

4.2.4. Differences in well-being dimensions and overall well-being across educational levels among EMUS

One-way ANOVA was conducted to examine differences in well-being dimensions and overall well-being across different educational levels among EMUS. The results, as shown in **Table 4**, indicated that there were no significant differences in well-being dimensions and overall well-being across educational levels ($P>0.05$).

Table 4. ANOVA results for well-being dimensions and overall well-being among EMUS by educational level

Dimension		Sum of squares	df	Mean square	F	P	Cohen's <i>f</i>
Meaning	Between groups	8.831	2	4.415	0.124	0.884	0.024
	Within groups	14985.982	420	35.681			
Achievement	Between groups	32.586	2	16.293	0.507	0.603	0.049
	Within groups	13500.043	420	32.143			
Engagement	Between groups	29.432	2	14.716	0.526	0.591	0.050
	Within groups	11743.197	420	27.960			
Positive emotion	Between groups	9.731	2	4.866	0.151	0.860	0.027
	Within groups	13528.018	420	32.210			
Relationships	Between groups	22.786	2	11.393	0.383	0.682	0.043
	Within groups	12488.467	420	29.734			
Overall well-being	Between groups	1.282	2	0.641	0.153	0.859	0.027
	Within groups	1765.049	420	4.202			

Note: * $P<0.05$; ** $P<0.01$

4.2.5. Differences in well-being dimensions and overall well-being across grades among EMUS

One-way ANOVA was also conducted to examine differences in well-being dimensions and overall well-being across different grades among EMUS. The results, as shown in **Table 5**, indicated that there were no significant differences in well-being dimensions and overall well-being across grades ($P>0.05$).

Table 5. ANOVA results for well-being dimensions and overall well-being among EMUS by grade

Dimension		Sum of squares	df	Mean square	F	P	Cohen's <i>f</i>
Meaning	Between groups	110.791	3	36.930	1.040	0.375	0.086
	Within groups	14884.022	419	35.523			
Achievement	Between groups	201.042	3	67.014	2.106	0.099	0.123
	Within groups	13331.586	419	31.818			
Engagement	Between groups	89.485	3	29.828	1.070	0.362	0.088
	Within groups	11683.144	419	27.883			
Positive emotion	Between groups	115.001	3	38.334	1.197	0.311	0.093
	Within groups	13422.748	419	32.035			
Relationships	Between groups	141.107	3	47.036	1.593	0.190	0.107
	Within groups	12370.146	419	29.523			
Overall well-being	Between groups	17.278	3	5.759	1.380	0.248	0.099
	Within groups	1749.053	419	4.174			

Note: * $P<0.05$; ** $P<0.01$

5. Conclusions and recommendations

The present study, grounded in the framework of positive psychology and utilizing the PERMA model, has provided valuable insights into the well-being status of EMUS in Yunnan. The findings highlight several key aspects that warrant attention and intervention to enhance the well-being of this unique student population.

5.1. Conclusions

5.1.1. Overall well-being status

The average overall well-being score of the EMUS was high (8.442, out of 10). This shows that there is a positive appreciation of their quality of life. However, the score distribution also showed that a minority of students were not at all satisfied, where individual differences and room for improvement are likely to exist.

5.1.2. Comparative analysis with HEUS

Compared with HEUS, EMUS reported higher levels of relationships and overall well-being, but not on positive emotion, meaning, engagement, and achievement. Thus, EMUS relates to others more positively and is in a better mood overall than HEUS, but their experiences in terms of emotional satisfaction, purpose, and personal growth are similar.

5.1.3. Gender differences

Male students had significantly higher scores than female students in both engagement and achievement in EMUS. In contrast, no differences by gender emerged in positive emotion, relationships, meaning, and overall well-being, suggesting that these are more equivalent experiences across gender here.

5.1.4. Educational level and grade variations

The study found no differences in dimensions of well-being or overall well-being for educational levels or grade levels. This indicates that EMUS well-being status is fairly steady over time in their academic trajectory.

5.2. Recommendations

5.2.1. Identification of needs among EMUS

The observed gender disparities in engagement and achievement imply that interventions should be personalized. For girls EMUS, programs focusing on higher self-esteem, leadership ability, and participation in extra-curricular activities may help reduce disparities in engagement and achievement. For boys, consider efforts to support emotional intelligence and healthy coping strategies to balance high levels of engagement and achievement with wellness.

5.2.2. Long-term support and monitoring

Higher education institutions need to regularly monitor the well-being of students so they can respond to any new challenges in a timely manner. Using the PERMA model as an assessment model, one can examine well-being among students in a multifaceted way. In addition, building out a specific support system, such as counseling and mental health resources, can provide focused support for students who might be flailing.

Funding

This research was supported by the Yunnan Provincial Department of Education Scientific Research Fund Project titled “A Study on the Current Status and Improvement Strategies of Well-being among Yunnan Ethnic Minority University Students from the Perspective of Positive Psychology” (Project Number: 2024J1326).

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Jun Y, Bo Y, 2022, Study on Well-Being and Influencing Factors of the Minority College Students in Yunnan Province. *Advances in Psychology*, 12(3): 589–597.
- [2] Seligman MEP, 2002, Positive Psychology, Positive Prevention, and Positive Therapy, in *Handbook of Positive Psychology*, 3–12. Oxford University Press, Oxford.
- [3] Diener E, 2000, Subjective Well-being: The Science of Happiness and a Proposal for a National Index. *American Psychologist*, 55(1): 34–43.
- [4] Robinson PM, 1988, Root-N-Consistent Semiparametric Regression. *Econometrica*, 56(4): 931–954.
- [5] Seligman MEP, 2011, *Flourish: A Visionary New Understanding of Happiness and Well-being*. Free Press, New York.
- [6] Diener ED, Emmons RA, Larsen RJ, et al., 1985, The Satisfaction with Life Scale. *Journal of Personality Assessment*, 49(1): 71–75.
- [7] Butler J, Kern ML, 2016, The PERMA-Profilier: A Brief Multidimensional Measure of Flourishing. *International Journal of Well-being*, 6(3): 1–48.
- [8] Ren Y, Zhao X, 2023, Analysis of the Current Status and Influencing Factors of Well-being among College Students. *International Public Relations Magazine*, 2023(3): 16–18.
- [9] Lin LH, Deng HM, Huang WL, 2023, Survey on the Current Status of Well-being among College Students. *Journal of Ningde Normal University (Philosophy and Social Sciences Edition)*, 2023(1): 98–105.
- [10] Hou ZH, Chieh L, Xu XF, 2019, The Impact of Demographic Variables on College Students’ Overall Well-being. *Higher Education Development and Evaluation*, 35(1): 54–71 + 91.

Publisher’s note

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

Architectural, Geographic, and Interpersonal Space: The Spatial Study of *The Remains of the Day*

Shuyue Yuan*

Beijing International Studies University (BISU), Beijing 100024, China

*Author to whom correspondence should be addressed.

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 is motivated by a particular interest in the spatial dimensions in Kazuo Ishiguro's novel *The Remains of the Day*. It focuses on the architectural, geographic, and interpersonal spaces that shape the protagonist's psychological state and personal transformation. Applying Henri Lefebvre's spatial production theory, Michel Foucault's discourse on power and space, and Edward Soja's Third space theory, this paper discusses Darlington Hall as a symbol of hierarchical power, the English countryside as a space of disillusionment, and Stevens's shifting social interactions. The paper reaches the conclusion that the creation of multiple spaces has a significant influence on the human spiritual world, while arguing that Ishiguro employs spatial poetics to reflect class structure, personal regret, and shifting historical realities.

Keywords: Kazuo Ishiguro; Stevens; Spatial poetics

Online publication: June 6, 2025

1. Introduction

Kazuo Ishiguro lives in the gap between different cultures since he was born in Japan and moved to Britain in his childhood. As a result, he pays more attention to people's inner feelings in the process of cultural change in his works. In the Academy of Achievement interview, Ishiguro admits that he has the experience of writing songs and that he avoids expressing emotions explicitly in the lyrics, leaving space for performance and music^[1]. These are things that are incorporated into his writing: "a lot of the emotion and a lot of what you are doing is hidden, it necessarily had to be between the lines" (Kazuo Ishiguro Interview). This proves that Ishiguro often erases some of the meaning he wants to express and leaves it to the readers to feel and paraphrase in his works.

It is noticeable that space has long been a fascinating subject in literature as well as in our daily lives. Literary works frequently employ space to reflect power dynamics, personal identity, and historical change. Kazuo Ishiguro's *The Remains of the Day* is widely recognized for its nuanced exploration of memory, loss, and identity. For that reason, the vast majority of studies on the book have been discussed and debated mainly from the directions of philosophy, psychology, and history. The theme of "self-deception" in philosophy comes up a

lot. According to Kathleen Wall, the content, form, and consequent saturation of the text are all unreliable, and it is a means by which the author can speak silently to the implied reader at will ^[2]. Molly Westerman likewise sees this linguistic ambiguity, ambivalence, and limitation in *The Remains of the Day* as a means of expression that provides “a dense account of its narrator’s split subjectivity.” Chinese scholar Deng Yingling agrees with this feature, arguing that unreliable narration, as a narrative technique involved in the thematic construction of the novel, blurs the boundaries between different events.

However, beyond its temporal structure, the novel’s spatial dimensions—both physical and psychological—play a crucial role in shaping its protagonist, Stevens. So far, there have been several studies that look at the subject of space in Ishiguro’s novels, and many of them focus on *The Remains of the Day*. While in the previous studies of the literature, scholars tend to focus more on the time dimension. In the later gradual expansion of studies, scholars then realized the importance of the spatial dimension for literary studies and began to achieve a major breakthrough from time to space. Joseph Frank believes that the two factors that distinguish literature from the plastic arts are time and space. Also, W. J. T. Mitchell notes that the form of space is the basis of human perception of the notion of time, and human beings cannot “tell time” without the medium of space. The attention to the production of space is related to the literary research from diverse directions. The space is not only a production of various processes of social formation and human interventions, but also acts back on humans and society itself, impacting, guiding, and even limiting behavioral possibilities.

Henri Lefebvre’s *The Production of Space* argues that space is not merely a physical entity but a socially produced structure embedded with ideology and power dynamics. His concept of perceived, conceived, and lived space provides a useful lens for examining how Darlington Hall operates as both a physical estate and a site of class-based hierarchy. Michel Foucault, in *Discipline and Punish*, explores how architecture enforces discipline and social control, particularly through spatial arrangements that regulate human behavior. His theory of panoptic surveillance is particularly relevant to the way Darlington Hall constrains Stevens’s mobility and shapes his self-perception. Edward Soja’s *Thirdspace* extends Lefebvre’s spatial triad by emphasizing space as fluid, dynamic, and transformative. His concept of Thirdspace captures the liminal, evolving nature of Stevens’s journey across England, illustrating how space can become a site of personal crisis and transformation.

By incorporating these spatial theories, this study aims to offer a fresh perspective on Ishiguro’s use of space in *The Remains of the Day*. This paper will explore the three primary spatial dimensions in the novel: architectural space, focusing on Darlington Hall as a site of power and control; geographic space, examining the English countryside as a realm of nostalgia and disillusionment; and interpersonal space, analyzing the way human interactions are shaped by physical settings ^[3].

2. The power of the architecture

2.1. The vanity ambition at Darlington Hall

People may become confused in a materialistic environment and end up with character flaws. And vanity is precisely one of the character flaws that aims to be superficial. The magnificent Darlington Hall is the source of Stevens’ vanity.

The exterior of Darlington Hall is magnificent, and the whole opulence and elegance of the building evoke Stevens’ admiration for status and worldly possessions. The interior of Darlington Hall is spacious and has a library, dining room, banqueting hall, drawing room, servants’ hall, servants’ pantry, etc. On the second floor,

several bedrooms have views of the lawn with the lush downs in the distance. The shadows of poplar trees can be seen on the gently rising grassy slopes. Darlington Hall is gorgeous and incredibly livable, as evidenced by all these facilities.

In addition, the doors of the library in Darlington Hall offer an unobstructed view “across the entrance hall to the main doors of the house”, which reinforces a sense of limitless power and privilege. The wide perspective brings out a sense that the master of the house has access to every resource available in the world at his fingertips. Stevens frequently moved in and out of this space, which subliminally influenced his conceit of overestimating himself that he internalized the grandeur and began to view himself as an integral part of the house’s status. His concern about the appropriate dressing for his road trip reveals how deeply he equates appearance with self-worth. He considers carefully the appropriate outfit to bring along and even thinks about whether to buy any new clothing specifically for the trip. Many suits that he has, in his opinion, are perhaps too formal for the proposed trip, while others are old-fashioned these days.

A deeper interpretation of the symbolism of the architectural space, Darlington Hall is its influence as the center of the world. The fate of entire nations is frequently decided in Darlington Hall by Lord Darlington and other political figures. For Stevens, he lives in a position where he can grasp the center of the world. He admits that “the world was a wheel, revolving with these great house at the hub, their mighty decisions emanating out to all else, rich and poor, who revolved around them.” This perception aligns with Lefebvre’s theory that space is socially constructed, reinforcing existing power structures.

2.2. The psychology of oppression in the Stevens’ room

The environment assumes an important role in understanding and analyzing human psychological and behavioral processes. The results of several in-depth studies have demonstrated that the psychological development of an individual is dependent on the interplay between the psychological characteristics of the individual and the traits of the surroundings. Stevens stays in a dark and enclosed space that keeps him bound in a cage and causes him to become internally suppressed, which contrasts sharply with the grandeur of Darlington Hall. This claustrophobic environmental factor influences his psychological condition. Stevens’ pantry is mentioned several times in the text from Miss Kenton’s perspective, “it seemed such a pity your room should be so dark and cold”, “Mr. Stevens, there is no need to keep your room so stark and bereft of colour”, and “Mr. Stevens, this room resembles a prison cell. All one needs is a small bed in the corner and one could well imagine condemned men spending their last hours here”^[4].

Stevens resists being swayed by the persuasion from Miss Kenton and acts distantly. The lack of color affects people’s perception of the room. For Miss Kenton, it is a prison cell, but for Stevens, it is a simple place to work without much concern. The cell-like pantry represents Stevens’ isolation and melancholy. Every corner and angle of the room and every secluded space where people hide is a metaphor for loneliness in the mind. Each piece of furniture acts as a barrier to keep people hidden from the outside world, and the overhang serves as an adequate ceiling; the boundaries of the room people see are already made by the shadows in the area. People’s bodies and psyches believe that they can be well circumvented when people with mental problems take refuge.

Stevens spends a larger portion of his day in the public places of Darlington Hall. From another point of view, it can be imagined that the psychological gap is formed when Stevens returns to his dim, prison-like pantry after spending most of his day in the extreme luxury of the space. The exquisite structure of the hall stands in sharp contrast to his pantry. There are two concepts that can be conjectured: the oppression of power created

by the space, and Stevens' self-repression. Lord Darlington is described by Stevens as "shy and modest" and "a truly good man at heart, a gentleman through and through"; therefore, the issue of power oppression is not necessarily present. The starkness of his room parallels his emotional repression. While Darlington Hall's grand spaces cultivate his aspirations, his room enforces his reality as a mere servant. This aligns with Foucault's idea of spatial discipline, where architecture enforces roles and behaviors. Stevens is subjectively reluctant to spend time decorating his pantry because he believes that it is the only way he can devote his full attention to serving Lord Darlington. When confronted by Miss Kenton with a vase of flowers brought to the table in his pantry, Stevens refuses her nice offer, "This is not an entertainment."

2.3. The illusion of authority in the servants' hall

The servants' hall is a space where the servants can congregate to relax in Darlington Hall. Its role is more like a tiny forum, where they hold spirited debates about the significant events that their employers discuss upstairs or the important matters in the newspapers, as well as talk about aspects of their profession. In general, the discussion of career goals and important social events calls for a visionary way of thinking. The scenario is similar to the upstairs employers discussing national affairs. As a result, the servants in the room have the illusion of identity, as if they are in the corresponding status of their employers to discuss their corresponding affairs. Foucault notes that speech serves both as an object of desire and as a means of concealing true subjugation. This further facilitates Stevens' quest for self-identity. In addition, the definition of a "great" butler is a subject of frequent disagreement among the servants, and the word "dignity" separates a "great" butler from one who is merely extremely capable. Stevens' engagement in these discussions, particularly on the ideals of a "great butler", reveals his deep need for recognition within the rigid class structure of Darlington Hall. The primary requirement for membership in the Hayes Society, which accepts "butlers of only the very first rank", is that "an applicant be attached to a distinguished household." The Hayes Society is regarded as the highest honor by servants. When people are working toward the same goal, there is an invisible competition and effort. Stevens' aspirations for "dignity" and "great butler" are based on these.

3. The transformation in geographical space

3.1. The journey from constraint to freedom

The author describes some of the beautiful scenery that Stevens sees while driving. Thick and leafy trees line the route, and mountains covered in lushness encircle the roads. The readers can feel the changes in Stevens' mood since the author's writing makes it plain. At first, Stevens feels odd because no one is in Darlington Hall for possibly the first time this century, and then he feels complicated as he sets off. During the first twenty minutes, he has no enthusiasm or anticipation at all. Later, as he drives toward the Berkshire border, the scenery is "continued to be surprised", and as he crosses the boundaries, he has "the experience of unease mixed with exhilaration." In Ishiguro's writing, Stevens' car trip is relaxing and encourages him to lower his defenses. This journey represents a shift from what Edward Soja describes as a "Firstspace"—the rigid, hierarchical structure of Darlington Hall—to a fluid "Thirdspace" where new experiences and self-reflections become possible. Stevens is forced to slow down the pace of life because he is no longer a servant who tenses up every nerve and forbids himself to make mistakes. Instead, he is a free man who wanders. As he says, "often I found myself slowing the Ford to a crawl to better appreciate a stream or a valley I was passing."

The impact of the switch in geographic space is, therefore, more akin to a journey of spiritual healing for Stevens. He rarely travels and is restricted to Darlington Hall by his duties. The external geographic space symbolizes his liberation from the seclusion of Darlington Hall and his entry into the unknown. Due to the isolation of Darlington Hall from other houses inhabited by civilians and Stevens' infrequent travels, Stevens' residence is cut off from the outside world. This isolation reflects what Foucault refers to as "heterotopia"—a space that is simultaneously real and illusory, existing outside of traditional social structures while reinforcing them through controlled environments. Before leaving, Stevens worries about the mansion being unprotected, but as soon as he departs, "the feeling swept over me that I had truly left Darlington Hall behind."

3.2. Landscapes and shifting class consciousness

Stevens' mental state is further relaxed when he climbs up to the best view in England. He is welcomed by "a most marvelous view over miles of the surrounding countryside" when he arrives at the clearing. There are miles of neighboring farmland, fields, and churches visible. The fields with sheep stretch to the far distance. The warm and light breeze on his face gives him relief to the soul. This moment aligns with Tuan Yifu's assertion that vast landscapes promote introspection and self-renewal, as open space contrasts with the confined and disciplined spaces of urban or aristocratic environments. The combination of dynamic and static landscapes has a profound psychological effect on Stevens. As "I felt the first healthy flush of anticipation for the many interesting experiences I know these days ahead hold in store for me," he begins to look forward to what is going to happen in the future, rather than following a routine servant's life. Not only does he marvel at the beauty of nature's landscape, but his long-suppressed mind starts to thrill at the sight of the vast outside world.

Another aspect of Stevens' transformation is the fact that he starts accepting advice from strange civilians. The best view in England is introduced by the Salisbury local elderly, before Stevens climbs, he initially positions the elderly as a vagrant and thinks "it is quite offensive and it may well have been the urge to demonstrate just how foolish his insinuation had been that caused me to set off up the footpath." This initial reaction aligns with Lefebvre's notion that space dictates social interactions, where elite spaces encourage social hierarchies and reinforce exclusionary attitudes. This supports what the study mentioned in the first section, that Stevens has already established a condescending mindset. His first impression of the elderly person who is less well-dressed is slovenly and rudeness. This reflects Stevens's attempt to set himself apart from the elderly because the elderly talk and behave differently from the great and dignified butler he perceives and seeks to be. However, it is remarkable that Stevens' inner feeling has changed noticeably after taking in the breathtaking scenery. His natural perception of persons of lower rank is altered as he starts to perceive them in a friendly way, "It occurs to me now that the man might just possibly have meant this in a humorous sort of way; that is to say, he intended it as a bantering remark."

3.3. Reflections on the past stubbornness in Moscombe

In the space of Moscombe, Stevens furthers his reflection on his past stubbornness. Stevens is unfortunately lost on his way to get help on foot after his car runs out of gas, "a field sloped down very steeply so that it fell out of vision only twenty yards or so in front of me", "to be up there on a lonely hill." The constant changes in geographical space show that the author is not only portraying Stevens as lost in a physical sense, but also implying that Stevens is starting to get lost in his self-perception in a psychological sense. Lefebvre's concept of "perceived space" is evident here, as Stevens struggles to navigate both the physical terrain and his shifting self-

identity. Stevens' past perception of how to treat people has gradually distorted, even if he is unaware of this. He is stuck in a space where he cannot locate himself with the correct values. Mr. Taylor from the Moscombe offers Stevens assistance, "If you didn't mind roughing it a little, sir, we could offer you a room and a bed for the night." It makes Stevens feel warm and is part of his acceptance of the stranger's offer once again. He gradually starts to open up to strangers rather than treating commoners or civilians with contempt. It represents a process of becoming better and reveals Stevens' encounters with inspirational people in his life.

The idyllic scenery of Moscombe is undoubtedly a little softer and more inviting than the luxurious Darlington Hall, "It is a rather cozy room, dominated by a large, roughly hewn table of the sort one might expect to see in a farmhouse kitchen, its surface unvarnished and bearing many small marks left by choppers and breadknives." The large, roughly hewn table contrasts with the spacious banqueting hall of Darlington Hall, and the new environment of this unfamiliar setting makes for a unique experience for Stevens. This space is characterized by its rustic simplicity, fostering a sense of warmth and authenticity. Tuan Yifu's theory of "place attachment" helps explain why Stevens finds unexpected comfort in Moscombe's humble setting, as spaces influence emotional and psychological well-being. The countryside has developed into a space distinguished by scenic beauty, a leisure area that relaxes, provides family entertainment and outdoor activities, and — most importantly — a place to escape the negative effects of city life. Therefore, the simplicity of the countryside warms Stevens' heart once again.

During his stay, Stevens engages in a discussion about what it means to be a gentleman. Stevens uses the term "dignity" to define it, but secretly considers this explanation as a passing thought that "running through my mind while listening to the preceding talk, and it is doubtful I would have said such a thing had the situation not suddenly demanded it of me." He initially defined changes to the later realization that his understanding was shaped by Darlington Hall's rigid hierarchy. Soja's "Thirdspace" emerges here, as Stevens negotiates between his former servitude-driven worldview and the more egalitarian perspectives of the villagers. The shift from Darlington Hall to Moscombe represents a spatial and ideological transformation, leading Stevens to question his past allegiances. Only when one is at ease can one convey their understanding and opinions about anything in a clear and unguarded manner. So in the current space of the rural farmhouse, Stevens is relaxed and honest in expressing his inner thoughts.

The shift in space, Stevens' temporary village room, also known as his sanctuary, signifies the beginning of his questioning of Lord Darlington, whom Stevens perceives to be a faith. Stevens' opinions and positions in relation to political affairs vary significantly from those of the villagers, who have maintained their democratic beliefs, while Stevens supports Lord Darlington who has an enthusiast for the Nazis. Stevens is ostensibly in denial about the villagers' views as being too idealistic, but they also encourage Stevens to think more deeply when he returns to his room. While he cannot fully reject his past, he begins to acknowledge that his loyalty to Lord Darlington was misguided. This aligns with Foucault's idea that power structures are internalized and only confronted through spatial displacement. Moscombe becomes a space of reflection, allowing Stevens to challenge the worldview he had clung to for so long. In recalling Lord Darlington's remarks on political leadership, Stevens argues that many of Lord Darlington's views "will seem today rather odd—even, at times, unattractive." By this point, Stevens is already aware of Lord Darlington's mistake of pursuing a shameful pro-Nazi policy. Stevens cannot accept it and excuses himself, "It is hardly my fault if his lordship's life and work have turned out today to look, at best, a sad waste — and it is quite illogical that I should feel any regret or shame on my own account." In this "sanctuary" of Moscombe, Stevens rejects the stand of Lord Darlington and isolates the views of the villagers.

He has the ability to reflect on the history of right and wrong, as well as the bravery to challenge Lord Darlington. Yet, he is currently unable to completely acknowledge the foolishness of his unconditional support for Lord Darlington.

