 2. Analysis of the impact of gender on psychological condition

To verify whether these gender differences are statistically significant, the study analyzed the data using the Chi-square test. As shown in **Table 4**, apart from the four indicators mentioned above (“being in a state of chronic fatigue”, “feeling depressed and difficult to feel happy”, “being unable to concentrate”, and “feeling a lack of social presence”) where there are no significant differences, the other eight indicators show statistically significant differences. Among them, six indicators, including “overthinking everything”, “being unable to make decisions”, “complete loss of self-confidence”, “feeling unable to overcome difficulties”, “suffering from insomnia due to excessive worrying”, and “avoiding problems”, are significantly higher for females than males. This reflects

that females may have relatively weaker psychological endurance compared to males, which could be attributed to their “delicate and sensitive” personalities. For the two options of “having no interest in life” and “feeling worthless”, males score significantly higher than females. This could be due to males potentially bearing more social responsibilities and pressures.

Table 4. Analysis of gender factors on psychological status

	Boys		Girl		Total	
	Number of people	Proportion (%)	Number of people	Proportion (%)	Number of people	Proportion (%)
Being in a state of excessive fatigue for a long time	721	69.5	1109	72.0	1830	71.0
Depressed and having trouble feeling happy	614	59.2	907	58.9	1521	59.0
Overthinking everything	400	38.6	902	58.5**	309	50.5
Unable to make a decision	348	33.6	705	45.7**	318	40.8
Inability to concentrate	561	54.1	851	55.2	832	54.8
No interest in life	409	39.4	423	27.4**	408	32.3
No social presence	304	29.3	400	26.0	704	27.3
Feeling worthless	310	29.9	237	15.4**	1412	21.2
No self-confidence	121	11.7	287	18.6**	1302	15.8
Unable to overcome difficulties	88	8.5	230	14.9**	547	12.3
Insomnia due to excessive worry	72	6.9	237	15.4**	1053	12.0
Avoiding Problems	57	5.5	200	13.0**	257	10.0

Note: ** $P < 0.01$

4.4. Risk analysis of psychological diseases

Based on the general diagnostic criteria of the GHQ-12 scale, if a participating student exhibits two symptoms, it can be judged as excessive psychological stress^[4]. If there are more than four symptoms, it indicates that the respondent either has or is developing a mental illness. This study analyzed the multiple-choice data from the surveyed students (**Table 5**). Among the 2,578 participants, 1,427 selected two or more symptoms, accounting for 55.4% of the total. The number of people who selected four or more symptoms was 984, accounting for 38.2% of the total.

In the stratified analysis based on gender (**Table 5**), the study found that the number of male students with two or more symptoms was significantly higher than that of female students. However, there was no statistically significant difference between males and females in terms of four or more symptoms.

The above results indicate that: 1) Among the surveyed students, more than half are experiencing excessive psychological stress, with a significantly higher proportion of male students compared to female students; 2) Nearly 40% of students either have or are developing mental illnesses.

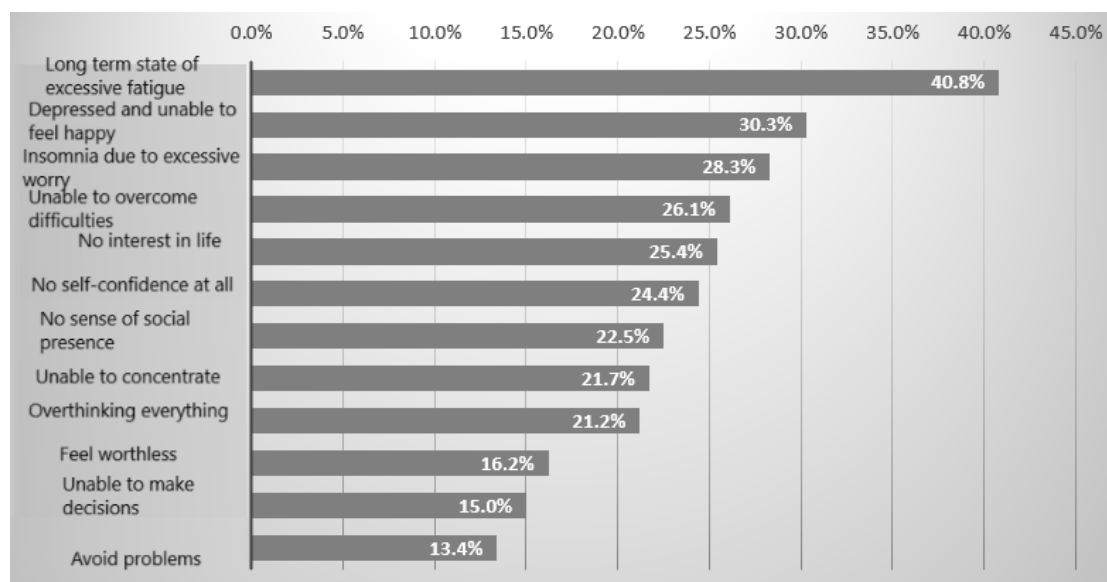
Table 5. Gender-related risk analysis of mental illness

	Boy		Girl		Total	
	Number of people	Proportion (%)	Number of people	Proportion (%)	Number of people	Proportion (%)
Two or more	611	59.1	816	53.0*	1427	55.4
Four or more	383	37	601	39	984	38.2

Note: * $P < 0.05$

4.5. Comparative analysis with data published by European scholars

Figure 3 is based on data from a study conducted by European scholars on over 3,000 PhD students in Flanders, Belgium, titled “Work organization and mental health problems in PhD students”^[2]. Comparing **Figure 1** with **Figure 3**, the authors find that “being in a state of chronic fatigue” and “feeling depressed and difficult to feel happy” rank in the top two positions, which corroborates the research findings from another perspective. Furthermore, upon comparison, it is evident that the percentages of various stress indicators in the results are generally higher than those reported by European scholars. This suggests that the stress levels of medical graduate students in China are generally higher than those of foreign graduate students. Interestingly, for the indicator “complete loss of self-confidence”, the research findings are significantly lower than those of European scholars. This implies that although the graduate students generally experience higher stress, often feeling fatigued and depressed and struggling to concentrate, they have not lost confidence and still have faith in their future research lives.

**Figure 3.** Proportion of the twelve indicators (Literature)

Regarding the risk of psychological illnesses, among the 2,578 participants in the survey, 1,427 reported two or more symptoms, accounting for 55.4% of the total, which is 4.4 percentage points higher than the 51% reported by European scholars. The number of participants who selected four or more symptoms was 984, representing 38.2% of the total, which is 6.2 percentage points higher than the 32% reported by European researchers. This suggests, to some extent, that the stress levels of graduate students in China are much higher than those of

European graduate students, and the severity of psychological conditions among Chinese graduate students is also greater, which deserves our attention.

4.6. Analysis of sources of psychological stress

Based on the analysis of psychological conditions, this study conducted a detailed regression analysis (examining causality and correlation) to identify the reasons for the current situation. The most relevant factors contributing to these symptoms were found to be academics, finances, and interpersonal relationships (including emotional life), which is consistent with reports from related articles ^[5-7]. Further stratified analysis (**Figure 4**) revealed that in terms of academics, doctoral students face greater stress than master's students due to the increased difficulty of their research topics and the higher requirements for graduation. Regarding financial stress, doctoral students experience more pressure than master's students, and male students face more stress than female students. This may be because doctoral students are typically older, and some may even have families, thus carrying greater family responsibilities and experiencing more pronounced psychological stress. Male students, due to their social and familial positioning, have higher expectations regarding their economic foundation. In terms of interpersonal relationships, male students exhibit greater stress compared to female students. This finding is highly consistent with the research results of Sun Xiaokai ^[8]. The reason for this may be that male students tend to have a more direct personality and may not handle issues as tactfully as female students.

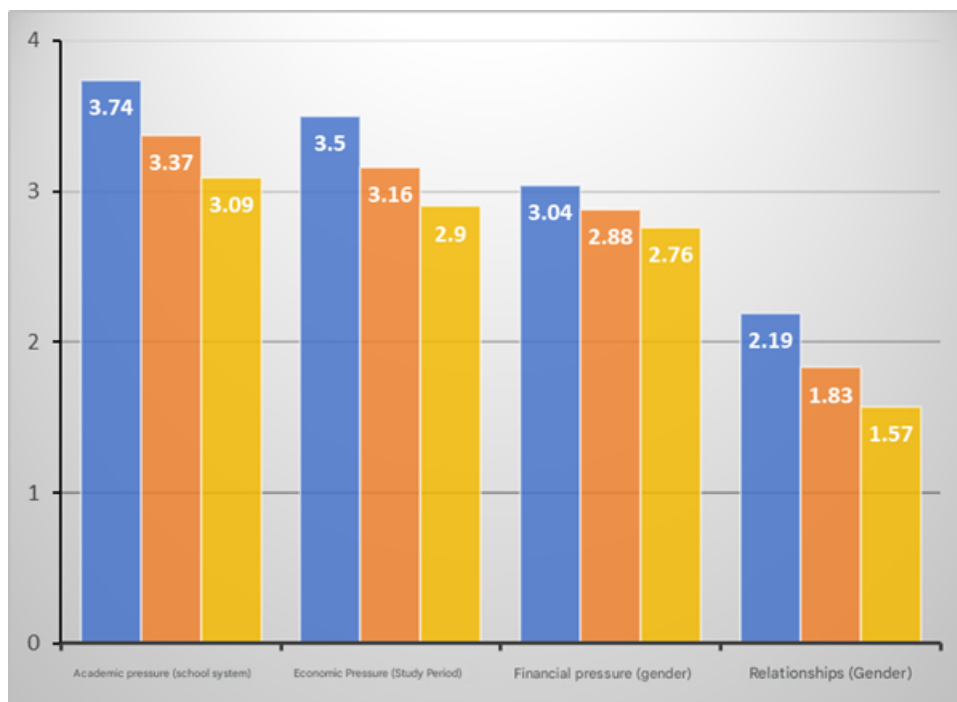


Figure 4. Hierarchical analysis of psychological stress sources

5. Discussion and suggestions

Currently, there are relatively few studies specifically targeting the mental health of medical graduate students both domestically and internationally, yet the psychological status of this group is far from optimistic. According to the longitudinal analysis conducted by Wang Xiaocui and others in 2014, the detection rate of psychological

abnormalities among medical graduate students has been increasing year by year, and the overall scores for depression and anxiety have shown similar trends^[9]. Combined with the findings of this study, the authors strongly believe that mental health education for medical graduate students is an urgent, enduring, and challenging task.

To effectively address the mental health education of medical graduate students, it is necessary to integrate the strengths of various departments based on the characteristics of this group, forming a concerted effort across the entire university.