4. The release in interpersonal space

4.1. The liberation at the Rose Garden Hotel

On the fourth day of the journey, Stevens arrives at the dining hall of the Rose Garden Hotel in Little Compton and makes a breakthrough for himself. Instead of being serious and nervous, he starts to learn to enjoy a life of leisure. He is no longer bound to the shackles of servant status. Stevens describes the ivy-covered Rose Garden Hotel as “while hardly luxurious, it is certainly homely and comfortable.” He delights in all the comforts and pleasures the hotel provides him. He believes that the hotel’s rear garden, which is furnished with several sets of tables, “is a very pleasant place to partake of meals or refreshments.” The contrast between this homely setting and the rigidly structured Darlington Hall symbolizes a shift from Lefebvre’s “conceived space”—an environment shaped by hierarchical and institutional structures—to “lived space”—a space of personal experience and emotional freedom. Therefore, it is reasonable to think that Stevens’ mentality has gradually changed from his previous stubbornness to a passion for a plan that brings joy. Stevens’ inner space to accept things from the outer world expands effectively.

Stevens’ newfound ability to appreciate his surroundings also manifests in his interpersonal relationships. Previously, he rejected Miss Kenton’s attempts to place a vase of flowers in his pantry, but now he acknowledges the beauty of a space designed for comfort rather than control. This suggests an opening of his psychological and emotional space, which allows for greater flexibility in his interactions. In addition, his communication space with Miss Kenton is also expanded. Stevens only wants to stay in a narrow, dark, unadorned “cell-like” pantry, and the meeting with Miss Kenton is confined to Darlington Hall. For Stevens, Darlington Hall has functioned as a Foucauldian disciplinary space, where self-restraint and emotional suppression were necessary for fulfilling his duties, which only required serving Lord Darlington inside the mansion. He consistently refuses to share with Miss Kenton any of his feelings on his doubts about Lord Darlington or his love for Miss Kenton. However, at the Rose Garden Hotel, their conversation moves to a brighter and more open space, “The light in the room was extremely gloomy on account of the rain, and so we moved two armchairs up close to the bay window.” The shift in physical space reflects a shift in interpersonal space, allowing Stevens to reveal himself more openly.

Furthermore, the impact of color and light on one’s mood is well-documented. Environmental psychologists such as Küller et al. argue that exposure to natural light influences psychological well-being and emotional openness. The Rose Garden Hotel provides Stevens with an environment where he is subtly encouraged to reflect and engage more personally with Miss Kenton. This contrasts sharply with the rigid, dimly lit halls of Darlington, where emotions were repressed. What can be proved conclusively is that the atmosphere of their communication is stable and pleasant. Stevens now has the courage to reveal himself and expose his inner thoughts to the bright outer world.

Finally, the interaction between Stevens and Miss Kenton takes on a new physical dimension. When picking up his car outside the hotel, Stevens finds himself “obliged to assist Miss Kenton” due to the large puddles. Such an intimate gesture would not have occurred at Darlington Hall, where social and physical barriers strictly dictated behavior. This moment represents an expansion of personal space into relational space, where Stevens’ deeply ingrained self-restraint is momentarily broken. It is clear from “our conversation took a more personal turn” that

Stevens now dares to express his concern for Miss Kenton, as opposed to the earlier Stevens, who would only talk with her about business-related issues and emphasized that their daily meeting in her parlour after work was “overwhelming professional” and “predominantly professional in character.” When Stevens picks up his car outside the Rose Garden Hotel, the large puddles “obliging me [Stevens] to assist Miss Kenton.” Such an intimate gesture would not have occurred at Darlington Hall in the past, and Stevens becomes affectionate in this moment. As a result, the space of his mind grows wider as the pace of his travels expands.

4.2. The emotional catharsis at Weymouth’s Pier

The novel ends with Stevens’ arrival at the pier of the seaside town called Weymouth. It is the culmination of Stevens’ psychological space and interpersonal space being released. Traditionally, seaside spaces have symbolized freedom and transformation in literature, and for Stevens, the pier represents his final confrontation with self-deception. People’s conception of the pier is bustling since there are mostly cargo ships coming and going, and diligent workers. The pier where Stevens is located is like a funfair that is lit up with colored lights. The bustling with visitors makes the pier appear vibrant and warm. The cheerful crowd warms Stevens and makes him feel less lonely in this joyful environment. A welcoming and accepting haven can be built even in a congested area. If the cost of this process of crowded adaptation is to be seriously considered, it seems to be an opportunity for one’s inwardness of the human personality. The overcrowding of the pier creates a heaven that can accommodate anyone and anything, Stevens is no longer a prisoner living alone in a cold cell but in a warm sanctuary. The positions Stevens sits in “have a good view from here of the sun setting over the sea.” The sea is a symbol for tolerance and freedom, and the author here implies that Stevens’ inner space becomes as vast as the sea at the end. He enjoys these leisurely and rare moments and decides to “remain a second night here so as to allow myself this whole day to spend in a leisurely manner.” He has learned how to release and relax himself, and is willing to pay more attention to reconciliation with himself. Stevens’ experience at Weymouth pier reshapes his understanding of place, allowing him to move beyond the confines of his past identity.

The most important point is that the man sitting on a bench with Stevens and the group of strangers opens up to him, so that he gets the ultimate spiritual release. The identity of the man is a retired butler; the same identity and similar experiences make Stevens feel as if he has found a confidant. He perhaps believes the man can empathize with everything he worries about, so he finally surrenders to confess everything about himself honestly, including his own regrets and his true assessment of what Lord Darlington has done wrong. This is the first time he confesses to a stranger. The man’s reassuring words and his approach and view on not having the energy to serve the employer provide Stevens with a reference. This aligns with Soja’s concept of “Thirdspace”—a realm where identity is fluid and redefined through experience. In this liminal space, Stevens moves beyond rigid social roles and embraces a more honest self-perception. Accepting the man’s advice and being motivated, “there is something to his advice that I should cease looking back so much, that I should adopt a more positive outlook and try to make the best of what remains of the day”, is the evidence to the Stevens’ progress in the space of the interpersonal relationships. Moreover, the conversation at the pier provides Stevens with a crucial moment of catharsis. He openly acknowledges that Lord Darlington’s decisions were flawed, something he had previously denied. This acceptance is reinforced by the presence of the surrounding crowd, which offers a sense of belonging rather than isolation. As Foucault suggests, social structures dictate personal identities, but they can be renegotiated through spatial displacement. Stevens’ experience at the pier allows him to redefine his sense of self outside of Darlington Hall’s authority.

Finally, Stevens' new outlook is expressed through his willingness to embrace humor and connection. While people wait together for the lights to turn on, the group of strangers behind Stevens becomes friendly and talkative, and this swiftly developed familiarity prompts Stevens to alter his manner of approaching people to get into a relationship. He, who once thought that bantering was unreasonable, now thinks that "it is not such a foolish thing to indulge in – particularly if it is the case that in bantering lies the key to human warmth." He even reorients his relationship with Mr. Farraday, as Stevens' desire for learning the bantering skills to surprise him indicates that Stevens has been able to put his former loyalty and dedication to Lord Darlington at the service of Mr. Farraday. People's sense of identity is diminished by the loss of a confined, controlled territory, so they attempt to exert as much control over it as they can by defining the relationship of "I", "We," and "Other." The "I" relates to the personal identity, the "we" is a common identity upheld by conjunct relationships to places, and the "other" is referred to as the outsider. For Stevens, Darlington Hall, which is owned by Lord Darlington, is gone, so his sense of identity within the house is greatly weakened. It has left Stevens feeling as if he is failing in his profession and is unable to carry out his duties. However, the particular space Weymouth's pier adds a sense of belonging to Stevens' "I", so he reaches a communication with his interpersonal self. The man who comprehends him is Stevens' "we", he creates Stevens's shared identity through their shared connection to the butler. Stevens' "other" is the group of strangers who interact and banter with each other as the lights come on. They give Stevens the key to the long-locked door of interpersonal connections.

5. Conclusion

Kazuo Ishiguro's *The Remains of the Day* masterfully extends the application of spatial theory in contemporary literature. By intertwining physical, geographic, and interpersonal spaces with the protagonist's psychological and emotional state, Ishiguro illustrates how spatial constructs shape human identity, power relations, and self-perception. By applying certain spatial theories, this essay explores the connection between Stevens' character development and the switching of space. This study has analyzed the novel's spatial dimensions through three primary lenses—architectural space, geographic space, and interpersonal space—to reveal how Stevens' journey across various spatial landscapes mirrors his internal transformation.

The three architectural spaces: Darlington Hall, Stevens' pantry, and the servants' hall, contribute to the formation of Stevens' oppressive psychology. The architectural spaces of Darlington Hall, including Stevens' pantry and the servants' hall, function as sites of oppression and psychological discipline. Lefebvre's theory of "conceived space"—where spatial structures reinforce ideological control—is evident in how Darlington Hall sustains the rigid social hierarchy, compelling Stevens to internalize servitude as dignity. Additionally, Foucault's concept of disciplinary space is reflected in the panoptic control embedded within Darlington Hall, shaping Stevens' behaviors and self-restraint. Through the spatial description of these locations, the author provides a claustrophobic space that paves the way for Stevens' gradually distorted inner state.

As Stevens starts his six-day drive, the novel's shifting landscapes become a site of self-reflection and gradual disillusionment. The author subtly reveals Stevens' gradual change of inner feeling due to the spatial transformation of the journey through the descriptions of the vegetation on the road, the open space referred to as "the best view in England," and the rural village of Moscombe, which contrasts with the claustrophobic rigidity of Darlington Hall, offering Stevens a "Thirdspace" (Soja) where new perspectives begin to emerge. Tuan Yifu's notion of "place attachment" highlights how Stevens' exposure to more fluid, unstructured environments

challenges his past assumptions and encourages him to reconsider his identity.

Coming to the end part of the journey, the author narrates the Rose Garden Hotel, where Stevens meets with Miss Kenton, and the Weymouth's pier, where Stevens encounters the retired butler and a group of strangers who quickly become acquainted with each other. These depictions of physical space serve more to illustrate the breakthrough in Stevens' interpersonal space. Stevens finally musters the courage to confront intimate personal relationships, his faults, and the collapse of his belief. Foucault's spatial displacement theory is evident here, as Stevens' interactions outside Darlington Hall allow him to redefine himself. As a result, Stevens no longer feels lost in his approach to the future and regains confidence in both himself and others. Stevens makes progress in interpersonal space by improving both his self-examination and his impression on others.

The novel unfolds with the complete process from the formation of trauma to the result of healing. It functions as a therapeutic model that dispels the shadows and embraces the light. Through the multiple transformations of space to heal the long-hidden confusion deep inside, the reflection on life, self-identity, and future is achieved. The novel gives an effective advantage to the development of spatial theory and the human spiritual world, enriches the regular form of expression of trauma literature, and explores the deeper substance of spatial theory. It also represents the authenticity of the struggle for survival of human beings in order to achieve their goals and dreams. In the novel, Stevens experiences the tragedy of life and then restarts his life on the journey. By employing spatial poetics, *The Remains of the Day* not only deepens the thematic exploration of memory, regret, and identity but also contributes to the broader discourse of space and power in literature. This study, therefore, affirms the essential role of spatial theory in understanding literature's engagement with human consciousness, social order, and emotional transformation.

Disclosure statement

The author declares no conflict of interest.

Reference

- [1] McCombe JP, 2002, The End of (Anthony) Eden: Ishiguro's "The Remains of the Day" and Midcentury Anglo-American Tensions. *Twentieth Century Literature*, 48(1): 77–99.
- [2] Rentfrow PJ, Jokela M, 2016, Geographical Psychology: The Spatial Organization of Psychological Phenomena. *Current Directions in Psychological Science*, 25(6): 393–398.
- [3] Sudjic D, 2005, *The Edifice Complex: How the Rich and Powerful Shape the World*. Penguin Press, London.
- [4] Wegner PE, 2002, *Imaginary Communities: Utopia, the Nation, and the Spatial Histories of Modernity*. University of California Press, California.

Publisher's note

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

The Future of Museums in Rapidly Changing Communities: The Case of Nanning Museum

Zhanghua Hu, Bei Qin

Nanning Museum, Nanning 530219, China

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 development of the times, Nanning Museum is actively implementing reform and innovation to better adapt to the requirements of the times. In this study, the focus will be on the in-depth analysis of the growth process of Nanning Museum in the process of transformation, with a particular emphasis on understanding the growth and changes of museums, in order to better explore diversified development models, improve the construction quality of Nanning Museum, fully tap into the contemporary value of museums, and promote the construction and inheritance of new era culture.

Keywords: Nanning Museum, Guangxi; Rapid change; Era innovation

Online publication: June 6, 2025

1. Introduction

Museums are important carriers of China's spiritual civilization and cultural construction, carrying rich historical and local cultures. Museums provide detailed records of the historical origins of local culture in social development, while also showcasing the influence of culture. Through understanding museums, local cultural customs, and other content can be better presented, thereby achieving the goal of cultural inheritance and promotion. The country also attaches great importance to the construction and development of museums, emphasizing that museums are important bridges connecting history and modern civilization, and museums should continue to grow and innovate in the process of change. With the development and progress of society, museums must also keep pace with the times and grow through change in order to better enhance their social influence and further promote the development and progress of social civilization^[1].

The 2025 International Museum Day theme, The Future of Museums in Rapidly Changing Communities, underscores the imperative for museums to adapt within dynamic global and sociocultural landscapes. As articulated by the International Council of Museums (ICOM), museums now stand at the forefront of societal transformation, navigating environments shaped by shifting global events and evolving public needs. This vision resonates deeply with Nanning Museum's founding philosophy: "The Growing Museum: A Civic Cultural Community for Dialoguing with History, Appreciating Art, and Transmitting Civilization." Today, museums

transcend their traditional role as repositories of artifacts; they have become proactive collaborators with the public, fostering pluralistic, inclusive, and harmonious cultural values. In an era of rapid change, museums function as living organisms—adapting, evolving, and expanding the boundaries of cultural dissemination and heritage presentation.

In recent years, the Nanning Museum in Guangxi has continuously achieved innovation in the process of transformation, better inheriting the urban culture of Nanning and promoting the high-quality development of cultural undertakings. The rapid growth of the Nanning Museum is an inevitable requirement for the development of the new era. Under the trend of globalization, influenced by national policies on museum development, digital technology, and social environment, the Nanning Museum in Guangxi has also shown an innovative development trend, better demonstrating the social influence of museums. In the future, how to maintain cultural depth and enhance international influence in the midst of change remains a topic worthy of in-depth exploration ^[2].

2. Overview of the Nanning Museum in Guangxi

In 1980, the Office of the Cultural Relics Management Committee of Nanning City, Guangxi, was established to perform administrative management of cultural relics and museum-related business functions. In 1992, the Nanning Museum in Guangxi was officially established, located in Nanning, the capital of Guangxi Zhuang Autonomous Region. It is a first-class museum in China with a total construction area of 30000 square meters, including an exhibition hall area of 12000 square meters. At present, the museum has a collection of 25000 pieces and 396 precious cultural relics/sets. From the type of collection, it includes various cultural relics from the Paleolithic era to modern times, such as stone tools, bronze ware, jade ware, ceramics, calligraphy and painting works, and textiles, providing sufficient collection resources for the Nanning Museum ^[3]. This museum plays a very important role in cultural heritage, and by keeping pace with the times and carrying out diverse museum activities, it provides guarantees for the innovative development of museums.

3. Dialogue with history, appreciation of art

The Nanning Museum has rich historical and cultural resources. In the context of the new era, by inheriting historical and cultural heritage, it can better guide the audience to appreciate the artistic charm of history and further build a culturally influential Nanning Museum.

On January 29, 2016, Nanning Museum's new building opened to the public free of charge. Housing two permanent exhibitions and three thematic displays, the museum showcases Nanning's historical and cultural identity through its rich collections, innovative curatorial approaches, and distinctive regional aesthetics. Visitors engage intimately with history and art, preserving local heritage while advancing its transmission.

Yongrong Huagui: Ancient Nanning History Exhibition chronicles over 10,000 years of Nanning's evolution from prehistoric times to the Qing Dynasty (1644–1912). Combining artifacts with multimedia installations, reconstructed scenes, and interactive displays, the exhibition vividly narrates the city's multifaceted history (**Figure 1**). Interactive elements enhance visitor immersion, blending education with experiential engagement.



Figure 1. Part of Yongrong Huagui: Ancient Nanning Historical Exhibition (Photo by Zheng Zhihao)

A Century of Yongcheng: Modern Nanning History Exhibition recreates the city’s transformations from the late Qing Dynasty to the present. Highlights include the Republican-era Street, featuring iconic arcade architecture, historic shops like Wanguo Grand Hotel and Dashengxiang Sauce Factory, and the Shuangma Well from the Song Dynasty (960–1279). Atmospheric lighting and soundscapes transport visitors to early 20th-century Nanning, making it a popular destination.

The 1929 Nanning Mutiny Exhibition chronologically details the causes, events, and outcomes of this pivotal uprising, celebrating the revolutionary contributions of figures like Deng Xiaoping.

Songs of the Land: Nanning Folk Art Exhibition pioneers a hybrid “exhibition-performance” format. It showcases indigenous folk music and the Nanning International Folk Song Festival, complemented by a 10-meter-high LED stage where dynamic light shows and traditional costumes immerse audiences in a multisensory experience.

Red Earth Rhythms: Lu Quanzhi’s Red Ceramics Art Exhibition highlights locally crafted red ceramics. The gallery’s crimson lighting evokes the primal interplay of “fire and earth” (**Figure 2**) while an on-site pottery studio offers hands-on workshops, aligning with festivals and temporary exhibitions to deepen public engagement.



Figure 2. Part of Red Earth Charm: Lu Quanzhi's Red Pottery Art Exhibition (Photo by Zheng Zhihao)

4. Pluralism, openness, and resource sharing

Temporary exhibitions serve as vital supplements to permanent collections, offering fresh perspectives and cross-cultural dialogue. Since April 2016, Nanning Museum has hosted 124 temporary exhibitions (averaging 12 annually), spanning archaeology, calligraphy, ethnic culture, fine arts, and natural sciences, ranking first in Guangxi's museum system for exhibition frequency.

In 2022, Nanning City Museum introduced Hebei Museum and Hebei Provincial Institute of Cultural Relics and Archaeology, King's Underground Palace: Hebei Han Dynasty Royal Exhibition. During the exhibition, the related views of the entry King's Underground Palace were 172,000 times, the related views of the entry King's Underground Palace on the TikTok platform were 136,000 times, and the related views of the entry Nanning Museum on TikTok were 4.213 million times. In addition to the introduction of exhibitions, the Nanning Museum in recent years to focus on the launch of different types of original exhibitions. In 2023, the original exhibition Image: The Aesthetic Appreciation of Costumes of Ethnic Minorities in Southwest China and its Contemporary Reconstruction hosted by the Nanning Museum has attracted more than 450,000 visitors in the past 7 months, and nearly 4 million people have watched the exhibition video on TikTok. The exhibition's main visual poster won the top 5 of the top 10 posters of the year of Chinese Museums and Art Galleries in 2022. In 2024, due to the high attention of hot search indexes such as Permanent Exhibition Index, New Exhibition Index, Visit Index, Nanning Museum won the list of top 100 national hot search museums in the second quarter and third quarter of 2024, and consecutively topped the list of Top 30 prefecture-level city museums in the first quarter, second quarter and third quarter of 2024.

5. Branding and community integration

Rich and colorful missionary activities in the museum attract visitors, build an interactive platform between the museum and the audience, especially the museum's characteristic activity brand, more able to retain the audience, seize the heart of the audience, and become a part of the audience's life world. Since 2017, Nanning Museum has focused on building the brand of museum characteristic activities. Based on the cultural characteristics of the museum, it has carefully designed and created the museum's Very 6+1 project based on the needs of the audience and the characteristics of different audience groups. Namely, art classroom, pottery workshop, art garden, museum, delicious food, little docent, cultural relics appreciation, six permanent activities, and a wonderful museum night feature activities. Since the implementation of the brand activity, it has been highly praised by the general public. The program No. 96 Steam Light Shop, designed and developed by the museum, was selected as one of the top ten representative education projects of museums in the region at the opening ceremony of the International Museum Day, Guangxi main venue and the Guangxi cultural expo tourism art activity week in 2024.

Every year, International Museum Day, Cultural and Natural Heritage Day, the Zhuang March 3 Festival, and other important festival activities during the New Year's Day, the Spring Festival, and the ASEAN Expo are the time nodes with high public participation, and also the focus of education activities. In 2023, Nanning Museum launched a series of online and offline research and education activities up to 262, with a cumulative audience of about 150,000 offline activities and about 130,000 clicks on online activities. During the Mid-Autumn Festival and National Day holiday in 2023, the number of visitors to Nanning Museum reached 147,000, the highest number of holiday visitors since the opening of the museum. In 2024, a total of 104 educational activities will be held around the exhibition, with 832,500 participants and 1,014 million participants participating in live streaming and event viewing.

6. Diversified development of technological innovation

With the development and progress of science and technology in our country, digital technology has been widely applied in various industries. In the context of digitalization, museums can better enhance their influence and expand their cultural dissemination effects by keeping pace with the times and innovating new paths for digital reform and development. By considering the innovative transformation path of museums under the background of digital technology, it is possible to better guide museums towards intelligent development. With the help of digital technology, silent cultural relics in museums can travel through time and space to have a "dialogue" with audiences ^[4].

From the perspective of the Nanning Museum, in the process of digital development, the use of digital technology has created a three-dimensional spatial model, which has provided support for the transformation and development of museums. For example, the Nanning Museum has leveraged the advantages of digital technologies such as AI and AR to achieve innovative changes in user interaction. In the construction of the museum, it has developed AR smart glasses for navigation, bringing a digital innovation experience to the audience. With the support of AR smart glasses guided tours, compared to traditional museum operation models, it can provide visitors with an immersive experience environment, fully demonstrating the advantages of digital technology, better enhancing the cultural experience of the audience, and strengthening their sense of identity with historical culture.

In the exhibition hall of the Nanning Museum, visitors can also see many developments and changes that

integrate digital technology. For example, in areas such as the Historical Scene Restoration Area and the Children's Archaeological Exploration Area, the Nanning Museum combines research on audience needs, uses digital technology to construct venues, enhances exhibition service space content, brings digital experience space to audiences, creates an immersive experience environment, and further improves the service quality of the Nanning Museum. Through the application of digital technology, the integration of history and modernity, culture and technology has been achieved, which better brings intelligent service models to the audience and further promotes the high-quality development of the Nanning Museum.

7. Expand channels and keep pace with the times

With the rapid dissemination of information, new media platforms are developing rapidly. WeChat public accounts have become an important window for the public to obtain information by virtue of their convenience and universality. Museums all over the country have joined the camp of WeChat public platform, and the fierce competition is becoming more and more intense. How to attract more audience attention has become a problem for museums to think about. How to stand out in the mass of information and attract more audience attention has become a difficult problem for museum operators to overcome. Nanning Museum made precise efforts and carefully planned a series of unique activities with the help of WeChat public account, covering exhibition publicity, interactive classes, online museums and cultural relics push and other rich sectors, successfully attracted a large number of fans' attention, and made a mark in the field of new media.

The Nanning Museum, through the WeChat platform, has launched the "Museum Online" themed WeChat posts featuring bronzeware, pottery, and jade artifacts; it has also conducted multiple online quiz events with prizes such as How Much Do You Know About the Luoyue Culture?, A Mini Science Class on Calligraphy and Painting Restoration: Flour World, and the Museum Fun Trip on International Museum Day on May 18th. These events enhance the audience's experience and interactivity through various forms, including text, videos, and animated games; the museum has also extensively utilized live streaming to carry out events like Big-name Live Streaming: The Director Tells the Story of Chaoyang Business Circle's Past and Present.

During the International Museum Day in 2020, Nanning Museum, in collaboration with Guangxi Broadcasting Station's Education Radio Program "Private Car 930" and Guangxi Audio-Visual, launched a live program called Cloud Touring the Museum through the antique-style street in the museum's modern exhibition hall. This program, known as Yongzhou Zhi Fou, was a multimedia live broadcast that was streamed across various online platforms, including the Private Car 930 Radio, Sina News, and Guangxi Audio-Visual, attracting nearly a million viewers. On the day of International Women's Day in 2022, the official Weibo account of Nanning Museum released the hashtag "Deng Yingchao, Daughter of Nanning" to promote the revolutionary deeds of Comrade Deng Yingchao to the public. The campaign received support from the official Weibo accounts of 65 cultural and museum systems, including the National Museum. The hashtag was viewed 786,000 times on that day, achieving a positive communication effect.