Firstly, schools must cultivate the self-regulation abilities of medical graduate students. As the saying goes, “the bell must be rung by the person who tied the knot.” Students should prioritize the cultivation of their self-regulation skills. Only with a “strong heart” can the subsequent work proceed smoothly. Schools need to help them fully leverage their subjective initiative and professional advantages, using their acquired knowledge of physical and mental health to maintain their own psychological well-being, embodying the principle of “healing others by first healing oneself.” Simultaneously, schools should assist them in accurately understanding and reasonably positioning themselves, objectively recognizing their actual abilities, and achieving self-actualization based on a multi-faceted, objective, and accurate self-perception, analysis, and evaluation. Additionally, schools should foster their positive and optimistic coping mechanisms. The research has found that when facing difficulties, a significant proportion of medical graduate students tend to experience anxiety, avoidance, and loss of motivation. Avoidance does not solve problems; instead, it only increases psychological pressure.

Secondly, schools must improve the mechanisms for mental health education and counseling. A robust organizational support system can ensure the implementation of various mental health education tasks. Universities should focus on the comprehensive development of individuals, emphasizing not only academic training but also education in areas such as mental activities. Only with physical and mental health can students achieve academic progress, career success, and happiness in life, enabling comprehensive and healthy development. Schools should integrate mental health education resources, refine mental health education promptly, and genuinely incorporate it into the school’s mental health education system. Furthermore, they should continue to organize key personnel, improve counseling and consulting mechanisms, and ensure that mental health counseling and consulting services are accessible to every graduate student.

Next, schools need to establish psychological early warning and intervention mechanisms. Compared to graduate students in other majors, medical graduate students possess considerable medical knowledge. Typically, they have the ability to self-regulate and the willingness to seek help. However, when an individual faces difficulties beyond their coping abilities, a psychological crisis may arise. While the number of psychological crises among medical graduate students may be relatively small, their severity can be greater. Universities should establish an early warning and intervention system based on freedom, safety, trust, and understanding, including information collection, assessment, intervention, and feedback. The construction of the intervention system requires the development of a crisis warning system, including a graduate student mental health survey system, a graduate student mental health reporting system, a psychological crisis assessment system, and a graduate student mental health information feedback system. Additionally, a crisis intervention system should be established, featuring measures such as support, treatment, containment, monitoring, and assistance.

Finally, schools must leverage the educational role of graduate student mentors. The current graduate education system in China adopts the European-style mentorship model, which fosters a unique relationship between doctoral students and their mentors. Recently, the Ministry of Education issued the “Opinions on Fully Implementing the Responsibilities of Graduate Student Mentors in Cultivating Virtue and Talent”, which clarifies

seven responsibilities for graduate student mentors, one of which is “focusing on the humanistic care of graduate students.” Mentors are the first point of responsibility for graduate students and have the duty and obligation to care about their mental health. In a previous study, the authors found that mentors are the decisive force in shaping laboratory culture, and their research achievements, academic influence, academic level, and moral standards directly impact their students. Therefore, mentors’ education on mental health can also have a significant effect ^[10]. Consequently, in the mental health education of medical graduate students, it is essential to fully utilize the guiding role of mentors, integrating professional education with educational nurturing. Mentors should not only serve as guides in academic pursuits but also as leaders in students’ lives and ideologies, becoming life mentors for the growth and development of medical graduate students and realizing the educational goal of teaching and nurturing.

Funding

This study was funded by the 2017 Shanghai School Moral Education Practice Research Grant No. 2017-D-005.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Ministry of Education, 2017, Discipline Construction Keeps Pace with National Development — A Review of Discipline Construction Since the 18th National Congress of the Communist Party of China.
- [2] Katia L, Frederik A, Alain DB, et al., 2017, Work Organization and Mental Health Problems in PhD students. *Research Policy*, 46(4): 868–879.
- [3] Gao JX, Shi XJ, 2006, Research on the Differences in Mental Health Between Male and Female College Students. *Journal of Tangshan College*, 2006(1): 74–76.
- [4] Li YM, Li YX, 2015, Multi-sample Analysis of the Structure of the 12-item General Health Questionnaire (GHQ-12). *Psychological Exploration*, 35(4): 355–359.
- [5] Dong SX, 2018, Research on the Psychological Pressure of Graduate Students and Its Influencing Factors. *Management and Technology of SMEs (First Edition)*, 2018(3): 126–128.
- [6] Ji X, 2018, Thoughts on College Counselors Carrying Out Student Work. *New West*, 2018(6): 95–96.
- [7] Li H, 2017, Exploring the Psychological Pressure and Coping Strategies of College Students. *Western Quality Education*, 3(19): 93.
- [8] Sun XK, 2012, Survey on the Current Status of Interpersonal Relationships Among College Students. *Archives*, 2012(9): 67–68.
- [9] Wang XC, 2014, Mental Health Status and Influencing Factors of Medical Graduate Students in a Certain University, thesis, Zhengzhou University.
- [10] Wang S, Bai G, Luo YX, et al., 2016, Research on the Role of Mentors in the Construction of Laboratory Culture in Medical Institutes. *Journal of Higher Education*, 2016(16): 213–214 + 216.