8. Thrive amidst change

At the outset of the construction phase, the concept of the growing museum was repeatedly discussed and refined. Over time, people have come to realize that museums are more than just static custodians of a city's history and culture; they should also serve as dynamic urban cultural hubs that transcend temporal and spatial dimensions,

bridging ancient and modern, breaking through regional boundaries, deeply integrating into the daily lives of ordinary people, and becoming an indispensable part of their living world.

In this era of rapid and continuous transformation, museums must align with societal changes, respond to global events, meet evolving social demands, and embrace iterative challenges to achieve sustainable development. In 2024, the Nanning Museum was awarded the prestigious title of National First-Class Museum, achieving this status in just eight years, which is a remarkable feat among national first-class museums in China. Through the dialectical interplay of inheritance and innovation, the Nanning Museum has actively explored effective pathways for cultural integration, continuously growing amidst change and ultimately realizing leapfrog development, infusing ancient culture with new vitality in the contemporary era.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Jia QH, 2024, Transformation and Empowerment: Application of Generative Artificial Intelligence in Museum Cultural Communication. *Communication and Copyright*, 2024(21): 83–85 + 89.
- [2] Chen N, Cheng J, 2024, Breaking the Walls of Museums: The Transformation of Digital Media and Artificial Intelligence. *Research on Natural Science Museums*, 9(4): 72–78.
- [3] Tie WZ, 2024, The Path and Transformation of Museum Culture Communication under the Background of Artificial Intelligence: Taking the Henan Provincial Museum System as an Example. *News Enthusiasts*, 2024(2): 55–57.
- [4] Meredith FC, 2022, Reflections on the Global Museum Transformation. *Art Museums*, 2022(3): 10–11.

Publisher's note

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

Research on the Composition Mechanism of the Golden Ratio: Aesthetic Processing of Visual Balance

Sufang Li*

Department of Design, Hansei University, Gunpo 15852, Republic of Korea

**Author to whom correspondence should be addressed.*

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: Does the golden ratio in composition bring about visual balance and aesthetic pleasure? What are its underlying mechanisms? This study explores composition and aesthetic preferences, suggesting that visual balance is dynamic and subjective in nature. The physiological structure of human vision, particularly the dominance of one eye, leads to visual field imbalance during aesthetic appreciation. As a result, the subjective center of balance in an image often aligns with the golden ratio point. The mechanism of aesthetic processing in visual perception contributes to the construction of subjective visual balance, and the visual stimulus generated by golden ratio composition may influence this aesthetic processing. Therefore, the aesthetic processing of visual balance can help explain the mechanism underlying the golden ratio in composition.

Keywords: Golden ratio; Visual balance; Aesthetic processing

Online publication: June 6, 2025

1. Introduction

The aesthetic appeal and universality of the golden ratio have been widely recognized ^[1-2]. Many artists have also utilized the golden ratio in their compositions ^[3]. Viewers often perceive a sense of universal beauty in works constructed according to the golden ratio, and this configuration tends to facilitate aesthetic fluency due to its ease of processing ^[4]. However, the underlying mechanisms of how the golden ratio functions during aesthetic processing remain unclear. To address this gap, the present study aims to explore, investigate, and analyze the mechanisms by which the golden ratio influences aesthetic processing and the nature of the aesthetic experiences it evokes.

2. Composition and aesthetic preference

2.1. Explanation of composition and balance

Composition refers to the organization of the interrelationships among objects and forms; it is central to the creation of works of art and to aesthetics itself, across both visual and other art forms ^[5]. A classic approach to understanding the essence of composition can be found in Gestalt psychology, with Rudolf Arnheim as a representative figure. Arnheim emphasized the holistic interpretation of an image or space, highlighting the existence of interacting and balancing forces within it. The sense of balance in an image is fundamental to composition.

Arnheim provided two classic explanations regarding compositional balance. On one hand, he proposed that the sense of balance in an image arises from the perceptual forces acting upon objects within a frame; when the various forces acting on an object neutralize each other, the object attains a state of balance. This definition applies to the equilibrium of visual forces as well, with the center of balance positioned where these forces reach equilibrium ^[6]. On the other hand, Arnheim pointed out that in a square frame, the center of balance is determined primarily by the intersection of its four axes—namely, the center formed by the crossing of the two sets of parallel sides and the diagonals connecting opposite corners ^[7].

Given these two accounts, is there a contradiction between Arnheim's views?

2.2. Contradictions in the research of Arnheim and his followers

Regarding the first viewpoint, Arnheim believed that under the influence of perceptual forces, one can intuitively identify a center within a geometric space without the need for explicit demarcation ^[8]. According to perceptual experience, there exists a point in the image where the forces from all directions reach equilibrium—this is referred to as the balance center. Palmer et al. conducted an in-depth study of Arnheim's concept of the "center", finding that the perceived center does not have to be the exact geometric center of the image ^[9]. Instead, it can vary in shape and location depending on the arrangement of objects and spaces within the scene. The center of a given object, or a group of objects, may also deviate from its precise geometric or center of mass ^[9]. However, Palmer and colleagues' experiments were conducted under restricted conditions—namely, in frames without other stimuli. In such scenarios, the object itself inevitably attracts visual attention, and its orientation naturally leads to a preference toward the interior of the frame. Consequently, these findings do not fully address the issue of balance within an image.

As for the second viewpoint, Arnheim and his followers argued that symmetrical patterns are inherently the most balanced and tend to elicit preference. For instance, Palmer and Guidi found through their experiments that the intersection of vertical and horizontal axes of symmetry is consistently perceived as the most ideal position ^[10]. This result aligns with Arnheim's perspective: within a rectangular frame, certain positions are particularly well-suited for object placement. Guidi and Palmer noted that most two-dimensional visual artworks are comprised of elements organized within a rectangular frame. The aesthetic success of such compositions likely depends on the interplay between the frame's internal structure and the arrangement of constituent elements. Arnheim asserted that the structural skeleton provided by the frame acts as scaffolding for the composition, and that elements arranged along this structural skeleton appear more balanced and stable. However, these views and experiments are based on empty frames, where visual perception is not influenced by other stimuli, resulting in relatively simple aesthetic judgments. In reality, aesthetic judgments may also be influenced by personal cognition and sociocultural factors. When there are multiple stimuli within an image, visual attention is not necessarily drawn to the center of the frame.

2.3. Application of Arnheim's theory in painting appreciation

Arnheim argued that the dynamics of forces are equally evident in the appreciation of painting ^[7]. During visual appreciation, the viewer serves as a dynamic center, scanning the entire composition in order to perceive it as an integrated whole. The viewer then selects a particular point as the focal center, establishing a dominant center around which the elements of the composition achieve overall balance. Arnheim also suggested that the issue of balance can be explained in physical terms: in a state of equilibrium, the various forces acting on an object cancel each other out, and each physical entity possesses a center of gravity or a point of support ^[7]. Fundamentally, Arnheim's theory of balance is a method of arranging objects within the visual field to achieve visual balance and even elicit aesthetic preference.

Tyler, however, critiqued Arnheim's balance theory as lacking a scientific foundation, arguing that it is based on Gestalt psychologists' theories regarding neural force fields in the primary visual cortex ^[11]. McManus posited that Arnheim's understanding was originally influenced by Denman Ross, endorsing a more explicit physicalist methodology ^[5]. Generally speaking, while viewers are certainly influenced by perceptual forces when appreciating an image, and the perceived center tends to gravitate toward the equilibrium of these forces, this balance point does not necessarily coincide with the geometric center of the frame, nor even lie near it. The experience of a composition is subject to a variety of visual stimuli, of which the equilibrium of forces is just one factor. The effect of the golden ratio in pictorial composition also conforms to the principle of force equilibrium, and is even more consistent with the characteristics of human visual physiology.

3.1. The golden ratio and visual physiology

The emergence of subjective dynamic balance in aesthetic appreciation is rooted in the physiological structure of human vision. Studies in visual physiology have demonstrated the phenomenon of the dominant eye, also known as the leading or preferred eye, which refers to the eye that provides dominant input during binocular vision ^[12]. When the inputs from both eyes are fused, regional imbalances can affect the overall strength of binocular signals, and the relative dominance of each eye may shift across different parts of the visual field ^[13].

The fundamental reason for this phenomenon lies in the uneven distribution of cone photoreceptors in the human retina, with the fovea exhibiting the highest density ^[14, 32]. This arrangement has a significant impact on visual acuity, which peaks at the center of the retina and rapidly diminishes toward the periphery, forming a pronounced sensory gradient. Due to the concentration of cones at the center of the retinal neural structure, sensitivity is biased toward the center. Under the influence of the dominant eye, the center of the combined visual field does not coincide with the geometric or physical center of the perceived image ^[16].

3.2. The golden ratio and visual psychology

Due to the influence of the dominant eye, binocular vision (including both the visual field and visual acuity) undergoes complex integration and competition, eventually achieving equilibrium through adjustment ^[17]. Once this balance is reached, a common visual field emerges. Visual balance within an image is a matter of subjective perception and is influenced by a variety of factors; disruptions to the structure of balance can shift the perceived center of equilibrium ^[18].

The perceptual center of a composition refers to the average location where all viewers direct their gaze when observing a particular painting. This perceptual center does not necessarily coincide with the geometric center of the canvas ^[19]; rather, it functions as the "center of gravity" in the perception of composition. It also corresponds

to what Dondis described as the “felt axis,” which divides the composition into vertical and horizontal quadrants, or to the “balance center” described by Arnheim ^[7, 20]. In essence, the perceptual center of a composition is subjectively determined—it represents the comprehensive center of gravity of visual elements within the image and serves as the balance center of the composition.

When a visual field is projected onto an image, its center is inherently subjective, as is the visual field center itself and the visual center ^[21–23]. The center of the visual field does not always align with the objective center, as studies have demonstrated the existence of a subjective center ^[15]. The subjective visual field center generally coincides with the subjective visual center and the perceptual center of the composition. However, the objective center of the visual field, affected by physiological factors, may be displaced from the symmetrical center of the visual field. During the appreciation of an image, visual attention guides viewers toward the subjective visual center, giving rise to a sense of subjective visual balance.

3.3. Golden ratio composition and aesthetic preference

How do the combined visual, physiological, and psychological phenomena influence visual appreciation? This is closely related to the structure of visual physiology and the use of golden ratio composition. During visual appreciation, elements within an image act as aesthetic stimuli that capture visual attention—for instance, aesthetic images in a visual search task are able to attract attention more rapidly, thereby initiating processes of aesthetic processing and experience ^[24]. Eye-tracking studies have shown that, under the influence of visual attention, the process of aesthetic appreciation typically begins with visual scanning. In the initial phase of visual search, viewers first perform a general scan of the visual object; when a visual stimulus is encountered, they then focus on it or repeatedly scan it, ultimately fixating on a particular region of interest for detailed visual processing ^[25]. If the point of visual interest during this processing coincides with the center of the visual field (the balance center of the image), it is likely to evoke aesthetic pleasure.

So, where exactly is this subjective visual center, or balance center? Will placing the main stimulus at this balance center elicit aesthetic fluency?

Experiments by McManus and Weatherby demonstrated that people have a spatial preference for placing objects within a graphic area, with the golden ratio point being the most preferred horizontal position. Tyler, through systematic studies of Renaissance and later portraits, found that artists tend to place one eye horizontally at the center of the portrait and the other eye vertically near the golden ratio ^[11, 26]. According to Tyler, such compositional arrangements not only produce visual balance and beauty but also tend to evoke aesthetic preference.

3.4. Golden ratio composition and aesthetic processing

Compositional structures based on the golden ratio are highly compatible with human visual physiology, easily evoking aesthetic preference and processing fluency. But why does the golden ratio composition possess visual appeal, and does aesthetic experience in art have an objective, biological foundation?

Di Dio and colleagues investigated the aesthetics of the golden ratio using functional magnetic resonance imaging (fMRI). Their studies revealed a natural preference for golden ratio proportions and showed that objective features of an artwork, such as specific compositional parameters, can evoke distinct neural activation patterns in observers’ brains. When participants viewed images structured according to the golden ratio, regions such as the right insula, lateral occipital cortex, and prefrontal areas were activated, indicating an objective neural response to beauty ^[27].

De Bartolo further explored golden ratio aesthetics through eye-tracking methods, finding that participants generally exhibited a marked preference for golden ratio proportions. Visual fixations were concentrated in regions corresponding to the golden ratio within the image ^[4]. This phenomenon can be explained by the higher visual impact of compositional elements positioned near golden ratio points or points of interest; these elements more readily attract visual attention and elicit aesthetic preference ^[9].

4.1. The general process model of aesthetic processing

Golden ratio composition, owing to the structure of human visual physiology, readily induces aesthetic fluency. But what is the mechanism for the aesthetic processing of such compositions? This can be analyzed using aesthetic processing models.

Graf and Landwehr proposed a dual-process model of aesthetics—the Pleasure-Interest Model of Aesthetic Processing (PIA model) ^[28]. According to this model, aesthetic processing can be divided into automatic processing and controlled processing. Automatic processing is an unconscious, stimulus-driven process, whereas controlled processing is a conscious, purposeful process that allows for more detailed evaluation of the stimulus. If a stimulus draws sufficient attention from the observer, controlled processing may be triggered, overriding the automatic response. When a perceiver’s need for cognitive enrichment or capacity for stimulus processing motivates further engagement, complex, perceiver-driven processing will occur. This can lead to nuanced, fluency-based aesthetic judgments such as interest, boredom, or confusion.

According to the PIA model, viewers first engage in automatic processing of a golden ratio composition—a rapid, unconscious response to the aesthetic stimulus. If this configuration is readily accepted, it generates fluency-based aesthetic pleasure, which can then facilitate further detailed (controlled) processing of the golden ratio image. However, research by Graf and Landwehr suggests that the effect of stimulus fluency on attractiveness is fully mediated by feelings of aesthetic pleasure, particularly during automatic processing ^[29]. This would imply that, in the absence of pleasure or fluency, further controlled processing would not occur.

However, in reality, disfluent compositions do not necessarily produce displeasure; rather, viewers may repeatedly scrutinize the image and continue to process it based on their aesthetic experience, sometimes developing aesthetic interest, which then motivates further controlled processing.

4.2. Aesthetic processing of golden ratio balanced composition

During subjective visual appreciation, the overall organizational structure of visual balance readily attracts the viewer’s attention. Artists and art theorists commonly assert that the “induced structure” generated by a balanced configuration is established spontaneously by the visual system. This structure determines how the elements within a composition are visually scanned, interpreted, and evaluated ^[6]. The aesthetic use of the golden ratio represents a method, whether objective or subjective, by which individuals employ their physiological characteristics during aesthetic appreciation to achieve aesthetic pleasure. It exemplifies dynamic aesthetics and subjective visual balance.

Under the influence of attentional cues, the eyes explore target objects through both saccades (scanning) and fixations. During eye movements, scanning and fixation combine to support aesthetic judgment and processing. Molnar proposed that the initial fixations are guided by a cognitive need, satisfying viewers’ curiosity about the content of the image ^[30]. These so-called “cognitive fixations” globally explore the visual field, primarily directed by image features that attract visual attention. Once a global impression is formed, viewers engage in a detailed

examination of visual features related to possible syntactic and semantic relationships. Scanning represents holistic exploration, while fixation enables further processing; this cycle can last several seconds—or fractions of a second—and is characterized by rapid, reciprocal alternation. Within just a few seconds, viewers repeatedly scan the focal point and compare local details to the overall atmosphere^[31]. The processing of golden ratio compositions that possess subjective balance also demonstrates these characteristics of scanning and fixation.

5. Research summary and outlook

The aesthetic processing of golden ratio compositions exhibits the characteristics of dual processing. In aesthetic activities, under the guidance of visual attention, viewers first engage in scanning and fixation of target objects. When a golden ratio stimulus is encountered, automatic processing happens instantaneously. If the balance structure of the image aligns with the viewer's subjective sense of equilibrium—that is, if the subjective and objective balance centers coincide—the viewer experiences a sense of fluent beauty. Conversely, if the composition does not conform to the perception of visual balance, the aesthetic processing is hindered, prompting the viewer to actively seek new points of stimulation for further aesthetic reprocessing. The processing of golden ratio compositions is marked by a balanced structure that facilitates aesthetic fluency and pleasure. During the act of appreciation, the compositional rules and intentions embedded by the artist in the image are recognized by viewers through the mechanism of composition, enabling the enjoyment of beauty.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Akhtaruzzaman M, Shafie AA, 2012, Geometrical Substantiation of Phi, the Golden Ratio and the Baroque of Nature, Architecture, Design and Engineering. The Artist and Journal of Home Culture, 2012(1): 1–22.
- [2] Page T, Thorsteinsson G, Ha JG, 2010, Natural Sections in Product Design. International Journal of Contents, 2010(6): 71–82.
- [3] Fischler RS, 1981, On the Application of the Golden Ratio in the Visual Arts. Leonardo, 1981(14): 31–32.
- [4] De Bartolo D, De Luca M, Antonucci G, et al., 2021, The Golden Ratio as an Ecological Affordance Leading to Aesthetic Attractiveness. Psych Journal, 2021(11): 729–740.
- [5] McManus IC, Stover K, Kim D, 2011, Arnheim's Gestalt Theory of Visual Balance: Examining the Compositional Structure of Art Photographs and Abstract Images. I-Perception, 2(6): 615–647.
- [6] Arnheim R, 1972, Art and Visual Perception. University of California Press, Berkeley.
- [7] Arnheim R, 1988, The Power of the Center. University of California Press, Berkeley.
- [8] Arnheim R, 1954, Art and Visual Perception: A Psychology of the Creative Eye. University of California Press, Berkeley.
- [9] Palmer SE, Gardner JS, Wickens TD, 2008, Aesthetic Issues in Spatial Composition: Effects of Position and Direction on Framing Single Objects. Spatial Vision, 21(3): 421.
- [10] Palmer SE, Guidi S, 2011, Mapping the Perceptual Structure of Rectangles through Goodness-of-fit Ratings. Perception, 40(12): 1428–1446.

- [11] Tyler CW, 2007, Some Principles of Spatial Organization in Art. *Spatial vision*, 20(6): 509–530.
- [12] Porac C, Coren S, 1976, The Dominant Eye. *Psychological Bulletin*, 83(5): 880–897.
- [13] Dieter KC, Blake R, 2015, Sensory Eye Dominance Varies within the Visual Field. *Journal of Vision*, 15(12): 268.
- [14] Curcio CA, Sloan KR, Kalina RE, et al., 1990, Human Photoreceptor Topography. *Journal of Comparative Neurology*, 292(4): 497–523.
- [15] Larnicol S, 1995, Étude de L'organisation du Champ Perceptif en fonction des Données Configurationnelles du Stimulus et analyse physiologique des Principes Pouvant l'expliquer, thesis, Paris.
- [16] Doorn AJ, Ridder HD, Koenderink JJ, 2013, Picture Perception and Visual Field. *Proceedings of the SPIE 8651, Human Vision and Electronic Imaging XVIII*, 865119.
- [17] Zhang P, Bobier WR, Thompson B, et al., 2011, Binocular Balance in Normal Vision and Its Modulation by Mean Luminance. *Optometry and Vision Science*, 2011(88): 1072–1079.
- [18] Locher PJ, Gray SL, Nodine CF, 1996, The Structural Framework of Pictorial Balance. *Perception*, 1996(25): 1419–1436.
- [19] Nodine CF, Carmody DP, Kundel HL, 1978, Searching for NINA, in *Eye Movements and the Higher Psychological Functions*. Hillsdale, New Jersey, 241–258.
- [20] Dondis DA, 1973, *A Primer of Visual Literacy*. M.I.T. Press, Cambridge, 27.
- [21] Leavitt JA, 2021, Neuro-ophthalmology: Visual Fields. *Mayo Clinic Neurology Board Review*.
- [22] Psotka J, Lewis SA, King D, 1998, Effects of Field of View on Judgments of Self-Location: Distortions in Distance Estimations Even When the Image Geometry Exactly Fits the Field of View. *Presence*, 1998(7): 352–369.
- [23] Simpson DA, Crompton JL, 2008, The Visual Fields: An Interdisciplinary History I. The Evolution of Knowledge. *Journal of Clinical Neuroscience*, 2008(15): 101–110.
- [24] Rolke B, Stepper MY, Seibold VC, et al., 2019, Aesthetic Stimuli Attract Visual Spatial Attention. *Art & Perception*, 7(1): 1–30.
- [25] Yang GZ, Dempere-Marco L, Hu XP, et al., 2002, Visual Search: Psychophysical Models and Practical Applications. *Image and Vision Computing*, 20(4): 291–305.
- [26] Tyler CW, 1997, One Eye is Usually Centred Horizontally (and near the Golden Section Vertically) in Portraits over the Past 500 Years. *Perception*, 1997(26): 18.
- [27] Di Dio C, Macaluso E, Rizzolatti G, 2007, The Golden Beauty: Brain Response to Classical and Renaissance Sculptures. *PloS one*, 2(11): e1201.
- [28] Graf LK, Landwehr JR, 2015, A Dual-process Perspective on Fluency-based Aesthetics: The Pleasure-interest Model of Aesthetic Liking. *Personality and Social Psychology Review*, 19(4): 395–410.
- [29] Graf LK, Landwehr JR, 2017, Aesthetic Pleasure Versus Aesthetic Interest: The Two Routes to Aesthetic Liking. *Frontiers in Psychology*, 2017(8): 15.
- [30] Molnar F, 1981, About the Role of Visual Exploration in Aesthetics, in *Advances in Intrinsic Motivation and Aesthetics*. Plenum, New York, 385–413.
- [31] Kaspar K, König P, 2011, Viewing Behavior and the Impact of low-level Image Properties across Repeated Presentations of Complex Scenes. *Journal of Vision*, 11(13): 26.
- [32] Lewis A, Garcia R, Zhaoping L, 2003, The Distribution of Visual Objects on the Retina: Connecting Eye Movements and Cone Distributions. *Journal of Vision*, 3(11): 893–905.

Publisher's note

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

The Construction and Practice of Cross-Cultural Dialogue: A Study on the Communication Strategies of Foreign Bloggers on the Douyin Platform

Xi Zhang*

School of Marxism, Shanghai Maritime University, Shanghai 201306, China

**Authors to whom correspondence should be addressed.*

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 context of anti-globalization, short-video platforms represented by Douyin have restructured the paradigm of cross-cultural communication and formed a new order of “platform-based survival.” This study takes foreign bloggers on Douyin as the research object and uses interpretive qualitative research methods to analyze their video texts, interactive contexts, and cultural practices through cultural depth description, multi-source triangulation verification, and critical deconstruction. The study found that foreign bloggers, through a three-dimensional integration strategy of “cultural symbols — emotional narratives — social practices”, used cultural contrast to create attention anchors, family narratives to reconstruct identity, and professional experiences to deepen social connections to construct dynamic cross-cultural dialogue mechanisms. Their communication practices not only break the one-way “gaze of the other” but also break down cultural barriers through symbolic interaction, emotional resonance, and participatory communication, forming a “micro-infrastructure” for mutual learning among civilizations in the digital age. The study provides a theoretical and practical basis for breaking through the theory of “civilizational conflict”, protecting cultural diversity, and building a community with a shared future for mankind.

Keywords: Intercultural dialogue; Douyin platform; Dissemination strategy; Symbolic interaction; Civilizations learn from each other

Online publication: June 6, 2025

1. Introduction

In the context of de-globalization, short-video platforms represented by Douyin are redefining the paradigm of cross-cultural communication. Individualized and fragmented communication undermines the authority of traditional media, creating a new order of “platform-based survival”^[1]. Platform technology reconfigures the mechanism of cultural identity and builds a new field of dialogue in digital civilization. Foreign bloggers, as “digital nomads”, construct mixed cultural texts under the influence of algorithms, interactions, and business logic, creating Homi Bhabha’s “interstitial space”, which is neither a middle ground for cultural replication nor transplantation.

The study provides evidence for breaking through the “clash of civilizations” theory and a theoretical basis for the protection of cultural diversity in platform governance.

2. Research design and methods

This study adopts the interpretive qualitative research paradigm, with “cultural depth description” as the core methodology, revealing the deep meaning construction process of cross-cultural dialogue through systematic interpretation of foreign bloggers’ video texts, audience interactions, and cultural contexts. The research design emphasizes “contextual sensitivity” and “interpretation of subject experience” and explores the essence of phenomena through narrative analysis, semiotic deconstruction, and participatory observation.

2.1. Typicality selection of research subjects

Based on the principle of purposeful sampling, the criteria for selecting 10 bloggers focused on three dimensions: depth of cultural dialogue, narrative complexity, and social influence. Among them, cultural dialogue depth means that bloggers need to continuously participate in Chinese cultural practices, such as Tie Dan’er learning dialects and Rose making traditional cuisine; Narrative complexity means that the video content contains explicit cultural conflicts and adaptation processes, such as the collision of educational ideas between the Victorians; Social influence refers to the formation of a stable cross-cultural discussion community in the comment section, such as the “Foreigners’ View of the Spring Festival Travel Rush” topic by the Association for the Study of Foreigners.

Case diversity is achieved through three dimensions: nationality, content type, and fan size, avoiding the limitations of a single cultural perspective (**Table 1**).

Table 1. Basic information list of 10 foreign bloggers on the Douyin platform selected in this article

Blogger name	Nationality	Douyin fan count	Main style	Video main content
Foreigner Chris	Norway	19.827 million	Cultural contrast life contrast	A comparison of the differences between daily life in China and Norway
Foodie foreigner Tie Dan’er	America	15.747 million	Dialect funny family narrative	Dalian dialect teaching, family interaction, and Northeast folk customs
Rose	Uganda	14.977 million	Rural life food making	Rural life in China, traditional cuisine, and family collaboration
The Berni Family	Italy	11.41 million	Family interaction Cultural conflict	Everyday Transnational Marriages Mother-in-law and daughter-in-law relationships, parenting
Danny Rui	Latvia	14.1 million	Study of film and television performance culture	Participating in Chinese TV dramas Learning Idioms
Old Wang is in China	Iraq	11.328 million	Food exploration	Social observations on food experiences across China
Ibo	Somalia	11.11 million	Localization of dialect comedy	Folk participation in variety shows
The Victorians	Russia	10.476 million	Educational conflict Cultural contrast	Differences between Chinese and Western education Children’s growth Record
Foreigners Research Society	Multinational	8.191 million	Cultural experience Social observation	Career experience Discussion on social issues
IShowSpeed	America	4.808 million	Customs of various countries	Cultural display

2.2. Multi-source triangulation for data collection

To enhance the validity of the study, construct three types of qualitative data: core text, activity context, and cultural background. For the core text data, the study plan to extract 20–30 representative videos from each blogger in the last three years, with priority given to those with over 1 million views and more than 5,000 comments and interactions, and record non-verbal symbols in the videos, such as the expression changes of Lao Wang when he visits the store; In terms of context of interaction, this study pays particular attention to “long article comments” and “cross-cultural debates.” Also, pay attention to collecting oral explanations from bloggers in live streams and fan groups; In terms of cultural background, this study focuses on supplementing the bloggers’ motives for coming to China and their cultural adaptation process through autobiographies and media reports, and comparing the narrative frameworks of similar local bloggers.

2.3. Analysis method: Interpretive meaning mining

This study employs contextualized interpretation and critical deconstruction to explore the multi-dimensional meanings of video text, audience interaction, and cultural practice layer by layer, from surface narrative to deep cultural logic. First, deconstruct the cultural tension in the video based on narratology and cross-cultural conflict theory, track the dynamic process of “culture shock — adaptation — reconstruction” through narrative arc analysis, and analyze the blogger’s identity positioning strategy; Secondly, using Roland Barthes’ symbol stratification theory, critically interpret the sensory presentation of visual, linguistic and behavioral symbols to reveal the construction mechanism of the “naturalization” authority of symbols; Third, examine the meaning negotiation among bloggers, audiences and algorithms in combination with online ethnography, and analyze the emotional resonance between rhetorical strategies in the comment section and cultural events; Finally, embed a reflective perspective to avoid the trap of cultural essentialism by comparing the blogger’s own account, audience feedback and third-party reports, and reflect on the cognitive limitations of the researcher as a native observer.

3. Analysis of the dissemination strategies of foreign bloggers on Douyin

The dissemination strategy of foreign bloggers on Douyin is essentially a three-dimensional integration of “cultural symbols — emotional narratives — social practices.” By creating attention anchors through cultural contrasts, reconstructing identities through family narratives, and deepening social connections through professional experiences, they not only monetize the traffic of individual IPs but also promote mutual learning among civilizations at the micro level.

3.1. Bidirectional coding of cultural contrast and emotional resonance: From symbolic conflict to meaning sharing

Foreign bloggers break the cognitive inertia of the audience by constructing “cultural symbol contrasts”, stimulating the audience’s curiosity, and creating a double visual and psychological impact ^[2]. For instance, Norwegian blogger Chris, a foreign blogger, has surpassed 30 million views in a single video titled “Norwegian vs. Chinese Breakfast Comparison”, which juxtaposes cold Nordic foods like rye bread and salmon with Chinese hot porridge and fried dough sticks, using the differences in tableware and ingredients to inspire cultural associations of “cold and warmth” among viewers. Such content satisfies the audience’s curiosity about heterogeneous cultures through exaggerated symbolic contrasts and enhances the dissemination efficiency of the content through contrast tension.

The deeper contrast strategy is reflected in “the recreation of cultural symbols”^[3]. For example, Ugandan blogger Rose combined traditional African weaving techniques with Chinese bamboo weaving skills to showcase “African-style Chinese bamboo baskets” in her video, which retain the vivid colors of Africa while incorporating the delicate structure of Chinese bamboo weaving. This “cross-cultural symbolic hybridization” not only creates a visual impact but also hints at the possibility of cultural integration.

While creating conflicts, bloggers make up for the alienation that cultural differences may cause through emotional narratives. The Iraqi food blogger “Old Wang in China” shed tears after being comforted by a neighbor saying “There’s no need to be afraid in China” in a video about “fear of firecrackers during the Spring Festival”, and heartwarming comments like “Welcome to become a new Chinese” flooded the comment section. This narrative arc, from “culture shock” to “emotional shelter”, transforms individual anxiety into collective identity, achieving a “soft landing” in cross-cultural communication.

The deep logic of emotional resonance lies in the construction of “empathetic communication.” For instance, when documenting the conflict in parenting concepts between China and Russia, the Victorian couple deliberately inserted scenes of their children crying to evoke a general resonance among the audience about “educational anxiety.” In the comment section, supporters of “Chinese tiger moms” and “Western freedom” debated, but eventually reached a reconciliation under the emotional consensus that “it’s all for the good of the children.” This three-part narrative of “conflict — reflection — consensus” effectively reduces cultural confrontation^[4].

Bloggers construct dual-meaning channels through cultural symbol coding, such as slang terms like “must-land” and “maliudi” in the Northeastern dialect skit of Somali blogger Ibo, and emotional value coding, such as “Victoria couple” documenting reconciliation scenes after conflicts in parenting concepts between China and Russia. The audience can perceive cultural differences at the symbolic level and resonate at the emotional level, thus breaking through the one-way communication limitations of the “other gaze”^[5].

3.2. Family narrative and localization integration: From cultural collision to identity reconstruction

In the video showcases of foreign bloggers on Douyin, the family scene is, to some extent, a micro-laboratory for cultural adaptation. The home is the core field for cross-cultural bloggers to showcase the process of cultural adaptation. The Italian blogger “The Beni family” has visualized cultural conflicts as concrete events through a series of “Cross-border mother-in-law and Daughter-in-law parenting battles” — the mother-in-law insists on taking traditional Chinese medicine baths, and the daughter-in-law advocates Western medical care. The video showcases the gradual integration of cultures through a narrative of their debates, compromises, and joint development of a “blend of Chinese and Western parenting”. Such content has not only received over 200 million views, but also sparked in-depth discussions in the comment section about the differences in parenting views between the East and the West. A similar example can be seen in Rose’s “African Family Collaborative Tea Making” video, where the husband splits firewood, the children pick, and the mother-in-law light the fire in collaboration, which not only showcases the family ethics of rural China but also incorporates the collective labor tradition of Uganda, creating a visual metaphor of “transnational family communities”.

The unique value of family narratives lies in their “everyday nature” and “authenticity”. The “clumsy sincerity” of the Bernys in their New Year video of bowing in Tang suits, though awkward in their movements, instead strengthens the audience’s recognition of their cultural identity. This “imperfect integration” strategy breaks away from the traditional “expert-like” didactic stance in cross-cultural communication and brings the

audience closer as “learners”^[6].

Dialects and regional symbols have become key tools for identity reconstruction in the localization strategy. American blogger Tie Dan’er, with his “Dalian Dialect Level 10” profile, integrates dialect teaching into the daily life of the city. In his work “Tie Dan’er’s Visit to the Market”, he bargains with vendors in Dalian’s characteristic “oyster flavor” dialect, interweaving “Northeastern humor” such as “How is this cabbage selling?” Bigger than my face!” And received high praise from Chinese fans. Such content, through the localization of language, eliminates the sense of distance from foreign identities and creates a “down-to-earth” communication image. A deeper level of localization is reflected in the deep engagement with regional culture. Somali blogger Ibo, for example, is not only proficient in the northeastern Chinese dialect but also participates in folk activities such as “pig slaughtering feast” and “Yangko dance” in his videos. Through his hands-on cultural practice, he has transformed himself from an “observer” to a “participant”, with comments in the comment section saying “This foreigner knows the rules better than the locals” marking the audience’s recognition of his “quasi-local identity.”

3.3. Deep engagement in professional experience: From social observation to value co-construction

Through career experience, foreign bloggers reveal the logic of how Chinese society operates as “participants” rather than “observers.” The “12 Hours Delivery Man” series by the Foreigners Research Association, which records details such as fines for late delivery and exhaustion from climbing stairs, has been viewed over 100 million times. The video not only shows the hardships of the industry but also analyzes through mechanisms such as algorithmic dispatching and user ratings, sparking a public discussion on “the platform economy and individual survival.” A similar practice can be seen in “Old Wang in China” “Night Market Vendor Experience” — from bargaining to buying goods to communicating with urban management officers, presenting a complete micro and small business ecosystem, the comment section is filled with exclamations of “So foreigners know the rules of the business world too.”

The deep value of the professional experience lies in the “de-spectacle” of social observation. For example, the Victoria couple documented the collectivist educational model in China’s early childhood education industry through the “Kindergarten Teacher Experience” video, contrasting it with individualized education in Russia. This presentation of cultural differences based on professional scenarios is more persuasive than abstract cultural theories^[7].

Career experience is not just a material for content, but a vehicle for transmitting cross-cultural values. When making traditional delicacies, Rose often invites villagers to participate. For example, Grandma Wang, 78, instructs Rose on fermenting rice wine. At the end of the video, Rose is marked “Inheritor of the craft: Wang Xiulan”, which respects local wisdom and builds her identity as a “cultural shaper.” The Victorians, on the other hand, transformed one-way communication into two-way consultation by inviting viewers to vote on the way of education through a live broadcast of the “China-Russia Teachers’ Debate Competition”, which attracted more than 500,000 people to participate in decision-making in a single live broadcast. This “community co-creation” model breaks the one-way output logic in cultural communication and creates a value chain of “traditional skills — international bloggers — global audiences.” The “Spring Festival Travel Experience” video work by the Foreigners Research Association is highly constructive. By documenting realities such as difficulty in getting tickets and crowded carriages, it concludes with the collective sentiment of “going home no matter how far”, achieving a balance between social observation and value transmission.

4. Cross-cultural dialogue mechanism: A practical path for breaking down cultural barriers

The essence of cross-cultural dialogue mechanisms is a dynamic negotiation process of symbols, emotions, and power. Foreign bloggers dissolve cultural boundaries through the creative recombination of symbols, build a foundation of trust through emotional resonance, and democratize the production of meaning through participatory communication. This mechanism not only reshapes individual cultural identities but also gives rise to new models of mutual learning among civilizations within the platform ecosystem.

4.1. Symbolic interaction: Conflict resolution and recombination innovation of cultural elements

Foreign bloggers create new forms of cultural expression by deconstructing the established meanings of traditional cultural symbols^[8]. In his “Nordic Minimalism vs. Chinese Fireworks” series, Norwegian blogger Chris Foreigner mixed Norwegian minimalist home furnishings with Chinese redwood furniture. In the video “Christmas Tree meets Red Lantern”, he wove a Chinese knot with Nordic pine branches, and the comment section was met with exclamations of “So simplicity and liveliness can coexist.” This recombination of symbols breaks the binary opposition of “Western modernity — Eastern tradition” and creates a third space symbol system. A similar practice can be seen in blogger Yibo’s “A New Interpretation of Northeast Folklore”, where he wore a dogskin hat and held an African drum while participating in the winter fishing at Chagan Lake in Jilin Province, blending Manchu fishing and hunting chants with African rhythms. The video was praised as “the right way to mix and match cultures.”

Language is not only a tool for communication, but also a medium for cultural negotiation. Deep language innovation is reflected in the Victorian couple’s Sino-Russian glossary of parenting terms, which translates “tiger mom” as “education commander” and “free-range” as “free explorer”, building a bridge of understanding in semantic conversion. When cultural symbols cause conflicts, bloggers often use dynamic adaptation to achieve meaning transformation. The process of correcting symbols from “misreading” to “rectifying names” turns cultural conflicts into educational opportunities^[9].

4.2. Emotional connection: A trust-building mechanism for empathetic communication

Foreign bloggers on the Douyin platform generally evoke emotional resonance through vulnerability narratives. They build emotional alliances by exposing the predicaments in cultural adaptation. In the “1001 Nights of Transnational Marriages” series, “The Berni Family” documents the helplessness of a Chinese husband when facing his first transnational mother-in-law and daughter-in-law conflict - the camera captures him smoking on the balcony late at night and using Google Translate to look up the definition of “filial piety”. This intimate display of vulnerability breaks the perfect image of the “cultural adaptor” and resonates strongly with the transnational marriage community.

By activating the cultural memory of the audience, the blogger achieves a deep emotional connection. In the project “Childhood in China for Foreigners Born in the 1990s”, the Association for the Study of Foreigners allowed Israeli blogger Gao Yousi to experience millennial memories such as rolling hoops, eating spicy strips, and copying lyric books. When he found the DVD of “The Story of Yingxian” in a flea market and blurted out, “Your Emperor, do you still remember Xia Yuhe by Daming Lake?” It instantly ignited the emotional breakpoint of Chinese 80s and 90s viewers, with comments flooding the screen with “This is my youth”^[10]. This transnational sharing of intergenerational memories elevates individual experiences to collective nostalgia, attracting 420,000

people to participate in content co-creation.

Foreign bloggers strengthen emotional bonds through ritualized interactions. In the video “I Celebrate the Little New Year in Dalian,” American blogger Tie Dan’er not only participated in the house cleaning and the Kitchen God worship, but also innovatively designed “cross-border kitchen candy”, replacing the filling with peanut butter. This new and old fusion of ritual remakes both respect tradition and reflect cultural identity.

4.3. Participatory communication: Meaning co-creation empowered by the audience

Bloggers make audiences co-conspirators in cultural dialogue by opening up their content creation rights. The “Foreigners’ Research Association” launched a topic called “What do Foreigners think?” inviting users to contribute their perspectives, such as a Canadian fan’s photo of the “bus seat giving controversy”, which sparked more than 3,000 systematic debates between Chinese and foreign audiences on “etiquette differences.” This decentralized content production breaks the vertical relationship of “blogger — audience” and forms a distributed dialogue network, achieving a paradigm shift from “cultural transmission” to “cultural co-creation.”

The platform algorithm serves as an accelerator for the diffusion of dialogue. When Ibo launched the “Northeastern Dialect Crash Course”, Douyin automatically pushed it to the “Dialect Protection” and “Cultural Inheritance” tag pools, attracting linguists to participate in the discussion. The in-depth analysis video of @Dialect Lao Zhang, a researcher at the Chinese Academy of Social Sciences (with 2.1 million views), resonates academically with the blogger’s content. This “grassroots—elite” algorithm-level interaction enables cultural dialogue to move beyond the entertainment level and into the public discourse space. It is worth noting that Rose’s Ugandan fans have reposted her videos on TikTok and added Swahili subtitles, creating a cultural relay chain from China to East Africa.

The study reveals that the cross-cultural practices of foreign bloggers have gone beyond mere content dissemination and evolved into a “miniature infrastructure” for mutual learning among civilizations in the digital age. Its value lies not only in resolving the “clash of civilizations” predicted by Huntington, but also in providing a concrete path for building a community with a shared future for mankind through the organic integration of “everyday dialogue” and “ritualized performance.”

Disclosure statement

The author declares no conflict of interest.

Reference

- [1] Zhou SM, 2023, Research on Chinese Short Videos by Foreign Bloggers, thesis, Sichuan International Studies University.
- [2] Zheng WB, Wang PL, 2024, Research on Cross-border Communication of Overseas Chinese Bloggers on Douyin Short Video Platform. *Research on the History of Overseas Chinese*, 2024(1): 19–27.
- [3] Yan HJ, 2023, The Cultural Dimension of the “Bridge Group”: Research on the Content Production and Dissemination of Short Videos by Foreign Internet Celebrities, thesis, Xi’an International Studies University.
- [4] Wu YQ, 2023, Research on the Content Logic and Social Practice Discourse of Short Videos of Transnational Couples, thesis, Xi’an International Studies University.
- [5] Nie KX, Yang SY, Ma M, 2023, Embodied · Space · Empathy: An Analysis of the Logic of Short Video

Dissemination from the Perspective of Cross-Cultural Communication. *New Observations on Media Convergence*, 2023(2): 14–21.

- [6] Wu JF, 2022, Research on the Characteristics and Roles of Cross-cultural Communication of Foreign Internet Celebrities, thesis, Hebei University of Economics and Business.
- [7] Zheng H, 2021, Research on the Dissemination of Chinese Culture Based on Self-Media Short Videos of Foreigners in China, thesis, Bohai University.
- [8] Wu SH, 2023, Research on the Cultural Heterogeneity of “Foreign Internet Celebrity” Short Videos under the Theory of Cultural Adaptation, thesis, Nanchang University.
- [9] Liu LY, 2024, The Current Situation and Path Prospect of Chinese Cultural Dissemination Based on “Self-Media” Short Videos. *All-media Exploration*, 2024(10): 36–38.
- [10] Li MY, 2024, Research on the Construction of the Chinese Image of Others and Their Overseas Communication Effects: Based on the Analysis of Short Video Comment Texts of the YouTube Account “Foreigners Research Association”. *Science and Technology Communication*, 16(11): 158–162.

Publisher’s note

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

Research on the Design of New Media Products for Barrier-Free Life of Visually Impaired People: Taking the App “Touchpoint Life” as an Example

Jiayi Shu¹, Dan Ni^{1,2*}

¹City Institute, Dalian University of Technology, Dalian 116600, Liaoning, China

²Pablo Borbon Campus, Batangas State University (BatStateU), Philippines’ National Engineering University (The NEU), Batangas 4200, Philippines

**Author to whom correspondence should be addressed.*

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 paper focuses on the “Touchpoint Life” app designed specifically for the visually impaired. The study deeply analyzes its functional settings for different visual impairment conditions and its diverse applications of AI technology. By sorting out the life difficulties faced by the visually impaired and the limitations of existing assistive tools, the unique value and innovation of the “Touchpoint Life” app are highlighted. The aim is to provide solid theoretical and practical references for improving the quality of life of the visually impaired and promoting the development of related fields.

Keywords: Visually impaired people; Assistive app; Touchpoint Life; Personalized functions; AI applications; Life convenience

Online publication: June 6, 2025

1. Introduction

In today’s digital society, blind individuals face significant challenges using smart devices, limiting their independence and opportunities ^[1]. “Touchpoint Life” leverages AI to provide personalized and accessible assistance, aiming to bridge the digital divide and enhance the quality of life for the visually impaired ^[2].

2. The current situation and needs of visually impaired individuals

2.1. Current situation

2.1.1. Travel difficulties

Visually impaired individuals face many challenges when traveling, including cluttered blind paths and insufficient guide dogs. Public acceptance of guide dogs is low, and the rights of visually impaired individuals to bring guide dogs are often not respected ^[3]. These issues highlight society’s neglect of their needs ^[4].

2.1.2. Information access barriers

Visually impaired individuals use mobile phones by placing the speaker near their ears, listening to audio cues, and using finger gestures to navigate. Single clicks select and read information, while double clicks activate functions. They often require about three times more clicks than sighted users for the same tasks.

2.1.3. Social limitations

In traditional and virtual social settings, blind individuals face barriers in understanding emotions and intentions due to the lack of visual cues. Mainstream social platforms are unfriendly to the blind, as their design relies heavily on visual elements, making basic operations like sending messages or adding friends extremely difficult.

2.2. Thinking based on the current situation and user needs

2.2.1. Functional requirements

Blind individuals have diverse software needs for daily life, including navigation with real-time traffic and obstacle detection, text recognition for information acquisition, and voice-interactive shopping for self-care.

2.2.2. Demand for ease of operation

Since blind people have limited vision, software design should focus on simplicity and clear voice guidance, supporting touch and voice interactions to reduce steps and ensure ease of use ^[5].

2.2.3. Personalization needs

Blind individuals have varying personalization needs due to differences in residual vision, habits, and scenarios. Those with weak vision need adjustable font sizes and contrast, while fully blind users focus on voice interaction. Operation preferences include gestures, shortcut keys, or voice commands ^[6]. Office users seek integration with productivity tools, while students need learning support. Customizable modules address these diverse needs.

3. Interface design and multi-dimensional innovation of “Touchpoint Life”

3.1. Interface design

For visually impaired individuals, a friendly and user-friendly interface design is crucial for their smooth use of the app. The “Touchpoint Life” app focuses on the following key elements in its interface design:

3.1.1. Simplicity, usability, and consistency

When visually impaired individuals use the app, they find it difficult to process complex visual information as easily as those with normal vision. The interface elements of the “Touchpoint Life” app have been carefully simplified, removing redundant decorative elements and complex visual effects. The design follows the principle of being easy to understand and operate, aiming to closely match the cognitive habits and operational capabilities of visually impaired individuals ^[7]. This reduces their learning costs and, to facilitate the memory and use by visually impaired users, the app should maintain a high degree of consistency in its application design style and operational logic.

3.1.2. High color contrast

Color contrast is crucial for visually impaired individuals to clearly distinguish interface content. The app deliberately uses high contrast color combinations to enhance visibility. During the color selection process,

strict color accessibility tests were conducted to ensure that even users with weaker vision can easily distinguish different interface elements.

3.1.3. Adding accessible labels

At the source code level of the app, adding detailed text descriptions for icons and images is a key step to ensure that visually impaired individuals can fully obtain interface information.

3.2. Design innovation

3.2.1. Integrating multimodal interaction

Breaking away from the traditional single interaction mode of apps, the “Touchpoint Life” app innovatively integrates multiple sensory input and output methods such as voice, touch, and hearing, creating a new interactive experience for visually impaired users.

3.2.2 Functionally targeted customized services

Fully recognizing the individual differences among visually impaired individuals, different modes are set based on visual residual degree, preferred functions, and living habits.

3.2.3 AI-driven community ecological function model

By leveraging AI technology, the app conducts in-depth analysis of multi-dimensional data such as user usage habits, operation behavior trajectories, and function usage frequencies ^[8]. It can intelligently understand users’ preferences and needs, and precisely recommend relevant functions and services, establishing an AI-driven community ecological function model to build an exclusive social space for visually impaired individuals, encouraging mutual assistance and friendly communication among users, and forming a positive social cycle.

3.2.4. API and ecosystem construction

With a focus on long-term development and building a comprehensive service ecosystem for visually impaired individuals, the “Touchpoint Life” app actively seeks commercial cooperation and opens API interfaces. Through cooperation with various related service providers, hardware manufacturers, etc., it integrates multiple resources and extends the app’s functions and services to broader fields, achieving multi-domain interconnection.

4. Function settings and targeted features of Touchpoint Life

4.1. Login settings

In the process of meeting the needs of visually impaired people, login, as the initial step of using the app, is of no doubt of great importance. Therefore, the developers provide two different login methods: voice login and manual login. The developers fully consider the operational capabilities and usage preferences of different visually impaired groups.

4.2. Communication and call function

In the communication and call function, the Touchpoint Life app supports both voice input and text input. For those completely blind people, voice input is more convenient. For visually impaired people with some vision, text input can also be operated ^[9]. This increases the flexibility of the function and takes into account the usage habits and scene requirements of different users.

4.3. Voice social function

Traditional social platforms have limited friendliness towards visually impaired people. Based on the special needs of visually impaired people in social aspects and the relatively limited social scope, the “Touchpoint Life” app innovatively creates an exclusive social circle for visually impaired people. Users can freely share their lives through voice or text. For the content published by users, dual expression modes of voice and text are set.