Publisher’s note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Development and Research Status of Hotel Digital Operation in China

Xianbing Ruan^{1*}, Xiaodong Ji², Boyang Shu^{1,2*}

¹School of Business Administration, Zhongnan University of Economics and Law, Wuhan 430073, China

²Wuhan Branch of China Tourism Academy, Wuhan 430079, China

**Corresponding author:* Xianbing Ruan, 18520618777@163.com; Boyang Shu, shuboyang53914@163.com

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Digital operation is the only way for China's hotel industry to adapt to the WEB 3.0 era in the future by reducing costs and increasing efficiency. This paper systematically combs the causes of the development of digital operation in China's hotel industry and analyzes the current situation and main problems of the development of digital operation in China from two dimensions of enterprise operation and technology. The motivation for the digital development of hotel operations mainly stems from the practical needs of business transformation and customer relationship optimization. With the goal of optimizing business processes and improving profit by relying on digital technology, it is committed to improving customer experience. The research shows that through digital empowerment, the sustainable development of digital operation of the hotel industry will ultimately promote the precise quantification of enterprise business objectives, the continuous increase of digital service products, and the innovation of customer experience perception service. At present, the development of digital operations in the hotel industry is faced with practical difficulties and challenges such as insufficient investment in digital projects and limited professional talents. In contrast to the rapid development of the industry, the current theoretical research literature on the digital operation of the hotel industry mainly focuses on the characteristics and motivation of the hotel digital operation, but its research still has the shortcomings of lagging research and superficial problems. The article suggests that the future research of the digital operation of hotels in China should be rooted in China's economic reality and deepened from two aspects of real industry cases and the international localization process.

Keywords: Hotel; Digital operation; Digital products; Digital technology

Online publication: April 3, 2025

1. Introduction

With the development of digital technology, the upgrading of digital technology has a significant impact on the development of various industries and the market environment ^[1]. As a labor-intensive traditional industry, the hotel has long faced the problems of low talent literacy and high operating costs, in which digital operation can provide new ideas for the development of hotels ^[2-4]. At present, foreign research on the digital operation of hotels is just

emerging, while the relevant research in China is scarce. The existing research mainly focuses on the concept, characteristics, influencing factors, and other aspects of the digital operation of hotels, and the research mostly stays in the surface analysis. There is no clear answer to the core factors, the dimensional composition of the factors, and the specific action paths affecting the digital operation of hotels in China. Therefore, in the theoretical research for the system of the development of the origin, connotation, and industry practice, fully analyze the influencing factors of the development of China hotel digital operation, determine the mechanism of various factors, and help managers combined with China's national conditions to explore the digital development direction, to improve the actual effect of digital operation, has become the key to the development of the hotel industry with high quality.

2. The source of the digital operation and development of hotels in China

In the course of the hotel development that has lasted for thousands of years, the promotion of various new technologies has formed the iteration of the contemporary and differentiated operation concept of the hotel industry. The application of digital technology in hotels originated from the use of the first hotel information system in the world in 1970^[5-6]. From the perspective of occurrence, the promotion of hotel digital operation is mainly based on the combination of four internal and external factors in **Table 1**.

Table 1. Analysis of the internal and external causes of the hotel's digital operation

		Change needs
Endopathic (inevitability)	Customer-centered full-service chain digital ecology is driven by the competition in the hotel industry	The transformation of the traditional service industry to the digital operation mode
External cause (necessity)	Mobile communications, cloud computing, big data, AI, face recognition, blockchain, the Internet of Things, and other new technologies to promote the application and technology of the traditional service industry.	Digital operation drives the high-quality development of the hotel industry to improve the competitiveness of the hotel industry, which is the need of the national modernization strategy
		Trigger conditions

Digital operation refers to surpassing the traditional operation mode, using various digital tools to manage daily business, summarize and analyze business data, plan the future development direction of enterprises, and use data and new technologies to reshape all production links, upgrade user experience, and improve operational efficiency^[7-8]. From this point of view, the hotel digital operation is the use of information technology, artificial intelligence and management information system (MIS) and other technical means and tools to the traditional hotel industry business processes and operation management link through new technology and data processing function remodeling and optimization, to realize the hotel operation management informatization with digital, intelligent, and diversified platform, to improve hotel operation management efficiency and customer experience of the new management mode. At present, the digital operation of the hotel is mainly reflected in four aspects: product digitalization, online business process, intelligent data application, and ecological competitive advantages.

3. Digital development process and industry status of hotels in China

3.1. Digital development process of the hotel industry

3.1.1. Early budding stage

In 1979, China developed the first hotel management software with a query function, which created the first hotel

management system in China. In 1990, CSHIS was soft-launched. In June 1993, Hangzhou West Lake software developed Foxhis system and domestic hotel management system DOS version. The Windows version was launched in 1998. Beijing Changzhou Network System Engineering Technology Co., Ltd. officially entered the hotel information system research and development field in 1998. In general, in the 1G and 2G era before 1998, China's hotel industry was still in the embryonic stage of informatization.

3.1.2. Informatization development stage

The development of hotel informatization in China is mainly concentrated from 1999 to 2017, which is the beginning of O2O, focusing on the introduction and application of big data and wireless technology to realize mobile and online development.