4.4. Community function for daily life

The community function of Touchpoint Life aims to build an online communication platform for visually impaired people for information sharing and mutual assistance. Relying on voice interaction technology, it facilitates various aspects of users’ daily lives, forming a closely connected and positive community atmosphere, and effectively improving the overall quality of life.

4.5. Map navigation function

Considering the different visual conditions of visually impaired people, we have designed three types of maps: Map 1, Map 2, and Map 3, to provide highly targeted services (**Figures 1, 2, and 3**)^[9].

Map 1 is mainly for fully blind and visually impaired people. These users have completely lost their visual perception ability. In Map 1 mode, the app uses advanced voice recognition and intelligent route planning technology. Users only need to hold the device and say the destination, and the system can quickly recognize it, and comprehensively consider factors such as distance, obstacle distribution, etc., to plan the optimal route, and provide real-time information on distance, obstacles ahead, traffic light status, and various emergencies, providing users with comprehensive voice guidance.

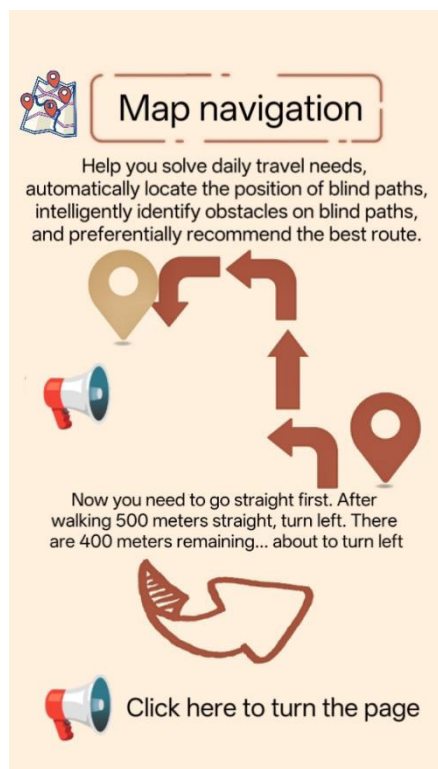


Figure 1. Concise navigation effect



Figure 2. Precise navigation effect

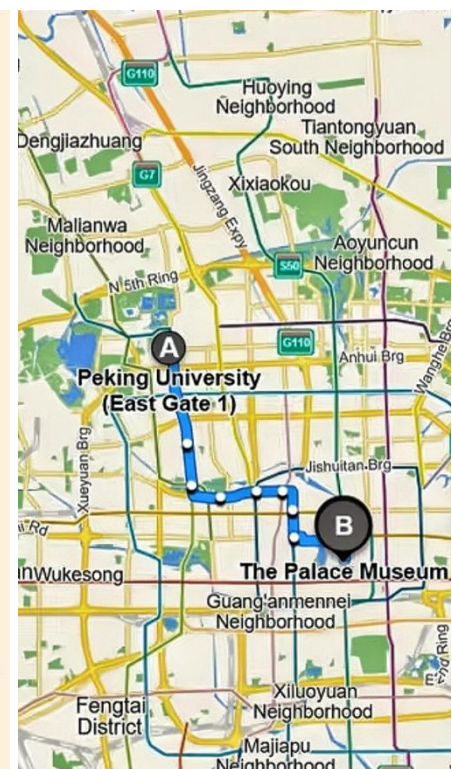


Figure 3. Bouncing map effect

Map 2 is designed for people with poor visual acuity or other low visual clarity issues. By using high-contrast color combinations and enlarged icons, it effectively enhances the readability of the map information. At the same time, the interface of the map is optimized and streamlined, filtering out unnecessary and irrelevant information, while retaining the core routes and key landmarks. This enables users to view and understand the map content more attentively and conveniently, thus facilitating the completion of navigation.

Map 3 is mainly designed for people with color blindness or other visual impairments who have some degree of visual ability. In this mode, the app adopts a unique pulsating icon design. These icons have distinct dynamic features and can stand out in the map interface, facilitating users to quickly and accurately identify and locate the target position. This effectively compensates for the visual recognition deficiencies of these users and helps them efficiently utilize the map functions.

4.6. Camera and album functions

The camera function has a special purpose for visually impaired individuals. Besides the traditional function of taking photos and framing scenes, it can also capture specific scenes or objects through voice commands. For those with poor vision or color blindness, the camera in the app can be used to record daily life. For users with more severe vision problems, it also has its specific functions, such as in situations requiring identity verification, users can take photos through voice commands to capture ID cards. The album function can manage photos through voice descriptions, making it convenient for visually impaired people to record important moments in their lives.

5. Conclusion

The “Touchpoint Life” app, with its targeted function settings for various visually impaired individuals, holds significant importance in improving the lives of visually impaired people. It not only resolves numerous issues faced by visually impaired individuals when using smartphones, but also provides strong assistance for them to integrate into social life^[10].

With the continuous development of technology, it is hoped that similar assistive applications can receive more promotion and improvement, further enhancing the quality of life for visually impaired people and promoting “the goodness of technology.”

Funding

The 2024 Class A Project of the University-level College Students’ Innovation and Entrepreneurship Training Program in Liaoning Province, titled “Touchpoint Life”: Design of an Intelligent Assistive App for Visually Impaired People (Project Number: X202413198009)

Disclosure statement

The authors declare no conflict of interest.

Author contributions

Dan Ni: provided guidance and support for the design of the project and the writing of the article.

Jiayi Shu: completed the design of the project and the writing of the article.

References

- [1] Zhao N, 2022, Mutual Promotion and Integration: Technological Empowerment and the Media Life of the Visually Impaired — Taking the Use of Smartphones by the Visually Impaired as an Example. *Media*, 2022(6): 71–72.
- [2] Chen Q, Yan XT, 2023, Bridging the Digital Disability Divide: Dilemmas and Breakthroughs in the Digital Survival of the Visually and Hearing Impaired. *Modern Communication*, 2023(9): 134–139.
- [3] Chen G, Li QK, 2023, In the Technological Presence: Digital “Blind Paths” and “Blind Sticks” as Infrastructure and the Urban Life of the Visually Impaired. *Journal of Journalism*, 2023(5): 49–60.
- [4] Liu F, Zhou T, 2022, Research on Barrier-Free Interaction in Digital Community Design. *Journal of Human-Computer Interaction*, 15(2): 112–125.
- [5] Huang LY, Liu TL, 2017, Research on the Interactive Innovation Design of Barrier-Free Products for Visually Impaired People. *Packaging Engineering*, 38(24): 108–113.
- [6] Tang Z, Jiang H, 2011, Research on the Barrier-Free Interactive Design of Electronic Products for the Elderly. *Packaging Engineering*, 32(14): 134–136.
- [7] Yang SQ, 2024, VisionZip: Longer is Better but Not Necessary in Vision Language Models. <https://arxiv.org/abs/2412.04467>.
- [8] Cao D, Hao WL, 2020, Research on the Needs Assessment of the Social Integration of Visually Impaired People — Based on Bradshaw’s Four-Fold Classification of Needs. *Journal of Changchun University*, 30(5): 110–114.
- [9] Chen J, 2024, Fudan University Research Team Develops AI Large-scale Model to Help Visually Impaired People “See” the World. *China News Network*. <http://finance.people.com.cn/n1/2024/0303/c1004-40187720.html>
- [10] Yao HJ, Huang JX, Wu WH, 2024, Mulberry: Empowering MLLM with O1-like Reasoning and Reflection via Collective Monte Carlo Tree Search. <https://arxiv.org/abs/2412.18319>

Publisher’s note

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

Research on the Contradictions and Coordination in the Integration of Agriculture, Culture, Sports, and Tourism Industries

Zongxu Huang, Tong Wei, Yaohan Tang*, Yi Zhou

Hunan Agricultural University, Changsha 410128, Hunan, China

**Author to whom correspondence should be addressed.*

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 rapid development of the social economy, the integrated development of agriculture, culture, sports, and tourism industries has become an important means to promote rural revitalization and regional economic growth. Against this background, this study analyzes the internal mechanism of the integration of agriculture, culture, sports, and tourism industries in detail, and proposes corresponding solutions based on the contradictions and challenges faced in the current integration process, hoping to provide some reference and assistance for the high-quality development of rural industries.

Keywords: Industrial integration; Agriculture, culture, sports, and tourism; Contradiction coordination

Online publication: June 6, 2025

1. Introduction

In the current era of rapid economic transformation, industrial integration, as an emerging economic development model, is changing the pattern of traditional industries at an unprecedented speed and scale. The integration of agriculture, culture, sports, and tourism industries, as an important part of this trend, not only provides new impetus for the transformation and upgrading of agriculture, culture, sports, and tourism industries but also injects new vitality into the implementation of the rural revitalization strategy and the diversified development of the regional economy. However, how to effectively address the problems existing in the promotion of the integration of agriculture, culture, sports, and tourism industries has become a primary issue that needs to be considered ^[1].

2. The internal mechanism of the integration of agriculture, culture, sports, and tourism industries

The integration of agriculture, culture, sports, and tourism industries is a complex interactive process involving

the mutual penetration and integration of the four industries of agriculture, culture, sports, and tourism. This process relies on resource integration, breaking down industrial boundaries to form a new industrial system and product formats, improving resource utilization efficiency, and promoting coordinated development. Through function recombination and value innovation, it constructs a new value chain, increases added value, creates an industrial superposition effect, and achieves a double-promotion of economic and social benefits. This process requires dynamic optimization, involving in-depth integration and adjustment in many aspects, and requires the active participation of all parties on the basis of equality, mutual benefit, and coordinated development. The in-depth integration of culture and tourism is an important foundation for this. It enriches the connotation of tourism, improves its level, enhances its charm, and at the same time provides a platform for cultural dissemination and exchange ^[3].

3. Problems existing in the integration of agriculture, culture, sports, and tourism industries

3.1. Lack of holism and depth in planning and design

At the planning and design stage, there is a lack of overall consideration among various industrial sectors, and an organic and unified whole has not been formed. The four industries of agriculture, culture, sports, and tourism act independently, and there is a lack of coordination in planning and layout, resulting in a blunt connection between various elements within the project, which fails to provide a smooth tourist experience. For example, in some rural tourism projects, the agricultural picking areas, cultural exhibition areas, and sports fitness areas are scattered. Tourists need to shuttle frequently between different areas, consuming a lot of time and energy, which greatly reduces tourists' satisfaction and revisit rate. In addition, there is also a problem of insufficient depth in the planning and design of the integration of sports and tourism ^[4]. Some places simply hold some sports events or build some sports facilities without combining sports activities with tourist landscapes and cultural experiences to form distinctive sports tourism products. For instance, although some mountainous areas have beautiful natural landscapes, the developed sports projects are only ordinary mountain climbing and hiking, lacking the exploration and innovation of local characteristic sports culture, and thus unable to attract more sports enthusiasts to experience ^[5].

3.2. Imperfect infrastructure and service system

The relatively backward infrastructure construction in rural areas is an important factor restricting the integrated development of the "agriculture, culture, sports, and tourism" industries. In many rural areas, the roads are narrow and in poor condition, and public transportation is underdeveloped, causing great inconvenience to tourists' travel. Especially in some remote mountainous areas or during peak tourist seasons, problems such as traffic congestion and difficult parking are particularly prominent, seriously affecting tourists' travel experiences. In addition, the public health facilities in rural areas are often insufficient. For example, the number of public toilets is small and the sanitation conditions are poor, making it difficult to meet the basic needs of tourists. At the same time, the information infrastructure, such as network communication, is also imperfect, resulting in tourists' difficulty in enjoying convenient Internet services in rural areas, which affects tourists' satisfaction and revisit rate ^[6].

3.3. Insufficient marketing and promotion efforts and single means

Insufficient marketing and promotion efforts are evident in "agriculture, culture, sports, and tourism" projects.

This is mainly restricted by funds, talent shortages, and a lack of awareness, resulting in insufficient publicity investment and a lack of systematic strategies. Despite rich local resources, profound cultural heritage, unique sports activities, and beautiful tourist landscapes, due to the above-mentioned limitations, the market popularity has not been widely promoted through the media, and it is difficult to attract tourists. At the same time, the lack of cooperation with tourism agencies and online platforms further reduces the project's exposure.

Current marketing means are limited to traditional advertisements, posters, etc., lacking innovation and interactivity, and it is difficult to meet the diverse needs of tourists in the digital age. Emerging media such as social media, short videos, and live-streaming have not been fully utilized, making it difficult to accurately reach the target audience. In addition, the lack of a tourist interaction and feedback mechanism limits the marketing effect, and it is difficult for project parties to adjust and optimize in a timely manner ^[8].

4. Practical paths for the integration of agriculture, culture, sports, and tourism industries

4.1. Developing characteristic sports tourism projects

The integration of agriculture, culture, sports, and tourism industries needs to rely on rural resources and market demands to create sports tourism products with unique charm. In rural areas with beautiful mountains and waters, outdoor sports such as hiking, rock climbing, and rafting can be developed. In rural areas with historical and cultural backgrounds, cultural projects such as martial arts performances and folk sports competitions can be launched. By combining with agricultural production, integrated projects such as farming experiences, picking competitions, and rural marathons can be developed, enriching the rural tourism supply, enhancing attractiveness, promoting economic diversification, driving farmers' income growth, and achieving in-depth integration and sustainable development of agriculture, culture, sports, and tourism ^[9].

4.2. Improving sports tourism infrastructure

To promote the integration of agriculture, culture, sports, and tourism industries, it is necessary to focus on improving the quality of rural sports tourism services and tourists' experiences. The practical paths include the following.

Transportation facilities: Strengthen the construction of rural roads to improve traffic capacity and safety; optimize public transportation and add rural tourism special lines; improve parking lots, charging piles, etc., to facilitate self-driving tourists.

Accommodation facilities: Encourage the development of characteristic homestays and agritainment, improve the accommodation quality, enhance the professional level of service staff through training, and create a characteristic accommodation environment combined with rural culture to enhance tourists' satisfaction ^[10].

Catering facilities: Explore and inherit rural food culture, and launch characteristic cuisine; strengthen health supervision and food safety management; develop sports-themed nutritious meals and outdoor picnics to meet diverse needs.

Sports venues and facilities: According to the actual situation of rural areas and tourists' needs, build hiking trails, cycling paths, rock-climbing walls, stadiums, etc.; pay attention to safety and environmental protection; combine with rural characteristics to create characteristic sports landscapes and leisure areas to enhance tourists' experiences ^[11].

These measures aim to promote in-depth industrial integration and sustainable development.

4.3. Innovating marketing and promotion models

In the digital age, the integration of agriculture, culture, sports, and tourism industries needs to leverage emerging media and technologies to enhance brand influence in a precise, efficient, and interactive manner. Use platforms such as WeChat, Weibo, and Douyin to release high-quality content, and accurately target the audience through algorithm recommendations. Carry out online interactive activities to enhance user stickiness. Establish an online tourism mall to provide convenient booking services, and optimize product structures and marketing through data analysis ^[12]. At the same time, invite Internet celebrities to conduct live-streaming interactions, showcase features, and promote products to enhance tourists' trust and purchase intention.

4.4. Strengthening policy support and guidance

In terms of policy support and guidance, local governments should:

First, establish an integration system and mechanism, build an integration platform, closely cooperate with relevant departments, and establish an organizational and promotion mechanism for the integrated development of agriculture, culture, sports, and tourism industries. At the same time, innovate the asset management model, encourage agricultural, cultural, tourism, and sports companies to conduct capital operations and secondary product development, and release the industrial economic value.

Second, to meet the demand for professional talents, establish an online-offline connected service platform and publicity window, increase the training of cross-border talents, broaden employment channels, build an investment and financing platform, implement tax preferential policies, and establish an integrated development association to promote the substantial development of relevant associations and provide decision-making support for policy-making ^[13].

Third, encourage the development of integrated agriculture, culture, sports, and tourism business institutions, promote the merger and reorganization of advantageous enterprises, create industrial groups and alliances, accelerate the pace of enterprises' "bringing in" and "going global", cultivate backbone enterprises, and promote chain-operation, joint-operation, and group-operation. Encourage the establishment of agriculture, culture, sports, and tourism organizations, guide their standardized and healthy development, cultivate well-known enterprises and brands, strengthen the construction of industry associations, build a communication bridge between the government and enterprises, encourage integrated development companies to enter the capital market, and expand relevant business segments ^[14].

Fourth, combine resource advantages, development trends, and economic transformation requirements to cultivate integrated agriculture, culture, sports, and tourism industries, and deeply explore cultural connotations. Reasonably utilize foreign capital and technology, draw on domestic and foreign experiences, and build an international cooperation system. Increase investment in cultural, sports, and tourism public service facilities, build sports public facilities in line with citizens' leisure needs, promote the construction of public service platforms, provide services such as information consultation, route design, traffic distribution, and event ticket booking, and promote the development of relevant insurance businesses.

4.5. Paying attention to ecological protection and sustainable development

Sports tourism activities, with their unique charm and wide participation, have become an important driving force for promoting agricultural ecological protection and sustainable development. They prompt rural areas to pay attention to ecological agriculture, reduce the use of chemical fertilizers and pesticides, promote organic

farming, and protect the ecological environment to attract tourists, thereby enhancing the ecological value of agriculture. At the same time, sports tourism projects such as hiking and cycling transform agricultural landscapes into tourism resources, protect the original features, and increase the added value of agriculture, promoting industrial upgrading. In addition, sports tourism extends the agricultural industry chain, driving the development of industries such as agricultural product processing, rural tourism catering, and farming experiences, creating employment opportunities, increasing farmers' income, and achieving a win-win situation of economic and ecological benefits. Farmers' awareness of environmental protection has increased, and they actively participate in ecological protection. This model promotes the green transformation of agriculture, promotes the diversification of the rural economy, injects new vitality into rural revitalization, and realizes the in-depth integration and coordinated development of agriculture, culture, sports, and tourism ^[15].

5. Conclusion

In summary, in the context of the rapid development of globalization and informatization, the integration of agriculture, culture, sports, and tourism industries has become an important force in promoting economic and social development. In this process, all regions should face up to the various problems and challenges in the integration process of agriculture, culture, sports, and tourism industries, and actively explore solutions to the existing problems in the current integration from the perspectives of strengthening resource integration and sharing, innovating products and services, optimizing infrastructure construction, and strengthening policy guidance, so as to point out a new direction for the sustainable and healthy development of agriculture, culture, sports, and tourism industries in the future.

Funding

Hunan Provincial Philosophy and Social Sciences Foundation Project (Number: 22YBA101)

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Zhang R, Li Z, 2025, Research on the Path of Promoting Rural Revitalization through the Integrated Development of Culture, Sports, and Tourism Industries in Wuling Mountain Area. *Wushu Studies*, 10(2): 154–156.
- [2] Wang YQ, Zhang YW, Tan YL, et al., 2025, The Integrated Development of Culture, Sports, and Tourism Industries in Ethnic Areas under the Background of Rural Revitalization: Value, Models, and Paths. *Sports Culture Guide*, 2025(2): 79–85.
- [3] Zhang YW, Xie X, Zhang XL, 2024, Research on the Integrated Development of Culture, Sports, and Tourism Industries Empowered by the Digital Economy. *Sports Culture Guide*, 2024(11):1–7 + 28.
- [4] Yang JL, Zhu J, 2024, Research on Strategies for Promoting Rural Revitalization in Shaanxi through the Integration of Culture, Sports, and Tourism Industries. *Tourism Overview*, 2024(21): 135–137.
- [5] Chu YJ, Ji ZF, Huang MR, 2024, The Value, Mechanism, and Promotion of the Integrated Development of Culture,

Sports, and Tourism Industries Driving Rural Revitalization. *Social Scientist*, 2024(5): 72–78.

- [6] Wu JJ, Yu Q, Wang W, et al., 2024, The Internal Logic, Driving Forces, and Strategic Paths of the Integrated Development of the “Culture, Sports, and Tourism” Industries to Promote Rural Revitalization. Abstracts of the 7th Guizhou Sports Science Congress, 52–53.
- [7] Zhu YC, 2024, The Application, Challenges, and Strategies of New-quality Productivity in the Integrated Development of Culture, Sports, and Tourism Industries. *Journal of Hubei University of Economics (Humanities and Social Sciences Edition)*, 21(7): 15–20.
- [8] Xiang CP, 2024, Research on the Integrated Development of Culture, Sports, and Tourism Industries under the Background of Chinese-style Modernization. The Sports Sociology Committee of the Chinese Sports Science Society. Proceedings of the 2024 National Sports Sociology Annual Conference (Volume I), 123–125.
- [9] Li TL, 2024, Research on the High-quality Development of the Integrated Culture, Sports, and Tourism Industries in Anhui Province. *Strait Science and Technology and Industry*, 37(1): 64–67.
- [10] La TT, Qu YF, 2023, The Internal Logic, Dynamic Mechanism, and Path Selection of the Integrated Development of China’s “Culture, Sports, and Tourism” Industries. Chinese Sports Science Society. Abstracts of the 13th National Sports Science Congress — Thematic Reports (Sports Industry Sub-committee), 868–870.
- [11] Li YH, Chen CL, 2023, Research on the High-quality Practical Paths for the Integrated Development of Culture, Sports, and Tourism Industries. *Sports Goods & Science and Technology*, 2023(21): 127–129.
- [12] Yang YN, Zhang WY, Zhang MY, 2023, Value Review and Implementation Paths of the Integrated Development of Culture, Sports, and Tourism Industries to Promote Rural Revitalization. *Sports Goods & Science and Technology*, 2023(14): 82–84.
- [13] Liu LN, 2023, Research on the Theoretical Connotation and Realization Paths of the Integrated Development of Culture, Sports, and Tourism Industries. *Journal of Puer University*, 39(2): 56–58.
- [14] Shan FX, 2022, Model Innovation and Mechanism Construction for the Integrated Development of China’s Culture, Sports, and Tourism Industries. Abstract Compilation of the 12th National Sports Science Congress — Poster Communication (Sports Industry Sub-committee), 365–367.
- [15] Han L, 2021, Research on the Integrated Development of Culture, Sports, and Tourism Industries of China’s Ethnic Sports Events from the Perspective of Symbiosis, thesis, Central China Normal University.

Publisher’s note

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

A Brief Discussion on the “Three Strictness” Safety Management Practice Model

Dawei Wang*, Jianqi Yu, Bangbang Wang

Tiantai Chicheng Electric Power Co., Ltd., Taizhou 317299, Zhejiang, China

**Author to whom correspondence should be addressed.*

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 paper focuses on the safety management of electric power construction enterprises, taking Tiantai Chicheng Electric Power Co., Ltd. as an example, to deeply explore the “Three Strictness” safety management practice mode. Elaborate its implementation background, analyze the concept, connotation, working methods and ways of the mode, demonstrate its important significance for consolidating the stable foundation, improving the quality of employees, optimizing the organization platform and promoting the safe and stable development of enterprises, and provide a reference example for the safety management of electric power construction enterprises.

Keywords: “Three Strictness”; Safety management; Practice mode

Online publication: June 6, 2025

1. Introduction

In power construction enterprises, safety is an eternal theme and the cornerstone of the sustainable development of enterprises. With the rapid development of the social economy and the continuous expansion of power grid construction scale, power construction enterprises are facing the pressure of their own development, and the imbalance between safety management and enterprise development speed is becoming more and more prominent^[1]. Tiantai Chicheng Electric Power Co., Ltd. in the past “Three Proximity Approach” flexible safety management education model, innovative implementation of the “Three Strictness” rigid safety management practice model, aimed at improving the level of safety management, to achieve the safety and development of the collaborative progress, this paper will launch an in-depth discussion.

2. “Three Strictness” safety management practice implementation background

2.1. A lack of crisis awareness and risk identification capabilities leads to the “boiling frog syndrome”

At present, some cadres and employees of Tiantai Chicheng Electric Power Co., Ltd. have a weak sense of

crisis and lack a keen insight into potential risks in the production process and environment ^[2]. In daily work, they are eager to be comfortable and slow to respond to environmental changes. In the face of emergencies and urgent repair tasks, due to the lack of early risk analysis, often hasty response. For example, in the emergency repair project of a substation equipment, the staff did not analyze the peripheral risks that may be caused by the faulty equipment in advance, and the chain reaction of adjacent equipment was accidentally triggered during the emergency repair, which almost caused a bigger accident. In the long run, the company's safety management has fallen into the dilemma of "boiling frogs in warm water", with all staff having a negative attitude towards safety production, the loss of management cohesion, and security hazards ^[3].

2.2. Neglecting detailed work and failing to nip problems in the bud, leading to the "For want of a nail" effect

Some employees turn a blind eye to details in their work and lack awareness of prevention. In terms of equipment management, the equipment ledger is not updated in time and is out of touch with the actual situation on site, resulting in long-term "sick operation" of the equipment. For example, an important equipment in a substation fails to update aging information in time due to daily inspection, and suddenly fails in a high-load operation, affecting the regional power supply. In the work process, illegal operations are not uncommon. To catch up with the construction period, the time is compressed at will, the phenomenon of waiting for review and issuing tickets is common, and the work ticket is not filled properly. When working on site, the wearing of personal protective equipment is not standardized, and the implementation of safety measures is not in place. These small omissions are like "nails on the horseshoe", which may lead to serious safety accidents, and enterprise safety management presents a "horseshoe effect."

2.3. The presence of a complacent mentality and evasion of responsibilities leads to the emergence of the "broken windows effect"

Although the company has established a production safety system and clearly defined the responsibilities of production safety, some departments have failed to implement it. Managers are busy with affairs, do not conduct in-depth research on production safety issues, interpret the accident notification vaguely, and punish those who violate the rules lightly. In a safety accident notification, responsibility is not clearly defined, and the responsible person is not seriously dealt with, resulting in employees being lucky, violations are repeatedly banned, "broken window effect" spawns within the enterprise, and there is a huge hidden danger in safety production ^[5].

3. The concept and connotation of the "Three Strictness" safety management practice mode

3.1. Concept introduction

The "Three Strictness" safety management means a serious attitude, rigorous work, and strict discipline. Combining the dynamic thinking of the company's employees and the status quo of safety management, from the three aspects of attitude, work, and discipline, through diversified measures, eliminate the adverse effects of safety production, and enhance the cohesion, carrying capacity, and execution of safety production ^[6].

3.2. Connotation

With a serious attitude to put an end to the "boiling frog syndrome", enhance the cohesion of safety production.

Safety production needs to uphold a “zero tolerance” attitude, as attitude determines behavior. The company’s employees maintain a serious attitude in safety management, deal with problems, and coordinate work more efficiently, which can effectively avoid the lack of responsibility, improve the operation process, and reduce safety risks. During a safety inspection, the staff investigated hidden dangers with a serious attitude, found and rectified key hidden dangers in time, and avoided accidents. Long-term adherence to promote all staff from “heteronomy” to “self-discipline” change, improving team cohesion ^[7].

Strict and meticulous work is needed to put an end to the “horseshoe effect”, control the safety production carrying capacity. Safety accidents follow the law of quantitative change to qualitative change, and any subtle, hidden dangers may cause great disasters. The company requires employees to work rigorously and carefully, starting with the feasibility of enhancing the operation plan, and reasonably analyzing the safety carrying capacity ^[8]. In a large power construction project, the team rigorously planned the process, strictly controlled the details, successfully avoided the safety problems that may be caused by the negligence of details, ensured the safe progress of the project, and controlled the safe production carrying capacity.

Strict and fair discipline to put an end to the “broken window effect” and improve the execution of safety production. The company’s safety management depends on the execution of all staff, and strict discipline is the premise of execution. Through clear disciplinary norms, strict punishment for violations, such as punishing the responsible person for rule violations to play a warning role, encourage employees to consciously abide by the discipline, and improve the execution of safety production ^[9].

4. The “Three Strictness” safety management practice mode of working methods and ways

4.1. Based on the system, standardize the “Three Strictness” safety education management process

Deepen the implementation of the safety responsibility system, serious employee safety attitude. The company signs the safety responsibility letter at various levels to ensure that the safety responsibility is passed to the person. Daily audit, inspection to add safety responsibility questions, and organize the “safety production law” knowledge competition. In a safety inspection, it was found that some employees had a vague understanding of their own safety responsibilities through questioning, and the training was immediately strengthened. The safety attitude of employees was significantly improved, and the awareness of responsibility and a serious attitude towards safety were strengthened from the legal level ^[10].

Vigorously promote the safety rules and regulations, and cultivate a rigorous style among employees. Organize the safety rules and regulations training in small classes, and interpret the construction operation rules word for word. Employees are required to enhance the feasibility of the operation plan and rationally analyze the safety carrying capacity. In a line construction project, the construction team strictly formulated the operation plan according to the training content, carried out the bearing capacity analysis of each link, avoided blind construction, standardized work behavior, and cultivated a rigorous style of work.

Comprehensively strengthen the safety assessment system and strictly enforce the organizational discipline of employees. The company strengthens the safety assessment system, adopts differentiated assessment methods for different personnel, time, and levels, and adheres to the principles of fairness, justice, and openness. Repeated violations of the staff are dealt with seriously, forming a warning within the company, and the consciousness of employees to abide by the organizational discipline has been significantly improved.

4.2. Carrier to promote results, promote the “Three Strictness” safety education culture publicity

Publicity in place to create an atmosphere: The company uses slogans, display boards, electronic large screens, work boards, etc., to create a high-pressure situation of “Three Strictness” safety management education ^[11]. Send “Three Strictness” SMS reminders at work, post slogans in office areas, create cultural corridors in reading rooms, and hang warning maxims in tool rooms. The “Three Strictness” safety management pocket books and cultural manuals were compiled to build a safety culture chain of “visual impact → perceptual understanding → thought change → behavior guidance → safe production.” In a certain project, employees were affected by a strong safety atmosphere and took the initiative to correct non-standard operation behaviors.

Use technology, strengthen supervision: In line with the popularity trend of smartphones, the company has set up a “Three Strictness” security management WeChat group, whose members cover external teams. Each department propagates superior safety documents within the group, communicates and solves daily safety problems, and shares excellent experiences. In the handling of an emergency safety incident, WeChat group quickly coordinated resources, efficiently solved problems, created a good atmosphere of safety production cohesion, and promoted the in-depth development of safety management.

Strict inspection and exposure of violations: Set up a “violation exposure column”, grassroots stations, and production departments to establish a “violation exposure desk”, establish violation files for each employee, and regularly expose violations. This encourages production safety personnel at all levels to strengthen safety responsibilities, take the initiative to investigate hidden dangers, and reduce violations. For example, after a violation case was exposed, the relevant departments quickly rectified, and similar violations were greatly reduced, which played a good warning role.

4.3. Training to improve quality and consolidate the foundation of “Three Strictness” safety education and management

Make plans to strengthen learning: At the beginning of the year, combined with the past safety management problems and staff thinking changes, prepare safety education and training plans, targeted course selection, start classes, and timely adjustment of training content. After the implementation of a certain annual training plan, problems such as negative attitude and weak awareness of staff safety have been significantly improved to promote enterprise safety production ^[13].

Intensive counseling and in-depth learning: For employees with low safety technology level and poor professional quality, and external personnel, a “special safety knowledge small classroom” is set up to teach students according to their aptitude and strengthen the comprehensive safety quality. In the small class training program, the safety skills and awareness of the training personnel have been significantly improved, and the operation error rate in the follow-up work has been greatly reduced.

Exchange and sharing: Regularly hold the “three power safety lecture hall”, inviting outstanding professionals and business backbone to share safety management experience and ideas for frontline employees, and stimulate employees’ motivation for self-improvement. After a lecture, employees learn from and share experience, optimize workflow, and effectively improve work safety.

Positive and negative education discrimination: On the basis of positive education, negative production safety materials are introduced, such as superior accident notification and typical violation cases, to form a sharp contrast and deepen employees’ awareness of production safety. In the case learning activities, employees have a deep

understanding of the harm of illegal behavior, and the concept of production safety has been further consolidated.

Theory test promotion: According to different stages of training, organize a variety of safety knowledge theory tests, including oral questions, written tests, computer operation and technical competition, etc., to test the training effect, provide a basis for follow-up training, and create a good atmosphere for all staff to learn safety knowledge. After a theoretical test, adjust the training focus according to the test results, and the training will be more targeted.

4.4. Execution serves as the guarantee and solidifies the practical application of the “Three Strictness” safety education

On the basis of the employee safety score system, the company constructs the “Three Strictness” safety score evaluation system, and sets different weights for scientific evaluation from the aspects of safety attitude, safety style, and compliance. The evaluation results are linked with employee performance assessment, professional title evaluation, and advanced evaluation, effectively constrain and standardize employee safety production behaviors, and solidify the results of the “Three Strictness” safety practice. In the employee performance evaluation, employees with high safety scores have more advantages in the evaluation, and are encouraged to actively practice the “Three Strictness.”^[13]

5. The significance of the “Three Strictness” safety management practice mode

5.1. Consolidate the foundation for stability

The “Three Strictness” safety management practice mode breaks the existing adverse effects of corporate safety management, and improves the cohesion, carrying capacity, and execution of safety management. Since the implementation, the number of serious violations of rules and regulations by employees has dropped sharply, and the violation rate of enterprise employees in the first quarter of 2025 has decreased by 35% compared with the same period last year. The company’s stable foundation is more solid.

5.2. Improving staff quality

This model promotes significant progress in safety attitude, work style, and compliance, and improves the overall quality of employees. Through a series of special activities, employees’ safety awareness has been greatly improved, and safe production and operation according to regulations have become habits, realizing the ideological leap from “heteronomy” to “self-discipline.”

5.3. Optimize the organization platform

The “Three Strictness” promotes the company’s deep participation in safety management work, and organizations at all levels cooperate in development and resonate with the same frequency. The innovative safety culture chain has enhanced the safety awareness of employees and optimized the organizational platform of enterprise safety management^[15].

5.4. Promote the safe and stable development of enterprises

The “Three Strictness” correct employees’ bad behaviors in production safety, correct safety attitudes, cultivate a rigorous style, and enhance discipline enforcement, so that production safety is always in an orderly and controllable state, and effectively promote the safe and stable development of enterprises.

6. Conclusion

Through the exploration and practice of the “Three Strictness” safety management, the self-safety awareness of the employees of Tiantai Chicheng Electric Power Co., Ltd. has been greatly improved, and the adverse effects affecting safety production have been prevented and eliminated from the root, fully stimulating the enthusiasm of employees for production, and significantly improving the cohesion, carrying capacity and execution of enterprise safety management. This practice model has an important reference significance for the stable development of safety production and safety management of power construction enterprises, and provides valuable experience for the industry safety management innovation.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Standing Committee of the National People’s Congress, 2021, Work Safety Law of the People’s Republic of China (Amended Version in 2021).
- [2] Li H, Zhang M, 2023, Research on the Dilemma and Breakthrough Path of Safety Management in Electric Power Construction Enterprises. *Electric Power Construction and Safety*, 45(3): 22–28.
- [3] Wang Q, 2022, The Key Role of Safety Culture Shaping in the Long-Term Development of Electric Power Construction Enterprises. *Management Innovation of China Electric Power Enterprises*, 2022(15): 56–59.
- [4] Zhao G, Sun Y, 2021, Construction of Electric Power Construction Safety Risk Identification System Based on Risk Matrix and Fuzzy Comprehensive Evaluation. *Modern Electric Power Engineering*, 38(4): 56–63.
- [5] China Electricity Council, 2024, In-depth Research Report on the Safety Management Status of the Electric Power Construction Industry in 2024. China Electricity Council, Beijing.
- [6] Chen H, 2023, In-depth Analysis and Prevention Strategy Discussion of Typical Electric Power Construction Safety Accidents. *Safety and Maintenance of Electric Power Equipment*, 2023(9): 87–90.
- [7] Zhou H, 2022, Exploration on Optimization Strategies of Electric Power Construction Safety Management from Multi-dimensional Perspectives. *Technology Innovation and Application*, 12(22): 167–170.
- [8] Wu D, 2021, Reflection on the Deviation of Safety System Implementation in Electric Power Enterprises from the “Broken Windows Effect” and Correction Paths. *Electric Power Safety and Management*, 33(6): 18–21.
- [9] Li L, Zhang Y, 2020, Development and Empirical Research on Safety Attitude Scale for Employees in Electric Power Construction Enterprises. *Frontier of Human Resource Management*, 8(4): 78–85.
- [10] Liu C, 2019, Evaluation of the Application Effect of Point System Management in the Safety Control System of Electric Power Enterprises, thesis, North China Electric Power University.
- [11] Wang J, 2018, Practical Exploration of the Fine Management Concept in the Safety Management of Electric Power Construction. *Engineering Construction Standardization*, 2018(22): 235–238.
- [12] Zhao F, 2017, Innovative Practice of Intelligent Technology Empowering Safety Supervision of Electric Power Construction. *Electric Power Informatization and Digital Transformation*, 15(11): 65–70.
- [13] Sun M, 2016, Research on the Strategies for Improving the Effectiveness of the Safety Training System of Electric Power Construction Enterprises. *Vocational and Technical Education*, 37(18): 56–60.
- [14] Chen S, 2015, Research on the Innovation of Safety Management Mode of Electric Power Enterprises Based on the

Reconstruction of Safety Culture Chain. *Modernization of Enterprise Management*, 2015(24): 88–91.

- [15] Electric Power Safety Supervision Department of the National Energy Administration, 2014, *Comparative Analysis and Enlightenment of Domestic and Foreign Electric Power Construction Safety Management Modes*. National Energy Administration, Beijing.

Publisher's note

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

Hospital Medical Student Care Program and Student Growth

Ying Liu^{1,2}, Bingjin Wang¹, Shangrong Li¹, Dongdong Yuan¹, Yao Yao^{1*}

¹Continuing Education Section of The Third Affiliated Hospital, Sun Yat-sen University, Guangzhou 510630, China

²Department of Infectious Diseases, The Third Affiliated Hospital of Sun Yat-Sen University, Guangzhou 510630, China

**Author to whom correspondence should be addressed.*

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 aimed to explore the impact of a hospital-based medical student care program on student growth. Through a systematic analysis of four modules—"Hospital Welcomes You", "Hospital Congratulates You", "Hospital Thanks You", and "Hospital Cares for You"—implemented at the Third Affiliated Hospital of Sun Yat-sen University, the study evaluated their effectiveness in enhancing students' sense of belonging, professional identity, and professional competence. The results, derived from a mixed-methods approach (questionnaires + interviews), demonstrated that the program significantly improved students' sense of belonging, career commitment, and mental health. This study validates the practical value of structured humanistic care in medical student education, provides a tangible case for fulfilling the "professional competence cultivation" requirements in medical education standards, and offers a replicable model for broader medical education practices.

Keywords: Care program; Student growth; Medical education; Professional competence; Humanistic care

Online publication: June 6, 2025

1. Introduction

During their clinical training and practice in hospitals, medical students face high-intensity academic demands and complex professional environments, posing challenges to their physical and mental well-being as well as career development ^[1-2]. Therefore, hospitals must not only prioritize the transfer of professional knowledge but also address students' psychological needs and cultivate their professional competence during medical education ^[3]. Humanistic care holds significant value in medical education, as it not only supports students' mental health but also strengthens their professional identity and sense of belonging ^[4]. The Third Affiliated Hospital of Sun Yat-sen University has implemented a series of care programs aimed at creating a supportive and stimulating learning environment for medical students, fostering their holistic development.

2. Research background and significance

2.1. Research background

During clinical training in hospitals, medical students undergo a transformative journey from theoretical knowledge to practical application, requiring not only the accumulation of professional expertise but also strong psychological resilience and professional competence. However, research indicates that students frequently experience significant psychological stress during internships and clinical rotations, leading to higher rates of anxiety and depression ^[4]. Additionally, professional identity and a sense of belonging profoundly impact their career development trajectory. Consequently, hospitals must implement systematic care programs to provide comprehensive support for medical students.

2.2. Research significance

This study examines the effectiveness of the medical student care program at the Third Affiliated Hospital of Sun Yat-sen University in enhancing students' sense of belonging, identity, and professional competence. The findings aim to provide a replicable model for other hospitals, fostering the holistic development of medical students.

3. Research methods

This study employed a mixed-methods research design that integrated both quantitative and qualitative research approaches. Quantitative data were collected through questionnaires administered to medical students, faculty members, and employers. The survey content encompassed students' satisfaction with the caring program, enhancement of professional competencies, and improvements in mental health. Qualitative data were gathered through interviews and focus group discussions involving medical students, faculty members, and hospital administrators. The questionnaire survey was conducted from May to July 2024, yielding 120 valid responses (from medical students). Interviews and focus group discussions took place between August and September 2024, involving 10 medical students, 5 faculty members, and 5 hospital administrators.

4. Implementation of the care plan for medical students in the hospital

4.1. Hospital Welcomes You

Through the opening ceremony, to create a strong opening atmosphere for new medical students, enhance their sense of belonging and identity. The activities include students signing in, receiving admission gifts, watching promotional videos, speeches by tutors, and other links. The results showed that more than 90 percent of medical students were satisfied with the module, believing that the opening welcome ceremony enhanced their "sense of ritual" and "identity."

4.2. Hospital Congratulates You

Through the graduation ceremony and the discharge ceremony, the graduating medical students are provided with a sentimental farewell ceremony. The activities include graduation precepts, graduation yearbook, student representatives' speeches, and so on. The results showed that more than 85 per cent of medical students and employers were satisfied with the module, believing that the graduation ceremony enhanced their "sense of ritual" and professional identity.

4.3. Hospital Thanks You

Through teachers' day activities, to recognize and thank educators for their contributions and enhance their sense of professional honor. Activities include a teacher's day promotional video, an excellent recognition conference, and small activities. The results showed that more than 80 percent of teachers were satisfied with the module, believing that teachers' day activities enhanced their sense of professional honor and belonging.

4.4. Hospital Cares for You

A full range of psychological support is provided for medical students through traditional Chinese festival celebrations, mental health concerns, and student symposia. Through a series of "tiny care" activities (including the issuance of food tickets for the Mid-Autumn Festival, the broadcast of videos of Spring Festival greeting activities) and mental health lectures, the hospital has provided all-around psychological support for medical students. The results showed that more than 90 percent of medical students were satisfied with the module, believing that the activities enhanced their mental health and professionalism. Playing the long-term value of "tiny care" has played an important role in the growth of medical students.

5. Humanistic care and students' growth

Humanistic care plays a significant role in medical education, as it not only contributes to students' mental health but also enhances their professional identity and sense of belonging. Through the implementation of four modules—"Hospital Welcomes You", "Hospital Congratulates You", "Hospital Thanks You", and "Hospital Cares for You"—the Third Affiliated Hospital of Sun Yat-sen University provides comprehensive support for medical students. These initiatives not only strengthen students' sense of belonging and identity but also foster their professional competence and psychological well-being.

6. Research results

6.1. Feedback from students

The questionnaire survey showed that more than 90 percent of medical students were satisfied with the "Hospital Welcomes You" and "Hospital Cares for You" modules, believing that these activities enhanced their sense of belonging and mental health. More than 85 percent of medical students were satisfied with the "Hospital Congratulates You" module, believing that the graduation ceremony enhanced their sense of professional identity. More than 80 percent of teachers were satisfied with the "Hospital Thanks You" module, believing that the Teachers' Day activities enhanced their sense of professional honor. "When I received the commemorative album at the graduation ceremony, I suddenly understood the significance of the white robe" (Zhang, a student of Clinical Medicine class 2018), "the monthly symposium made it difficult for us to have channels to give feedback, and this sense of being valued was very precious."

6.2. Feedback from teachers and management departments

Interview results indicate that faculty members generally believe the care program helps enhance students' sense of belonging and professional competence (**Tables 1 and 2**). Through opening welcome ceremonies and graduation rituals, students can better adapt to the hospital's learning environment and strengthen their professional identity^[5]. Additionally, mental health lectures and student symposiums provide effective psychological support, contributing

to their comprehensive development, while the ceremonies reinforce their professional identity ^[6].

Table 1. Evaluation of the influence of medical students on different aspects of CCPS (*n*=120)

Evaluation items	Very satisfied	Fairly satisfied	Average	Less satisfied	Very dissatisfied
Increased sense of belonging	90 (75%)	20 (20.8%)	5 (4.2%)	0	0
Increased professional identity	85 (70.8%)	29 (24%)	6 (5%)	0	0
Improved mental health	85 (70.8%)	30 (25.0%)	5 (4.2%)	0	0
Improved professionalism	75 (62.5%)	40 (33.3%)	5 (4.2%)	0	0
Helps to adapt to the hospital learning environment	88 (73.3%)	30 (25.0%)	2 (1.7%)	0	0
Helps relieve study stress	80 (66.7%)	35 (29.2%)	5 (4.2%)	0	0
Helps increase motivation to learn	82 (68.3%)	33 (27.5%)	5 (4.2%)	0	0

Table 2. Evaluation of specific activities in each module of the care programme by medical students (*n*=120)

Evaluation items	Very satisfied	Fairly satisfied	Average	Less satisfied	Very dissatisfied
The hospital welcomes you for the opening ceremony	90 (75%)	25 (20.8%)	5 (4.2%)	0	0
The hospital congratulates you on your graduation	85 (70.8%)	30 (25%)	5 (4.2%)	0	0
The hospital thanks you for the Teachers' Day activity	80 (66.7%)	35 (29.2%)	5 (4.2%)	0	0
The hospital cares about you holiday wishes and welfare distribution	75 (62.5%)	40 (33.3%)	5 (4.2%)	0	0
The hospital cares about you Chinese New Year greeting activities	70 (58.3 percent)	45 (37.7%)	5 (4.2%)	0	0
The hospital cares about you mental health talk	85 (70.8%)	30 (25%)	5 (4.2%)	0	0

7. Discussion

This study confirms that the hospital's medical student care program, through its "Welcome-Cultivate-Farewell" phased intervention model, has significantly enhanced students' sense of belonging, professional identity, and mental health levels. Specifically, educational rituals such as opening ceremonies and graduation events serve as crucial "liminal experiences", effectively facilitating medical students' professional identity transition ^[7-8]. Meanwhile, "micro-intervention" measures, including mental health lectures, symposiums, and Mid-Autumn Festival meal vouchers, have generated notable cumulative effects through sustained organizational support ^[9]. This model provides an operational practice solution that aligns with the support service requirements outlined in WFME standards ^[10].

Regarding practical implementation and promotion, the standardized operational procedures and evaluation system established in this research demonstrate strong transferability. Other hospitals can adapt the program's modular design according to local cultural contexts, such as integrating opening ceremonies with regional medical

traditions or developing more distinctive care initiatives ^[11]. This combination of flexibility and standardization offers valuable insights for the innovative development of medical humanities education.

Funding

2023 Guangdong Province Undergraduate Teaching Quality and Teaching Reform Project 2. 2023 Guangdong Province Undergraduate Teaching Reform Project of “New Medical Science”: Application of Smart Information Platform in Undergraduate Teaching 3. 2023 Sun Yat-sen University Higher Education Reform Project.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Wang XS, 2009, The Relationship between Cognitive Demand, Professional Commitment, Career Decision-making Self-efficacy and College Students' Learning Adaptation, thesis, Shaanxi Normal University.
- [2] Liu WH, Tang F, 2023, Investigation and Analysis of the Ideological State and Related Factors of Medical Students in the New Era. *Technology and Health*, 2(18): 121–124.
- [3] Frank JE, 2005, The CanMEDS 2005 Physician Competency Framework. http://rcpsc.medical.org/canmeds/CanMEDS2005/CanMEDS2005_e.pdf
- [4] Rotenstein LS, Ramos MA, Torre M, et al., 2016, Prevalence of Depression, Depressive Symptoms, and Suicidal Ideation Among Medical Students: A Systematic Review and Meta-Analysis. *Jama*, 316(21): 2214.
- [5] Zhong YX, Jiang PY, Zhang LJ, 2022, Exploration of the Professional Spirit Education Function of Medical School Ceremony in the Perspective of Interactive Ritual Chain Theory — Taking the 2020 Graduation Ceremony of Peking University Health Science Center as an Example. *Chinese Medical Ethics*, 2022(2): 35.
- [6] Yue X, 2009, Reshaping One's Own Image and Enhancing Personality Charm — On the Quality Requirements of Mental Health Education for Contemporary Teachers. *Chinese Education Research Series*, 2009(0): 161–163.
- [7] Sieber SA, Gennep AV, Vizedon MB, et al., 1961, The Rites of Passage. *The American Catholic Sociological Review*, 21(4): 363.
- [8] Vizedon M B, Caffee G L, Gennep A V, 2004, The Rites of Passage. University of Chicago Press, Chicago.
- [9] Holloway SWI, 2013, Qualitative Research in Nursing and Healthcare. Open University Press, Berkshire.
- [10] Cao DP, Zhao G, Zhao SB, et al., 2007, Cognition and Practice of Global Accreditation Pilot Evaluation of Medical Education. *Chinese Journal of Medical Education*, 27(1): 7–9.
- [11] Creswell JW, Clark VLP, 2007, Designing and Conducting Mixed-methods Research. Sage, Thousand Oaks.