In terms of hotel and information technology iteration, major OTA platforms were established around 2000, which promoted the development of online booking in hotels. In 2007, China's first direct connection technology service provider was established, taking the lead in establishing the direct connection with international hotel groups and launching the certificate scanning system to realize the rapid identification and registration of residents. Subsequently, the CRS model was further built to promote the progress of booking technology for high-end hotel groups. In 2011, the revenue management software began to be promoted in the hotel industry. Dianping was launched in 2003, focusing on customer communication and gathering consumer experience, which changed the environment of hotel customer experience comments. In 2006, Hornet's Nest was established, which shifted the hotel's user experience sharing to the content level, and officially opened the UGC era. In 2009, Hangzhou Huanglong Hotel was upgraded to be the world's first smart hotel. In 2012, Beijing Kerry Hotel took the lead in introducing paperless office solutions, opening the digital era of guest experience. In 2013, the hotel entered the era of Internet + new media marketing, opened the application of the WeChat public account, and actively developed its own app to enter the mobile Internet market. In the same year, 7 Days Hotel took the lead in supporting WeChat payment, and Beijing International Hotel took the lead in introducing a cloud breakfast service. In 2014, the hotel's 4G network was basically covered, and it took the mobile channel as the main battlefield of OTA competition and opened the O2O mode. Some hotels support mobile terminal self-service room selection and self-service check-in, introduce an intelligent customer control system, or even have a mobile phone door card mode, where guests can use WeChat to directly open the room door lock.

Hotel information technology began to focus on customer service and improve efficiency and entered a critical period of technology development from 2015 to 2017. At this stage, the hotel has basically completed the information construction, but the data efficiency has not been stimulated. In 2015, related enterprises will further optimize the hotel operation's business technology and promote the digital development of the hotel. For example, OTA invested hotel PMS system deeply excavates the data before and during hotel stay; Alipay began to be widely used in the industry. Subsequently, the hotel industry widely used the code scanning order service, as Flying Pig announced creating a "smart hotel." In 2015, the e-commerce industry was booming, from transaction e-commerce and content e-commerce iteration to short video e-commerce, which promoted drastic changes in the hotel operating environment. Flying Pig launched "credit live" digital hotel products to innovate the hotel experience; hotel mobile PMS began to sprout and explore the community marketing model based on big data. In 2016, under the promotion of cloud computing, the hotel entered the cloud transformation stage and began to use the geography evaluation management system to optimize online management and customer experience. In 2017, the first unmanned intelligent hotel was opened in China, which gradually promoted the application of self-service

machines and AI intelligent voice devices. Then, the hotel began to introduce the WeChat small program, build a private domain system, and develop the private domain traffic.

3.1.3. Data Platforming stage

From 2018 to 2020, the digitalization of hotel marketing will further develop, greatly enriching the online products and making the online penetration rate reach 70%–80%. The application of hotel digital technology has entered the outbreak period. All hotels vigorously develop self-service machines, the Internet of Things, robots, face recognition, blockchain, and other technologies, and the pace of development of digital operations is accelerating. The concept of “decentralization” has been continuously deepened in the hotel operation. The first hotel in China to support virtual currency payment has opened, realizing the development and application of intelligent service, full-scene identity recognition, and face recognition technology. In 2018, the central settlement platform was launched, and China Travel Service Group began to explore and build a data platform. The good development prospects of the hotel industry have also attracted many giants to explore the hotel market. AutoNavi map began to adjust its internal structure and focus on the layout of the wine travel industry. Pinduoduo began to sell hotel accommodation products and develop the online tourism business; iQiyi entered the hotel industry to create VR entertainment hotel space. In 2019, China Mobile and Ctrip signed a strategic cooperation to create a 5G ecosystem, marking the entry of the 5G era. The concept of HOS in the hotel is further deepened, and the robot automation is widely concerned. Hotel PMS under the promotion of capital, the market gradually formed four giant patterns, namely, Ali Shiji, Meituan Hong, China Soft International, and Hangzhou Green Cloud. In 2018, the hotel began to lay out new retail scenarios to create differentiated competitive advantages. In terms of new hotel openings, Alibaba built the first future hotel in China. Baidu released Duer OS smart hotel solutions and landed in Shengkeng Hotel. In 2020, with content e-commerce entering a period of vigorous development, the rise of hotel live streaming with goods, and further pay more attention to and optimize the channel combination management. Enterprises in other fields greatly entered the hotel field, Xiaohongshu reached cooperation with orders to achieve direct connection of home stay; Amap online “secure accommodation hotel”, support online booking; Tiktok layout of the wine travel market, to create its own platform trading closed-loop ecology. Traditional hotels have begun to embrace “contact-free services” and have successively opened up digital RMB payment channels.

3.1.4. Development stage of digital intelligence

After 2021, under the influence of the pandemic, the hotel will enter an accelerated period of digital operation and development and start to develop into data and platform. The hotel uses big data algorithms, the Internet of Things, 5G, and artificial intelligence to analyze customer data deeply and start the development of digital intelligence. Digital intelligence is a product of the DT (Data Technology) era, which refers to relying on cloud computing, the Internet of Things, big data, and AI technologies to realize intelligent perception and decision-making, enrich executive functions, improve adaptive learning ability, and enhance data efficiency. The hotel industry has carried out a large number of business cooperations with the app and introduced and upgraded the data platform. In 2021, the hotel industry generally supports the direct booking business in the app^[9]. The new hotel booking business is directly connected to Ctrip and the Cheng Yilong platform. The hotel introduces a large number of data platforms to provide support for the digital closed-loop management of the hotel. The internal self-service machine of the hotel is directly connected with the public security system, and the customer’s identity information can be directly verified online. China Jinjiang Group, Huazhu and Beijing Capital Travel Home Hotel and other head hotels

and star hotels continue to improve the digital level, to create intelligent rooms and digital intelligence operation system. Jinjiang Group started the pilot of “digital hotel”, focusing on seven scenarios of online booking, online room selection, one entry, intelligent customer control, intelligent customer control, room information service, quick departure, regional room cleaning and sharing, accelerating the application of Internet, 5G, AI, and other digital technology sharing, to create a more convenient customer experience. Huazhu Group makes use of digitalization to build core competitiveness, create “Hua shopkeeper” self-service all-in-one machine and “easy series” digital products, and improve the operation efficiency. It has realized digital services such as “30 seconds check in, 1 second check out”, intelligent voice customer room control, and intelligent delivery robot mission, which not only improves the efficiency of hotel service operation but also provides convenience and a sense of technology for guests to enter. This paper summarizes the four aspects of development strategy, development characteristics, technical support, and business innovation, and divides the transformation process of hotel digital operation into six stages and levels of L1–L6 (**Figure 1**). This paper summarizes the development process of hotel digital operations in China from the perspective of key actions (**Table 2**).