Publisher's note

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

Application of BIM Technology in Informatized Construction Management of Municipal Engineering

Mingmin Zhang^{1*}, Shuang Wang²

¹Xinjiang Jiaotong Vocational and Technical University, Urumqi 830000, Xinjiang, China

²Beijing KSJ Software Technology Co., Ltd., Beijing 100193, China

**Author to whom correspondence should be addressed.*

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: Municipal engineering is complex and involves large-scale construction. With the improvement of modern construction levels, traditional construction models and methods for municipal engineering are relatively lagging behind, and problems such as information silos and potential safety hazards during the construction process remain to be solved. How to meet the high-standard requirements of municipal engineering and improve the construction quality and efficiency is a key issue that needs to be overcome at present. BIM technology is a three-dimensional (3D) model information technology that can integrate and share relevant engineering information to reasonably control project costs, improve construction progress management, and quality control. Based on this, this article briefly summarizes the application advantages of BIM technology, the main problems existing in current municipal engineering construction management, and analyzes the specific applications of BIM technology in informatized construction, hoping to promote the development of urban infrastructure construction towards intelligence and refinement.

Keywords: BIM technology; Municipal engineering; Informatization; Construction management

Online publication: June 6, 2025

1. Introduction

Against the background of the transformation of municipal projects, municipal engineering adheres to the concepts of green environmental protection and high-quality projects, and introduces BIM technology for project construction management. BIM technology can effectively improve the efficiency of construction progress management and cost control, realize information sharing and collaborative work, and provide safety guarantees for construction projects, bringing a revolutionary change to project engineering management. Relevant municipal project managers should deepen their research on BIM technology to effectively solve various problems in municipal engineering construction and improve the construction level and quality of municipal engineering.

2. Application value of BIM technology in municipal engineering construction management

2.1. Improving the accuracy and visualization of construction engineering design

The emergence of BIM technology enables designers to create 3D models, presenting various components of municipal engineering, such as roads, bridges, drainage pipes, and underground pipelines, in an intuitive 3D form. This 3D model can not only display the appearance of the project but also integrate rich engineering information, such as the dimensions, materials, and performance parameters of components, helping designers conduct comprehensive analysis and optimization^[1]. During the design process, the collision-detection function of BIM technology can automatically check for design conflicts between different specialties. For example, in the design of municipal utility tunnels, collision detection can be used to find out whether there are intersections or collisions between different pipelines, such as water supply and drainage pipes, power cables, and communication optical cables. By identifying and solving problems in advance, design changes and rework during the construction process can be avoided, thereby improving the accuracy and reliability of the design.

2.2. Optimizing construction plans and improving construction efficiency

By combining the construction schedule plan with the BIM 3D model to form a 4D construction simulation, construction workers can intuitively see the time sequence and spatial changes of the entire construction process and clearly understand the work content and construction sequence of each construction stage^[2]. Taking municipal road construction as an example, BIM 4D simulation can be used to display the sequence and time arrangement of various construction links such as road base laying, surface course pouring, and installation of ancillary facilities. Potential problems in the construction process can be identified in advance. In response to these problems, construction workers can adjust the construction plan in a timely manner, reasonably arrange the construction sequence, and optimize the construction site layout to ensure the smooth progress of the construction process. At the same time, BIM technology can also allocate and optimize construction resources reasonably. By inputting information about various construction resources, such as labor, materials, and equipment, into the model and combining it with the construction schedule plan, the demand for resources can be analyzed in real-time, and preparations for resource allocation can be made in advance to avoid resource waste and shortages.

2.3. Strengthening communication in project construction and improving the coordination of construction projects

Municipal engineering construction involves multiple specialties and participants, such as design units, construction units, supervision units, and property owners. Communication and coordination among all parties are crucial. With the help of BIM technology, information sharing among project parties can be achieved, providing a real-time communication and collaboration environment for all parties^[3]. For example, during the construction process, the design unit can upload the latest design plans and modification opinions to the platform in a timely manner, and construction workers can start construction according to the new design requirements immediately. At the same time, the construction unit can also provide feedback on the problems found and suggestions to the design unit and other relevant parties through the platform, and all parties can negotiate and solve them together. In addition, the visualization function of the BIM model enables more intuitive communication among all parties, allowing them to express their views more accurately, improving communication efficiency and the accuracy of decision-making.

2.4. Improving the ability to control construction quality

Construction quality is the lifeline of municipal engineering. With the help of the BIM model, construction workers can monitor construction quality in real-time and adjust deviations during the construction process in a timely manner, effectively ensuring project quality. For example, in road construction, construction workers can use professional measuring equipment to monitor the construction site in real-time according to the quality standards, such as road surface slope and flatness set in the BIM model, and compare the monitoring data with the standard data in the model. Once a deviation between the actual construction data and the standard data is found, construction workers can take immediate measures for rectification to ensure that the construction quality is always under control^[4]. At the same time, during the construction process, quality inspection data, construction records, and other information can be associated with the BIM model to form a complete quality information file, providing a basis for subsequent project acceptance or solving quality problems during the use process.

3. Characteristics and main problems of current municipal engineering construction management

3.1. Disconnection between the construction process and plan

Municipal engineering usually involves large-scale construction, involving numerous participating units and a wide range. This complexity greatly increases the number of uncertain factors during the construction process^[5]. In some project practices, the actual construction process may deviate from the initial construction design plan, which will slow down the construction progress of the municipal project. At the same time, it will also restrict and negatively affect the maintenance of on-site project management levels and the improvement of resource allocation efficiency.

3.2. Great difficulty in engineering quality control

Ensuring engineering quality is the core factor affecting the construction level of municipal engineering and a major problem that project managers need to solve urgently. In many municipal projects, the construction period is tight and the tasks are arduous, leaving project managers and construction workers with insufficient time for adjustment and optimization. As a result, it is difficult to achieve an efficient balance among the construction progress, construction quality, and cost investment, hindering the construction process of municipal engineering projects^[6].

3.3. Many restrictive factors in the urban environment

Against the background of urbanization construction, the diverse needs of the urban internal environment pose certain challenges to municipal engineering construction. For example, urban old-road renovation projects can affect the daily travel of urban residents, forcing construction parties to frequently adjust the construction plan, which in turn affects the project construction period and quality^[7]. During the construction of drainage and greening projects and other municipal projects, it may have an impact on the urban environment. These influencing factors not only increase the difficulty and cost of construction management but also prolong the construction period.

4. Applications of BIM technology in the informatized construction of municipal engineering

4.1. Progress management

The core of project progress management is to develop an appropriate construction plan based on the established

project progress plan. During the project implementation, comprehensive and full-process supervision of the actual project completion status is carried out, and the actual progress is compared in detail with the pre-planned progress^[8]. The four-dimensional construction progress model, constructed based on BIM technology, combines the time dimension with the 3D BIM model, bringing a new perspective and method to municipal engineering progress management. Before the project starts, by importing the detailed construction progress plan into the BIM model, each construction task is associated with the corresponding 3D model component, forming a dynamic and visual construction progress simulation. For example, in municipal bridge construction, the BIM 4D model can clearly display the time sequence and progress arrangement of each construction link, such as pier pouring, bridge erection, and deck paving, allowing construction workers to visually observe the dynamic changes of the entire construction process^[9]. During the construction process, with the help of relevant BIM software and technical platforms, the construction progress can be monitored in real-time. If the actual progress of a construction task lags behind the planned progress, the system will automatically issue an early warning and visually display the deviation through charts, color-coding, etc. At the same time, using the dynamic adjustment function of the BIM model, construction managers can optimize and adjust the construction progress plan according to the actual situation^[10].

4.2. Quality control

“Quality First for Century-Long Projects” has always been the fundamental and unshakable goal of municipal engineering project quality. Therefore, in the entire process of municipal engineering construction, emphasis should be placed on pre-construction quality control and in-process supervision. The core concept of prevention-first should be firmly established, and the intensity of quality control should be effectively strengthened^[11].

BIM technology plays an important role in municipal engineering quality control. During the construction process, by associating quality data with the BIM model, integrated management of quality information can be achieved. For example, in a road construction project, quality inspection data such as road surface compaction and flatness are input into the BIM model and associated with the corresponding road model components. Construction workers and quality managers can view the quality data of each part at any time through the BIM platform, intuitively understanding the project quality status. Moreover, the visualization feature of BIM technology makes quality inspection more convenient. Through the 3D model, inspectors can clearly see every detail of the project, making it easier to identify potential quality problems and effectively avoid various mistakes caused by subjective factors of personnel during the construction process^[12]. In addition, when quality problems are found, BIM technology can also achieve rapid traceability of the problems. By checking the BIM model information associated with the quality problems, including construction time, construction workers, and materials used, the cause of the problems and the responsible person can be accurately identified, providing a basis for formulating targeted solutions^[13].

4.3. Assisting in topographic survey work

Municipal engineering is usually related to the construction of roads, bridges, and other projects in various regions. Whether building roads in cities or uninhabited areas, topographic surveys are required in advance. Engineering surveys, especially preliminary surveys, are key tasks in municipal engineering. Traditional survey work requires manual sampling and mapping. However, in the face of complex terrain, the actions of surveyors are restricted, and even the life safety of surveyors may be threatened. Even in flat areas, since surveyors need to hold equipment

by hand, it will affect the accuracy of the collected data. These adverse factors have a negative impact on survey work. BIM technology can use drones to obtain images and radar to obtain positioning during the survey stage to collect more accurate data. Subsequently, the data collected by the drones is imported into BIM software to construct a real-scene 3D model, improving work efficiency and accuracy and reducing the risks of manual sampling. On this basis, the surface model formed based on the survey can help construction units design the optimal plan and facilitate the calculation of site engineering quantities.

4.4. Cost control

The BIM model integrates rich engineering information and can accurately calculate the engineering quantities of various materials and components in municipal engineering, enabling effective control of project costs. For example, in a municipal road project, the BIM model can accurately calculate the quantities of materials such as sand, gravel, cement, and asphalt required for the road base and surface course, as well as the number of various drainage pipes, inspection wells, and other components, providing a reliable data basis for cost accounting. Through BIM technology, resources such as labor, materials, and equipment can also be reasonably allocated and optimized according to the construction schedule plan and engineering quantity information. Specifically, before construction, by inputting relevant information about resources, such as the skill levels of personnel, material supply situations, and equipment performance parameters, into the BIM model and combining it with the construction schedule arrangement, the system can simulate the construction process under different resource allocation schemes, analyze the utilization efficiency of resources and cost consumption, and thus select the optimal resource allocation scheme^[14]. In addition, BIM technology is integrated into the entire life cycle of the project. It can carry out simulation modeling for each construction stage of the project. Through precise calculations of the model, the progress details of each construction stage, as well as the specific situations in terms of labor allocation, capital investment, and mechanical equipment use, can be accurately deduced. Based on these data, the cost composition required for each stage is further analyzed in depth, so as to accurately obtain the total construction cost of the project. Then, this total cost is rigorously compared with the actual value of the project, and the parts with differences are carefully sorted out and analyzed in depth, so as to control construction costs, reasonably optimize resource allocation, and improve the economic benefits of the project^[15].

5. Conclusion

BIM technology has become a key force in promoting the transformation of informatized construction management. With its advantages of visualization, simulation, and collaboration, BIM technology can effectively solve many problems in municipal engineering construction, further improving project quality, shortening the construction period, and reducing costs. Although BIM technology faces problems such as costs, talent shortages, and poor software compatibility during the application and promotion process, with continuous industry research in practice, these difficulties will eventually be overcome, providing impetus for the high-quality development of urban construction.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Fang XL, 2025, Exploration of the Construction Path of Informatization in Municipal Engineering Management. *Urban Construction Theory Research (Electronic Edition)*, 2025(7): 46–48.
- [2] Zhang Q, Zhang XW, Han L, 2025, Application of BIM Technology in Informatized Construction Management of Municipal Engineering. *Urban Construction Theory Research (Electronic Edition)*, 2025(6): 214–216.
- [3] Wang Y, 2025, Research on the Construction Optimization of Municipal Engineering Based on BIM. *Housing and Real Estate*, 2025(5): 62–64.
- [4] Fu W, 2024, Research on the Application of BIM Technology in Municipal Engineering Construction Management. *New Urban Construction Science and Technology*, 33(10): 160–162.
- [5] Gao TB, Chen CH, Yuan XM, et al., 2024, Application of BIM Technology in Airport Municipal Construction Management. *Technology Innovation and Application*, 14(30): 172–175 + 180.
- [6] Jia CS, 2024, Research on the Application of BIM Technology in the Construction Stage of Municipal Road Engineering. *Urban Construction Theory Research (Electronic Edition)*, 2024(28): 208–210.
- [7] Xu SW, Wang ZD, Wang Y, 2024, Discussion on BIM Technology in Municipal Engineering Management. *Building Materials Development Guide*, 22(16): 91–93.
- [8] Song Y, 2024, Research on the Progress Risk Management of Residential Projects Based on BIM, thesis, Guizhou University.
- [9] Guan TY, 2024, Application of BIM Technology in the Construction of Rail Transit Engineering. *China Municipal Engineering*, 2024(3): 23–26 + 152.
- [10] Deng ZY, 2024, Construction Process Management of Prefabricated Municipal Engineering Based on BIM Technology. *China Brand and Anti-Counterfeiting*, 2024(6): 78–80.
- [11] Liu B, 2024, Research on the Cost Management of Government-Invested Projects Based on BIM, thesis, Yangzhou University.
- [12] Wang JJ, 2024, Application of BIM Technology in Informatized Construction Management of Municipal Engineering. *Intelligent Building & Smart City*, 2024(5): 81–83.
- [13] Chen YL, Huang P, Yang J, 2024, Research on the Application of BIM Technology in the Construction Management of Rail Transit Mechanical and Electrical Engineering. *Sichuan Architecture*, 44(2): 259–262.
- [14] Yang H, 2024, Application of BIM Technology in Municipal Road Construction Management. *Intelligent Building & Smart City*, 2024(2): 182–184.
- [15] Tang HY, 2024, Optimization of Municipal Construction Project Management Based on BIM Technology. *Intelligent Building & Smart City*, 2024(1): 72–74.

Publisher's note

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

A Comparative Study of Chinese and English Hot Words of the Year from the Perspective of Sociolinguistics — Taking 2024 as an Example

Yemin Yue*

School of Foreign Languages, Central China Normal University, Wuhan 430079, Hubei, China

**Author to whom correspondence should be addressed.*

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: Language is a system of arbitrary vocal symbols used for human communication. It can reflect the change and development of society. Today, people often use language to communicate in various ways subtly. Thus, each year's hot words may somehow reflect people's minds directly and indirectly, which also expresses some messages of the whole society. Moreover, the hot words of the year in diverse countries also reflect the social and cultural background of the country differently, through which people may find current and future trends around the world. Under these circumstances, this paper chooses hot words of 2024 as an example, mainly comparing the Chinese and English buzzwords through the aspects of sociolinguistics. The study attempts to analyze the connotation, characteristics, and political, social, and international background of hot words, and compares the hot words in different countries, to reveal the current social development trend and cultural differences of different countries, and even the direction of future development.

Keywords: Sociolinguistics; Hot words of the year; Comparative analysis; Communication; 2024

Online publication: June 6, 2025

1. Introduction

In this section of the paper, the research background and purpose will be shown. The study mainly discusses the importance of language and the combination of social phenomena and linguistics in today's research ^[1-3].

1.1. Research background

With the acceleration of globalization and the development of society in today's world, language, as a communication tool, is becoming more and more important for its expression of the rapid change of life ^[4]. At this time, new internet words, hot words, and other linguistic phenomena spread rapidly on social media and become the focus of public attention. These phenomena not only enrich the language system but also reflect the social culture, values, and people's way of thinking ^[5].

As an important part of the linguistic phenomenon, the hot words of the year show distinct characteristics of the times and cultural background. They not only reflect the social hot spots, cultural trends, and people's psychological states at that time, but also indicate the changes and development of language under different cultural backgrounds. Moreover, Chinese and English are the most common languages used in the world. Thus, with this broad user base, the comparative study of Chinese and English hot words of the year can be authoritative and convincing. In addition, China and most English-speaking countries play important roles in international affairs. And through this research, the researchers may deeply understand the mutual influence and integration of the two languages in the background of globalization ^[6].

1.2. Research purpose and structure

By comparing the hot words of the year in China and English in 2024, this paper aims to achieve the following goals:

First, it gives a detailed analysis of this year's hot words, from the aspects of meaning, origin, and extended meaning. Thus, the researchers can have a basic grasp of these words, and it is beneficial for later analysis.

Second, it mainly reveals the political, social, and international backgrounds behind each language, respectively. Through this study, the researchers can see how these hot words reflect current social trends, popular culture, and evolving language. When analyzing, this paper also makes a comparison and contrast of the hot words ^[7]. Through this, the researchers can improve the understanding of the two languages and promote the understanding between different language communities. Additionally, it can promote the understanding and integration between different cultures and provide effective guidance for cross-cultural communication. The whole process of analyzing also improves problem-solving skills.

2. Elaboration of sociolinguistics

Sociolinguistics is the study of language and linguistic behaviors as influenced by social and cultural factors. And it is an independent discipline that emerged in the 1960s. Sociolinguists are concerned with the role language plays in maintaining social characters within a community, and they strive to identify linguistic features that are used in specific situations and that signify various social relationships among participants ^[8].

With increasing social changes, closer interpersonal communication, and rapid technological advancements, language changes are accelerating, providing sociolinguists with numerous valuable topics for research. This discipline focuses on how language varies and changes in different social contexts, influenced by factors such as age, gender, education, occupation, race, and so on. For instance, an American English speaker might use different grammatical forms depending on their education level, social class, or the desired effect on their listener.

In summary, sociolinguistics offers insights into how language shapes and reflects social identities and cultural norms by examining the relationship between language and various social factors. As society continues to evolve, sociolinguistics will continue to play a crucial role in understanding and interpreting the ever-changing landscape of language and its social context ^[9].

3. Analysis of Hot words of the year

3.1. Introduction

3.1.1. Chinese Hot Words

The study chose “Hanyu Pandian 2024 (汉语盘点)” as the main source of Chinese hot words of the year. It

has gone through two stages of people's recommendation of words and experts' selection, which is popular and authoritative^[10].

The domestic character is “zhi (智).” It not only refers to the “wisdom” of artificial intelligence, but also represents the “wisdom” that people can understand and adapt to the trend of history in this period of scientific and technological revolution. The domestic word is “New quality productivity (新质生产力).” It is a new term that the chairman of the CCP first mentioned during his investigation in Heilongjiang Province in September 2023. Compared with traditional productivity, new quality productivity pays more attention to technology, innovation, and high efficiency. What is more, the international character is “change (变),” which means change. It can be explained from many aspects: the change of lifestyle, the change of social landscape, the change of international relationships, and so on. And the international word is “AI (人工智能).” Artificial intelligence is the study of how to make computers do intelligent work that only people could do in the past, and is considered one of the three cutting-edge technologies in the 21st century, which is widely popularized and applied in today's society^[11].

Other selected words are “wen (稳),” “low-altitude economy (低空经济),” “zhan(战),” “Paris Olympic Games (巴黎奥运会),” “banweier (班味儿),” and so on.

3.1.2. English hot words

The English hot words of the year in this paper are mainly chosen from three famous dictionaries: Oxford, Cambridge, and Collins Dictionaries.

First, Oxford Dictionaries has declared their word of the year is “Brain Rot.” The first recorded use of brain rot was found in 1854 in Henry David Thoreau's book *Walden*, which reports his experiences of living a simple lifestyle in the natural world. But now, brain rot is defined as “the supposed deterioration of a person's mental or intellectual state, especially viewed as the result of overconsumption of material (now particularly online content) considered to be trivial or unchallenging. Also: something characterized as likely to lead to such deterioration” (Oxford Dictionary).

Second, Cambridge Dictionary announced its hot word is “Manifest.” It is a quite common word meaning to show a feeling, attitude, etc. While it has a different meaning in this year, which means to use methods such as visualization and affirmation to help one imagines achieving something he or she wants, in the belief that doing so will make it more likely to happen. Definitely it turns into more positive and detailed.

Third, the hot word of the year in Collins Dictionary is “Brat.” Its original use is to describe children with bad behavior. However, it is newly defined in 2024 as characterized by a confident, independent, and hedonistic attitude. The shift was triggered by the release of the British singer Charli XCX's album *Brat*, which spawned the cultural phenomenon of “Brat Summer”, symbolizing a confident and slightly rebellious lifestyle and bold style of dress.

Other selected words are quishing, ecotarian, dynamic pricing, anti-tourism, delulu, and so on.

3.2. Comparison and contrast

3.2.1. Semantic aspect

Many hot words in 2024 have shown their different meanings than ever, and it is a trend under the circumstances of a rapidly developing world^[12].

The Chinese character “智” can be interpreted from many aspects. It not only refers to artificial intelligence but also means the wisdom of people solving century-old problems and the wise applications people used in

the technological revolution. In English, the word “brat” has turned from a negative word into a positive one. It reveals the confident and independent attitude of some young people in modern society. They are not tiresome children who play tricks without consideration, but are people with their own attitudes towards this disordered world. What is more, the word “manifest” also shows its different meaning than ever. According to the Cambridge Dictionary’s editors, “manifest” has been looked up 130,000 times, making it one of the most looked-up words of 2024. Many people are under the impression that the word “manifest” only means “to provide evidence for.” But in fact, the word mentioned in 2024 is a new use, which refers to a positive psychological suggestion method. It can be interpreted as believing in yourself when trying to do something.

“Through the development and the changes of time, words are given new meanings or new usages different from the original meanings” (Ran Liu, cited in Chen, S, 2015). Above all, people can find that both Chinese and English words show an extended meaning in 2024, which has become a language trend.

3.2.2. Political aspect

New changes in modern society will inevitably bring new problems. National governance has become an important challenge for governments and officials around the world. The hot words in Chinese and English both reflect people’s attention on the current society and international situation.

For instance, the character “change (变)” can be interpreted from many aspects: turbulence in the world, such as regional conflicts and terrorism. In the face of many changes in international politics, China needs to seek opportunities, respond to challenges, and maintain strategic resolve and flexibility. Although the hot words in English do not reflect politics directly, people can dig out some information below the surface. The word “brain rot” seems to urge people to be alert and pay much attention to the political issues and rational judgment ability.

One subtle difference the researchers can notice between the hot words of the two languages is the underlying attitude. Chinese buzzwords tend to give positive affirmations and encouraging responses. They celebrate the right thing and provide exciting information. However, English buzzwords tend to criticize the current state of affairs, expose the ugliness and seriousness of things, and push people to do better. They are more likely to point out shortcomings and urge change ^[13].

3.2.3. Social aspect

Language is not only the carrier of culture, but also the witness of history. It faithfully records the year’s struggle, social changes, and the style of the times. Hot words in 2024, in particular, show people’s different attitudes towards life.

Another hot word selected in China is “banweier (班味儿)”, which means the characteristic of working people who dress in sloppy clothes and without makeup, and is a concrete representation of the daily commute. It expresses workplace anxiety and work fatigue in a helpless and humorous way. However, this tells people that if they cannot change the reality of the rush, they could try to defuse it with light humor. This word shows the reality of life exactly. Under the high pressure of the economy, many adults need to do more work than ever, which always makes one lose positive attitudes towards life. Moreover, it seems to be an urge for the government and enterprises to produce more beneficial policies to relieve working stress.

Moreover, in English, most words precisely express the true society and people’s viewpoint. In the past year, the use of “brain rot” has surged by about 230%. This reflects the public’s deep concern that excessive addiction to surface information and entertainment provided by the Internet may lead to intellectual decline. Its popularity also

arouses people's reflection on other internet phenomena: information cocoon and shallow reading. Social media and online video have indeed enriched life and brought convenience to information. However, people are gradually realizing that long-term immersion in low-level fragmented information will lead to a decline in concentration, memory, cognitive level, and ability to process complex tasks. It is unimaginable what will happen when people gradually lose logical thinking and systematic analysis ability, and become superficial and lazy.

Another word in English is "manifest." It was looked up more than 130,000 times on the Cambridge Dictionary website this year and is widely used in mainstream media. In the context of the global economic downturn and frequent mental health problems, "manifest" has become a source of spiritual comfort and support for many people. It encourages people to actively imagine the future, to draw the motivation to move forward in adversity.