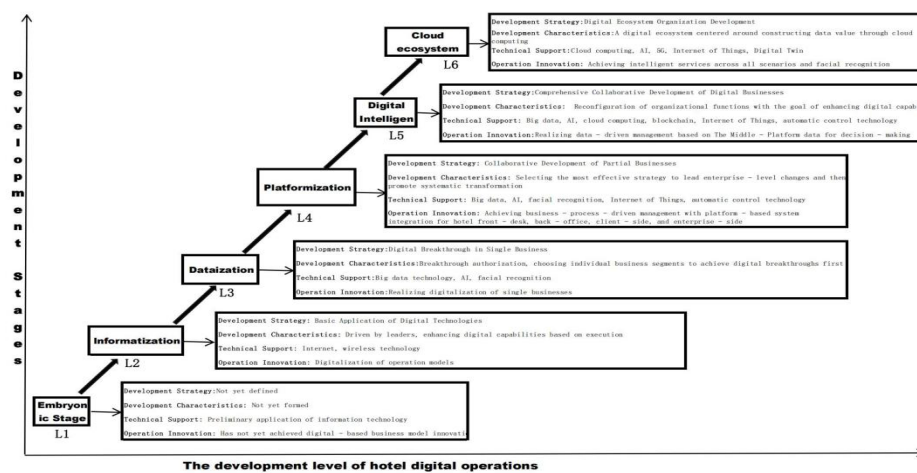


Figure 1. The evolution process and development level of hotel digital operation in China

3.2. Digital operation status of the hotel industry

3.2.1. Application of core technologies

At the present stage, the core technologies involved in the development process of hotel digital operation mainly include four technologies: intelligent room, artificial intelligence, AR / VR, and mobile technology (**Figure 2**). Among them, the smart room allows customers to voice control indoor media, curtains, air conditioning, lighting, and other hardware facilities or call services through the hotel app, Amazon Alexa, Google Assistant, and other software. Artificial intelligence is mainly used in hotel chatbots to collect customer data, provide personalized check-in experiences, and simplify the hotel service process. AR/VR can provide customers with virtual rooms and all hotel infrastructure so that users can experience the hotel environment in advance through smartphones and VR headsets. Mobile technology is the backbone of the continuous development of hotel digital operations, which can effectively strengthen the connection between customers and the hotel and provide customers with real-time information such as advanced booking, flight schedule query, and hotel map.

Table 2. Development process of digital hotel operation in China based on the perspective of key actions

Stage of development	Technical aspects	Corporate aspects	Keyword
Initial bud stage (Before 1998)	In 1979, the first hotel management software with a query function was developed in China	In 1987, the Nianhua company was established	Electronize Informatization
Initial application of information technology	In 1990, CSHIS was developed in China	In 1990, Beijing Zhongsoft Haotai Hotel Computer System Engineering Company was established	
	1993 Qianli horse hotel management system DOS version was launched	In 1992, Guangdong Labor Computer System Development company was established	
	In 1998, the hotel management system WINDOWS version was launched	In June 1993, Hangzhou Xihu Software Co., Ltd. was established	Online wireless technology Big data Mobile
		In 1998, Beijing Zhongshi Foundation Network System Engineering Technology Co., Ltd. was established	
Informatization development stage (1999-2017)	In 1999, domestic OTA platforms were established successively, promoting online hotel booking. In 2007, a direct connection channel between hotel groups and OTA was established	Dianping was established in 2003 to change the market environment of hotel marketing	Online wireless technology Big data Mobile
Open the hotel industry O2O prelude	In 2007, the certificate scanning system was developed to realize the rapid identification and registration of guests. In 2008, domestic enterprises built the CRS mode and innovated the reservation technology of high-end hotel group	In 2006, Homet's Nest was established, officially opening the UGC era	
	2011 revenue management software in the hotel industry landing and promotion	In 2007, China's first direct technical service provider was established	
	In 2011, wireless technology application, mobile terminal application was launched in the hotel industry	In 2009, Huanglong Hotel was upgraded to the world's first smart hotel	Self-service machine Blockchain Internet of Things Robot Face recognition
	In 2012, the new media became a new marketing platform for the hotel	In 2011, high-star hotels joined the newly emerging army of group buying	
	In 2013, the hotel industry began to use the WeChat public account and cloud breakfast service	In 2012, Beijing Kerry Hotel took the lead in the paperless office, opening the era of digital experience for guests	
	In 2015, the hotel opened the one-key billing mode; Alipay is widely used	In 2013, many hotels opened the Internet + new media marketing mode and supported WeChat payment	Artificial intelligence Internet of Things 5G Big data Cloud computing
	In 2015, the hotel mobile PMS began to sprout, and the industry data awareness rose	In 2014, hotels basically used the 4G network and O2O mode, taking mobile channels as the main battlefield of OTA competition. In 2015, some hotels supported mobile terminals to select rooms and check in independently or introduced an intelligent customer control system. In 2015, the OTA platform invested in PMS to mine the data before and in hotels	
	In 2016, the hotel entered the stage of cloud transformation and began to use the geography evaluation management system to build the scanning code ordering service and artificial intelligence hotel	In 2017, China's first unmanned reception smart hotel opened	
	In 2017, the self-service machine began to promote the application; open the WeChat small program application to build the private domain system	In 2017, Flying Pig announced the construction of Hangzhou Xixi Paradise as an "artificial intelligence hotel"	
Data platform development stage (2018-2020)	In 2018, it was further "decentralized" and began to support virtual currency payments	In 2018, the internal structure of Amap was adjusted, focusing on the layout of the wine tourism industry	Artificial intelligence Internet of Things 5G Big data Cloud computing
Hotel technology application has entered the outbreak period	In 2018, intelligent service & full-scene identity recognition and face recognition technology began to develop	In 2018, Alibaba will build the first future hotel in China	
	In 2019, the 5G ecology was created, and the hotel management system PMS formed four major system patterns	2018 Baidu Duer OS Smart Hotel solution landed in deep pit Hotel	
	Robotic automation has attracted wide attention in 2019	In 2018, the hotel began to lay out new retail scenes and highlighted its differentiated competitive advantages	Artificial intelligence Internet of Things 5G Big data Cloud computing
	In 2019, the central settlement platform began to launch	In 2019, China Mobile signed a strategic cooperation with Ctrip to create a 5G ecosystem	
	VR technology was popularized in 2019	In 2019, Pinduoduo launched its hotel accommodation products and entered into online travel	
	In 2020, the hotel will rise live with goods, optimize the channel combination, and develop "contact service."	In 2019, iQiyi began to build a VR entertainment hotel space	Artificial intelligence Internet of Things 5G Big data Cloud computing
	In 2020, the hotel's digital RMB payment channels will be opened	In 2020, TikTok will lay out the wine tourism market and create a closed-loop trading ecology of its own platform	
Digital intelligence development stage (after 2021)	Develop the app cooperation business in 2021 and later and reference and upgrade the data platform	In 2021, Ctrip's "Planet" was officially opened, integrating brand products, content, and activities	Artificial intelligence Internet of Things 5G Big data Cloud computing
The hotel industry digital intellectual development era	In 2021, the hotel self-service machine and the public security system will complete the direct guest identity verification of the online Internet of Things application scope extension	In 2021, TikTok will realize the hotel booking function in the app	
	Digital twin enables data visualization scene construction	In 2021, HangTravel will add a hotel booking business, directly connecting Ctrip and Tongcheng Yilong platform	
	The value advantage of data is further highlighted		

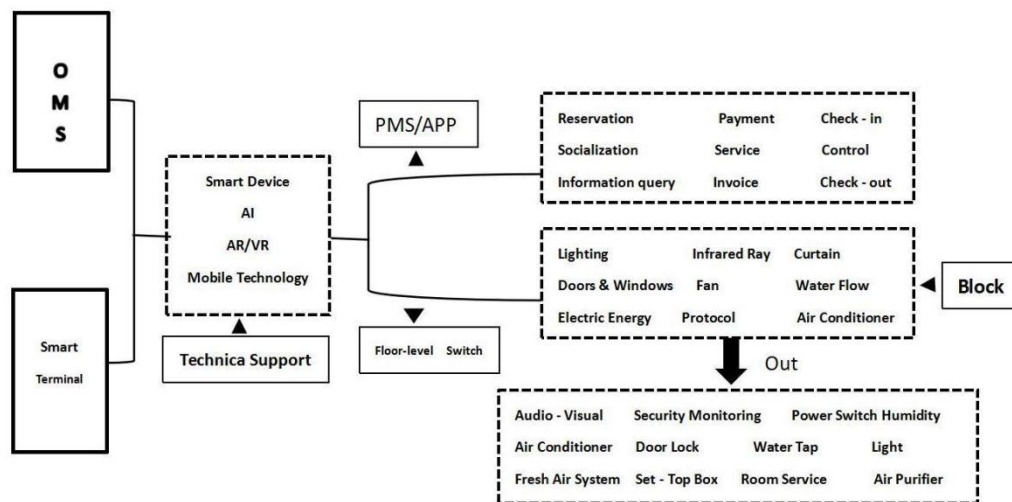


Figure 2. Technical function module in the digital operation of the hotel

The application of the core technology in the digital operation of hotels mainly shows the following characteristics. First, it enriches the digital product supply under the hotel's digital operation strategy. Under the impact of the pandemic, hotel operations rely more on digital products and use digital technologies such as 5G and AI to accelerate the development of new products. In this case, the hotel gradually realizes online room selection, intelligent customer control, one key, micro service, quick departure, and other services to improve the operation efficiency. The usage increased by 52.38% in 2020 from 2019 and 21.76% in 2021 from 2020, reaching a new high in 2021. Second, promote the hotel booking channels gradually turn to online. The main hotel channels for consumers are OTA, accounting for about 29.27%, followed by hotel WeChat mini program and public account, accounting for about 27.64%, and again for the traditional hotel reservation number and direct check-in. Third, to assist the hotel to develop private domain traffic. With the upgrading of the Internet, digital technology, app research and development technology, most hotels began to actively establish new traffic platforms, such as payment, social networking, content planting grass, short video and other platforms, and obtain good user conversion effect. Among the many new platforms, the hotel's WeChat official account is still the platform with the most attention from the hotel's We Media, followed by the hotel's TikTok, Xiaohongshu, Kuaishou, and other platforms.

In the era of 5G, digital hotels shifted operations into the fast lane, as powerful technical infrastructure can provide an excellent hotel experience. Guest experience and hotel operations and big data, artificial intelligence, Internet of things, control technology, cloud computing technology, the depth of the fusion application, and cloud ecological development will be the future of hotels to break the barriers of physical space and solid hardware, building up the new pattern of intellectual development.

By sorting out the landmark events in the development process of hotel digital operation in the 1G to 5G era since the 1980s, this paper summarizes the application of various key technologies in different development stages of hotel digital operation in **Table 3**.

Table 3. Development dynamics and key technology application of hotel digital operation development in the 1G–5G era

Time interval	Development dynamics	Key technology applications	Trend
1G era 1980s–1994	In 1990, the hotel POS system integration and central management information system appeared, and the system CSHIS was born In 1993 Qianli horse hotel management system DOS version was launched In 1994, the first online hotel directory was Travel web.com, the first hotel website in the same year (Hyatt and Promus Hotel Corporation)	Electronic communication technology Computer information technology	Electronize Informatization
2G era In 1995–2008	In 1995, Choice and Holiday Inn pioneered the online booking system to provide real-time central booking for guests In 1996, Expedia was founded, the Travelocity website was launched, and the era of online hotel booking was opened In 1999, domestic OTA platforms were established successively to promote online hotel booking In 2000, Marriott took the lead in building a revenue management system based on J2 EE applications In 2002, China's first online order engine officially appeared (Derby Software) Founded in 2003, Dianping is dedicated to the communication and aggregation of urban consumption experience In 2006, the Homet's Nest was founded, and the hotel UGC era was opened In 2007, Shiji Chang Lian, the first direct connection technology provider in China, was established to build a direct connection channel with international hotel groups 2007 Develop the certificate scanning system to realize the rapid identification and registration of residents In 2008, domestic enterprises built the CRS model and innovated the high-end hotel group booking technology	Information technology Internet technology	Online informatization
3G era In 2009–2013	In 2009, Choice Hotels pioneered the hotel mobile app along with Intelity In 2009, Hangzhou Huanglong Hotel was upgraded to build the world's first smart hotel Digital concierge systems emerged in 2010 World's first built-in iPad in 2010 (New York Plaza Hotel) In 2011, Meituan, Nuomi, and other group buying models rose, Gaoxing Hotel joined the group buying army, and mobile terminal applications opened In 2012, Kerry Hotel Beijing took the lead in introducing paperless office solutions, opening the digital era of guest experience In 2013, Beijing International Hotel took the lead in launching the cloud breakfast service In 2013, the hotel began to develop its own app and enter the mobile Internet market In 2013, the first hotel in China to support WeChat payment was launched (7-day hotel)	Wireless technology Mobile Internet technology	Mobile paperless
4G era In 2014–2019	In 2014, the room entry is keyless, the mobile phone is the door card mode, and the room door lock can be directly opened In 2014, 4G network basically covered and entered the hotel industry, and mobile channel became the main battlefield of OTA In 2014, the Meituan app rose to prominence, focusing on the middle and low-end hotels In 2014, the O2O mode was first used in the industry, and the mobile terminal self-service room selection and self-service check-in and check-out rooms were promoted in the hotel industry In 2014, the intelligent passenger control system began to be widely used in the hotel industry The world's first robot hotel opened in late 2015 in Japan (Henn-na Hotel) In 2015, based on the development of the WeChat platform, the hotel mobile PMS began to appear, the first one-click billing mode in China In 2015, the first intelligent robot was put into use in Hangzhou New Century Mingdu Hotel In 2016, the hotel industry evaluation management system began to be online to optimize online management and guest experience In 2018, the first unmanned reception smart hotel was opened in China, and the self-service machines began to gradually promote and apply In 2018, the application of face recognition technology was launched, marking the first future hotel in China to achieve intelligent service and full-scene identification	Big data Self-service machine Internet of Things robot Face recognition	Platform datamation
5G era From June 6, 2019, till now	In 2018, the world's first virtual currency payment hotel appeared—the Etherian Hotel in Aba Tibetan and Qiang Autonomous Prefecture 2018 Baidu Duer OS Smart Hotel solution landed in a deep pit hotel In 2018, the internal structure of Amap was adjusted, focusing on the layout of the wine tourism industry In 2019, China Mobile and Ctrip signed a strategic cooperation to create a 5G ecology, and China's liquor and tourism industry entered the 5G era In 2019, iQiyi entered the hotel industry to create a VR entertainment hotel space In 2020, Pinduoduo launched its hotel accommodation products and entered into online travel In 2020, Xiaohongshu and orders have reached a cooperation to realize the direct connection of B & B In 2020, Tik Tok will lay out the wine tourism market and create a closed-loop trading ecology of its own platform In 2020, Amap will launch the "peace of mind hotel" to support online booking In 2020, the hotel industry will begin to fully apply the "contactless service" In 2021, the Nianhua Hotel will become the first batch to realize digital RMB payment application scenarios In 2021, Tik Tok will realize the hotel booking function in the APP In 2021, HangTravel will add a hotel booking business, directly connecting Ctrip and Tongcheng Yilong platform	Cloud computing Digital twin AI Blockchain	Number of wisdom Cloud ecology