All in all, the hot words of 2024 in two languages show the strict situation people are facing in this society. The coexistence of challenge and opportunity, pessimism and optimism, reflection and encouragement contributes to this colorful world. Although there are many uncertain and dark elements in the world, most people in different countries try their best to deal with wisdom and optimism spontaneously^[14].

3.2.4. International aspect

In addition to the above aspects, the differences between Chinese and English hot words are also reflected in the attention paid to international events.

For China, the international word of the year "AI (人 工 智 能)" highlights the importance of technology popularized around, although it is not a new word anymore. The development and application of artificial intelligence technology are profoundly changing international politics, economy, culture, and other fields, becoming a new highland for competition among countries. At the same time, AI also brings ethical, security, employment, and other challenges, which require international organizations and countries to strengthen cooperation and jointly develop rules and standards. In addition, the international character "change (变)" also reflects the turbulence and instability in the international situation, such as regional conflicts, terrorism, climate change, and other global issues, which need all countries to work together to solve to maintain world peace and stability^[15].

For English, the three topic words of the year pay more attention to people's minds than international affairs. However, some words, such as "ecotarian", can reflect people's focus on the international ecology. The word refers to a person who only eats food produced or prepared in a way that does not harm the environment. In this age of environmental pollution, westerners call on actions to reduce harm to the Earth, which is also a reflection of their awareness of the world.

Today, under such an international situation, China tries to seek new development opportunities, cope with various challenges, and maintain strategic focus and flexibility. The international words reflect China's active participation in global affairs and its contribution to international peace and development. And western people also try to find problems from some aspects, and are willing to solve them together.

4. Conclusion

Language is one of the most direct ways to observe current situations and problems around the world. Through this detailed analysis of Chinese and English hot words of the year, it can be found that today people are facing many mental problems due to the pressure of society, which can be caused by the intense international competition and a downward economic trend. But people try to resolve them through positive psychological suggestions and an open

attitude. At present, people are in a century of great changes, rapid development of technology, and an uncertain political situation; what they can do is to grasp every opportunity and make themselves stronger. At a time when global conditions are deteriorating, stability is progress. Ordinary people in the world should give up fantasy, face reality, and relieve anxiety altogether.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Liu R, 2015, Sociolinguistic Analysis of Internet Hot Words. *Education Journal*, 6(6): 60–69.
- [2] Song WQ, 2015, A Comparison of Chinese and English Hot Words of the Year. *Chinese Lexical Semantics*, 2015(9332): 83–90.
- [3] Li B, Zhang JM, 2024, Collective Characteristics, Potential Risks and Value Guidance: A Study on Youth Social Mentality behind 2023 Buzzwords of the Year. *Journal of China Studies*, 2024(2): 3.
- [4] Ding XW, 2024, Feeling the Changes of the Times through Annual Buzzwords. *Henan Daily*, 6.
- [5] Guo Y, 2024, Annual Buzzword “Brain Rot” Serves as a Warning. *Sichuan Daily*, 6.
- [6] Zheng Y, 2020, A Study of Annual Buzzwords from the Perspective of Social Cognitive Linguistics: Taking the Oxford English Dictionary’s Words of the Year as Examples. *Journal of Tianjin Foreign Studies University*, 27(1): 47–57 + 159.
- [7] Zhang HH, 2024, An Analysis of the Characteristics of English Buzzwords of the Year 2022 from a Sociolinguistic Perspective. *Overseas English*, 2024(21): 70–72.
- [8] Zhu J, 2019, A Comparative Study of Chinese and German Buzzwords of the Year from a Sociolinguistic Perspective. *Journal of Nanjing Institute of Technology (Social Science Edition)*, 19(2): 25–31.
- [9] Dong XL, 2018, Linguistic Functions of English Neologisms from a Sociolinguistic Perspective. *Journal of Liaoning University of Technology (Social Science Edition)*, 20(3): 60–62.
- [10] Qi B, Li M, Wang RD, 2023, A Comparative Study of Chinese and English Internet Neologisms in the Past Decade from a Sociolinguistic Perspective. *Overseas English*, 2023(4): 86–88.
- [11] Xie SJ, Zhang LY, 2025, A Study of the Internet Buzzword “XX□□ (XX Buddy)” from the Perspective of Cognitive Sociolinguistics. *Journal of South China Normal University (Social Science Edition)*, 2025(1): 131–140 + 207.
- [12] Ming L, 2014, Lexical Variation in Internet Vocabulary from a Cognitive Sociolinguistic Perspective. *Journal of Anshun University*, 16(3): 24–25 + 34.
- [13] Huang XF, 2015, Exploring the Generative Mechanism of Internet Neologisms from a Cognitive Sociolinguistic Perspective. *Journal of Hubei University of Economics (Humanities and Social Sciences)*, 12(4): 123–124.
- [14] Mu Q, 2017, The Development of Internet Buzzwords from a Sociolinguistic Perspective. *Journal of Guangzhou Open University*, 17(5): 57–60 + 110.
- [15] Li SY, Wang Y, 2021, A Study on Lexical Variation in Internet Vocabulary from a Cognitive Sociolinguistic Perspective. *Youthful Years*, 2021(13): 22–23.

Publisher’s note

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

Exploration on the Application of Big Data in Food Production Safety Supervision

Xiang'an Liu*

Haide College, Ocean University of China, Qingdao 266100, Shandong, China

**Author to whom correspondence should be addressed.*

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 guarantee of food safety has the characteristics of systematization and complexity. All the links need to pay attention to quality, including production, circulation, and so on. In the era of big data background, food safety supervision has changed significantly, strengthened the use of information technology, and promoted the quality of food supervision and management. From the perspective of food production safety supervision, this paper analyzes the application value of big data technology and puts forward specific application strategies, aiming to carry out high-quality food production safety supervision work, accumulate experience for subsequent food safety assurance, and provide reference for safety supervision work optimization.

Keywords: Big data; Food production; Safety regulation

Online publication: June 6, 2025

1. Introduction

Food safety is closely related to people's well-being. In order to ensure the safety of people's lives, it is necessary to pay attention to the development of food safety supervision and follow the bottom line of food safety^[1]. With the advent of the era of big data and the continuous development of information technology, it can be infiltrated into the food safety supervision work, improve the intelligent and modern level of food production safety supervision, and point out the right direction for subsequent supervision and management work. With the rapid development of society and economy, big data technology is widely used in the field of food safety and has been widely valued by government departments^[2]. Due to the abundance of food data, the supervision of food production safety can play the role of big data technology, improve the effectiveness of supervision, and play a good technical support role.

2. The application value of big data in food production safety supervision

In the supervision of food production safety, the use of big data technology shows the characteristics of large data

scale, multiple data types, and good data value ^[3]. Professionals can skillfully use big data technology to process food information, such as production and sales, so as to synchronize data and supervision, effectively extract data information, and provide information for the smooth development of supervision work. Based on this, food production safety supervision work has gradually transformed into intelligence and refinement, and the specific application value is as follows.

2.1. Integrating food safety data

Based on the help of big data technology, the risk of food production safety supervision link breaks the bondage of personal subjective judgment, mainly combined with food production link testing, data processing, etc., to carry out a comprehensive comparison. For example, the clenbuterol problem in the catering market, the food supervision department needs to combine event information and data to carry out effective identification activities and clarify the production direction of clenbuterol, to carry out targeted monitoring and management activities. In addition, professionals can use big data technology to break the previous data sampling problems, carry out reasonable supervision in the face of food transportation, sales and other links of data, effectively save and analyze the food safety risks of different links, and judge the food production safety risks faced by different regions ^[4].

2.2. Improving safety supervision capabilities

In the face of food production safety supervision, professionals can use big data technology to continuously mine food data, effectively process data, improve the production process, scientifically manage food classification activities, identify food production risks in a timely manner, and provide countermeasures for regulatory authorities. Big data technology has an analytical role, which can facilitate professionals to extract market consumption information, conduct in-depth analysis of food production trends, and clarify the law of food safety events ^[5]. In addition, food production safety supervision has professional characteristics. Professionals can use big data technology to harvest more safety risk content, improve the effectiveness of supervision, and clarify the probability and scope of food safety risks, so as to formulate timely measures to improve the quality of professional supervision work.

2.3. Strengthening public opinion management on safety

In the supervision of food production safety, the use of big data technology is of great value. Regulators can use data-based and information-based tools to build a comprehensive supervision mechanism and optimize different aspects, including prevention, control, and treatment ^[6]. Through the development of the whole chain supervision, food safety issues can be accurately and efficiently dealt with. At the same time, the release of transparent information can facilitate professionals to use big data technology, carry out scientific research work, regulate the behavior of food production enterprises, and require them to comply with laws and regulations, so that consumers can buy safe and healthy food. In addition, the use of big data in food production safety supervision can have a multi-faceted impact. First, big data technology can facilitate regulatory departments to carry out real-time supervision, effectively grasp social public opinion, and timely discover and respond to food safety problems of the public. The development of the above activities can effectively carry out food safety publicity work, so that the masses actively participate in food production safety supervision work. Second, the regulatory authorities can combine the results of big data to adjust and optimize the supervision strategy of food production safety, avoid the spread of bad public opinion, and make the food market more stable.

3. The application strategy of big data in food production safety supervision

3.1. Strengthen top-level design and improve supervision effect

China's food production safety smart supervision activities, its application practice has some problems, especially at the overall level ^[7]. From a specific point of view, the food supervision departments in different regions lack the construction of data information sharing mechanism ^[8]. Due to the intelligent supervision of food production safety and grasp its work basis, the policy needs to pay attention to the following aspects and carry out a good top-level design. First, pay attention to the convergence of multi-subject forces, build a national level food production safety supervision system, and carry out good overall planning work. Based on the guidance of the unified planning policy, food supervision departments in various regions need to pay attention to the optimization of food supervision work, point out the right direction for practice, effectively carry out intelligent supervision work, and reduce the waste of funds and human resources. Second, establish a unified food production supervision policy and clarify the data standards for smart supervision. With the help of top-level design, it can provide a reference and basis for the smooth development of smart supervision of food production, smoothly build smart food production supervision data, provide help for information exchange, and build a cross-regional information exchange platform. Through unified standards and requirements, food production supervision data can be collected, laying the foundation for subsequent intelligent supervision work, and promoting the construction of a national supervision mechanism to have a good data support effect. Third, the food production supervision database in different regions can be combined to carry out intelligent evaluation activities, play the role of big data technology, and carry out resource integration work. And all kinds of food safety supervision information can be centralized, thus promoting the sharing of regulatory data and effectively exerting the value of the current regulatory database. Fourthly, the government needs to play a supporting role to provide support for the intelligent supervision of food production safety in various regions, and rationally allocate policies and funds to effectively narrow the regulatory information gap in different regions and improve the quality of food production safety supervision.

3.2. Make good use of big data technology to optimize risk early warning

Starting from the supervision of food production safety, big data technology has played an important role in effectively adjusting the early warning work of food safety risks ^[9]. Professionals can use big data technology to carry out real-time monitoring, analyze food production safety data, identify possible food safety problems, improve decision-making guarantees for the smooth development of supervision, and avoid the emergence of food safety problems. Food safety risk early warning work can provide a guarantee for food production safety, so that teachers can carry out timely monitoring work, clearly identify food safety risks in a timely manner, and take scientific and reasonable countermeasures to avoid the emergence of food safety accidents ^[10]. Among them, the integration of big data technology can optimize the food safety risk early warning work and effectively play its technical role. From the perspective of traditional food safety supervision, it mainly relies on manual sampling and statistical analysis, but the food industry chain is complicated and huge, and it is difficult to deal with diversified data in the traditional mode. However, through the use of big data technology, the data can be processed and analyzed efficiently, so that the food safety risk warning activities have the characteristics of accuracy and timeliness ^[11].

In addition, professionals use big data technology to skillfully use the early warning system, integrate the construction of multi-level models and algorithms, and carry out diversified risk assessment activities ^[12]. For example, professionals can build a good early warning model based on real-time data and a knowledge graph,

accurately and effectively analyze potential risks, and reduce the problem of false positives and missed positives. Food safety risk early warning of big data technology has good advantages, but the specific application process faces challenges such as data quality, privacy, and technology updates. Based on this, professionals can carry out continuous optimization, carry out data collection work, and with the help of pre-processing and analysis activities, carry out data sharing, improve safety policies, promote the use of big data technology, and carry out good risk early warning activities^[13]. In the process of using specific big data technology, in order to improve the early warning effect of food safety risks, professionals need to carry out real-time monitoring, data analysis and other activities, play the role of big data, effectively improve the effect of food safety supervision, mitigate the possibility of risk, accelerate enterprise optimization, and build a safe and transparent food market atmosphere.

3.3. Optimize the regulatory environment and carry out comprehensive management

In the current era, the development and dissemination of the concept of collaborative education has been valued by the government, and relevant policy documents have been issued. In order to effectively realize the transformation of social governance, it is necessary to actively absorb external forces, carry out scientific social management activities, effectively enhance the enthusiasm of all subjects to participate in social governance activities, carry out good social governance activities, and promote the transformation of intelligent food supervision. To develop from the perspective of pluralistic co-governance. However, food production intelligent supervision activities, belong to a new management method, most people do not know enough about the relevant content, the understanding of food safety intelligent supervision is insufficient, the government plays a leading role, can be for professional personnel, carry out special skills training, assessment, and effectively improve the use of food production safety supervision equipment^[14]. Through the development of regular activities, teachers can be helped to familiarize themselves with the functions of supervision equipment and software, and effectively apply them to supervision activities, and effectively improve the level of production management. In the food safety supervision activities, the public plays the role of participants, while the food supervision departments need to pay attention to the development of publicity activities, skillfully use various ways, such as the Internet, television, and periodicals, popularize the knowledge of food production supervision, improve the quality of the masses. At the same time, the government and enterprises can carry out social activities to make food production safety the theme, to help the masses intuitively understand the significance of food safety supervision. By expanding the channels for the masses to participate, they can actively integrate into the safety supervision work, enhance their self-confidence and enthusiasm, and provide help for the comprehensive management of food production safety. From the perspective of food enterprises, enterprises play the role of corporate responsibility. In order to effectively supervise food production safety, it is not only necessary to strengthen the awareness of the main responsibility, promote enterprises to fulfill their responsibilities, and carry out good production and operation work. In addition, it can also use the improvement of incentive measures to enhance the enthusiasm of professionals and the masses, effectively carry out food safety co-governance activities, provide security for food production activities, promote the formation of an intelligent supervision system, carry out diversified governance, and promote the construction of a comprehensive governance pattern.

3.4. Strengthen personnel training and innovate big data technology

In the supervision process of food production safety, the ability of supervisors directly affects the effectiveness of supervision^[15]. In this regard, in order to effectively carry out production safety supervision work, it is necessary

to pay attention to the innovation of personnel supervision concept, carry out good guidance activities through advanced supervision ideas, and successfully carry out food safety supervision behavior, which can be started from the following perspectives.

First, pay attention to the optimization of traditional supervision activities, towards the development of digital supervision. In the past food production safety supervision, often need to rely on manpower to carry out supervision work, under the background of the current era, through the use of big data technology, can improve the intelligent level of supervision work, strengthen the use of modern science and technology, good digital supervision, big data as the basis, optimize the working ideas of professionals, and effectively improve the effectiveness of supervision. Second, to promote the transformation of supervision methods, the development of preventive supervision is needed. In the current era, food production safety is a basic livelihood issue. After the emergence of related problems, the regulatory authorities carry out accountability supervision passively, and the punishment carried out after the fact, it is difficult to fundamentally solve the food safety problem. Based on this, the regulatory department can carry out preventive supervision, effectively reduce the occurrence of damage, and truly keep pace with the times. Third, to promote the development of multi-angle supervision. For a long time, the government has played the role of the main body of food safety supervision, and specific regulatory practices are prone to some problems, such as poor regulatory effect and insufficient supervision. With the emergence of regulatory problems, regulatory departments need to change the concept of food supervision and form a diversified concept of food supervision, so as to effectively exert the value of smart supervision. Effectively improve the effectiveness of supervision.

4. Conclusion

To sum up, in the food safety supervision work, the supervision department can use big data technology innovatively, grasp the influence of various factors, carry out real-time and dynamic supervision work, so that the supervision has a higher depth, effectively reduce the work pressure of professionals, ensure the development of production supervision work, and ensure the safety of food production. Specifically speaking, the regulatory authorities can point out the direction for the supervision of smart production by strengthening the top-level design, optimizing the regulatory environment, and focusing on the training of professional talents, to have a good technical support effect. By promoting the innovation concept among professionals, the industry can meet the needs of production safety supervision, clarify the channels for public participation, create a good regulatory environment, and promote the smart transformation of food safety governance.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Jin P, Ye LM, Meng W, 2024, Application Analysis of Big Data Technology in Food Safety Supervision. Food Safety Guide, 2024(1): 7–9.
- [2] Wu SY, 2023, Application of Information Technology in Food Safety Supervision. China Food, 2023(8): 53–55.
- [3] Peng CJ, Chen SJ, 2024, Analysis of the Application of Big Data Technology in Food Safety Supervision. Food

Safety Guide, 2024(20): 23–25 + 29.

- [4] Hou J, 2021, Application of Computer Technology in Food Safety Traceability System. *Electronic Technology and Software Engineering*, 2021(10): 132–133.
- [5] Gao JM, 2023, Application of Big Data Technology in Food Safety Supervision. *China Food*, 2023(19): 133–135.
- [6] Zheng Y, Huang Y, Lu JY, et al., 2023, Research on the Construction of Big Data Quality Evaluation System for Food Safety Supervision. *China Standardization*, 2023(15): 68–73.
- [7] Zheng HW, Zhang MZ, Lei L, 2023, Application of Big Data Technology in Food Safety Supervision. *Laboratory Testing*, 1(3): 43–49.
- [8] Zhong YJ, 2023, Research on Food Safety Supervision Issues under the Background of Big Data, thesis, Anhui Polytechnic University.
- [9] Liu Z, 2023, Application of Big Data Technology in the Quality and Safety Supervision of Edible Agricultural Products. *Modern Food*, 29(9): 100–102.
- [10] Tao Q, Cui XH, 2020, Strengthening the Research on the Application of Big Data in Food Safety. *Chinese Journal of Food Hygiene*, 32(3): 223–227.
- [11] Huang TT, 2020, Research on Food Safety Supervision under the Background of Big Data, thesis, Anhui Polytechnic University.
- [12] Bao JH, 2019, Innovative Thinking of Safety Supervision in the Big Data Environment — Taking Food Safety as an Example. *Food Safety Guide*, 2019(24): 12.
- [13] Niu Y, 2022, Thoughts on the Application of Big Data and Intelligence in Food Supervision — Review of “Research on the Supervision System of Online Shopping Food Safety”. *Journal of Food Safety and Quality Inspection*, 13(9): 3059–3060.
- [14] Han Z, Wang HX, Gong L, et al., 2022, The Application and Challenges of Big Data Technology in Food Safety Supervision. *Journal of Food Safety and Quality Inspection*, 13(3): 956–962.
- [15] Xu L, Dang R, 2020, The Application of Big Data Technology in Food Safety Management — Review of “Supervision and Practice of Food Production Safety”. *The Food Industry*, 41(7): 364–364.

Publisher's note

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

Optimal Control Study of an SEIQRS Model with Three Interventions on Complex Networks

Shangqing Gong^{1,2}, Jianyong Dai^{1,2*}

¹School of Resources Environment and Safety Engineering, University of South China, Hengyang 421001, Hunan, China

²Key Laboratory of Emergency Safety Technology and Equipment of Nuclear Facilities in Hunan Province, Hengyang 421001, Hunan, China

**Author to whom correspondence should be addressed.*

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: Infectious diseases pose a significant threat to human life, health, and safety. Therefore, it is crucial to develop effective control strategies. This paper aims to address this concern through the construction of an SEIQRS model on complex networks. This model focuses on viruses that have an incubation period and are infectious during this period. In order to minimize the costs, optimal control theory is used to solve the time-varying control problem of vaccination, quarantine, and treatment. Subsequently, numerical simulations are performed to analyze the pros and cons of different control combinations, as well as the impact of parameters on the effectiveness of control. By doing so, better control strategies can be developed, and the relationship between parameters, contagion, and control can be revealed.

Keywords: Optimal control; Complex networks; Epidemic model; Numerical simulation

Online publication: June 6, 2025

1. Introduction

The world is currently facing a serious situation with regard to the spread of infectious diseases. There is therefore an urgent need to study the patterns and conditions of transmission of these diseases. On the one hand, there is the re-emergence of infectious diseases that used to be widespread in the past. On the other hand, new infectious diseases such as COVID-19 are emerging from time to time, threatening the physical and mental health of the people and the public safety of society. Taking steps to block the spread of the virus is crucial in protecting people's lives and health, as well as maintaining social stability.

Classical infectious disease dynamics revealed the transmission threshold law through the SIR/SIS hamartomatous model, but assumed a limitation of uniform population contact ^[1-3]. Complex network theory breaks through this limitation by abstracting individual exposure to network structure, and Pastor-Satorras showed that the transmission threshold in scale-free networks tends to zero as the network size grows, which explains the mechanism of the sustained global spread of modern infectious diseases ^[4]. Current research

focuses on: the effect of network topological features (degree distribution, clustering coefficients) on spread, the spreading patterns of dynamic and weighted networks, and the modeling of factors such as media awareness and protective behavior^[3, 5–7]. Control strategies have evolved from constant value control to optimal control, and balancing the cost and effectiveness of prevention and control by means of vaccination and isolation treatment has formed an important research direction^[8–9]. This field provides theoretical support for the development of precise prevention and control strategies by constructing a networked propagation model.

An attempt is made in this paper to analyze the advantages and disadvantages of different control combinations to provide some theoretical basis for the development of control strategies. The purpose of this investigation is to examine the effect of different control combinations and the effect of different model parameters on the control effectiveness.

2. Dynamic optimal control of an SEIQRS epidemic model on a complex network

2.1. SEIQRS epidemic model

The SEIR model divides the total population into four compartments: Susceptible (S) (uninfected individuals at risk of infection), Exposed (E) (infected individuals in the latent period with some infectiousness but no symptoms), Infected (I) (symptomatic individuals with higher infectiousness), and Recovered (R) (immune individuals no longer participating in viral transmission). By integrating the mean-field theory of complex networks, and assuming a constant total population, a latent period with infectiousness, and bilinear incidence rates, the SEIRS model on complex networks can be formulated as follows:

$$\begin{aligned}\frac{dS_k(t)}{dt} &= -\beta k S_k(t)(\Theta_1(t) + \theta \Theta_2(t)) + \delta R_k(t) \\ \frac{dE_k(t)}{dt} &= \beta k S_k(t)(\Theta_1(t) + \theta \Theta_2(t)) - \eta E_k(t) \\ \frac{dI_k(t)}{dt} &= \eta E_k(t) - \mu I_k(t) \\ \frac{dR_k(t)}{dt} &= \mu I_k(t) - \delta R_k(t)\end{aligned}\tag{1}$$

In Equation 1, β is the effective transmission rate, θ is the coefficient of the effective transmission rate of the incubator, δ is the rate of immune failure, k is the degree of the node, η is the outbreak rate, and μ is the natural recovery rate.

$\Theta_1(t) = \frac{1}{\langle k \rangle} \sum_k k P_k I_k(t)$ and $\Theta_2(t) = \frac{1}{\langle k \rangle} \sum_k k P_k E_k(t)$ represent the average contact rates, which denote the probability that any node is connected to an infected individual (I) or an exposed individual (E). The average degree of the node is denoted by $\langle k \rangle = \sum_k k P_k$, and $P_k (k=1, 2, \dots, n)$ represents the degree distribution of the node.

Additionally, three controls, namely vaccination $\alpha(t)S_k(t)$, quarantine $q(t)I_k(t)$, and treatment $\sigma(t)I_k(t)$, are introduced to the SEIRS model on complex networks to obtain the SEIQRS model with controls on complex networks (Equation 2). Here, the parameters α , q , and σ represent the proportion of the population receiving vaccination, quarantine, and treatment, respectively.

$$\begin{aligned}
\frac{dS_k(t)}{dt} &= -\beta k S_k(t)(\Theta_1(t) + \theta \Theta_2(t)) - \alpha S_k(t) + \delta R_k(t) \\
\frac{dE_k(t)}{dt} &= \beta k S_k(t)(\Theta_1(t) + \theta \Theta_2(t)) - \eta E_k(t) \\
\frac{dI_k(t)}{dt} &= \eta E_k(t) - (\mu + q + \sigma) I_k(t) \\
\frac{dQ_k(t)}{dt} &= q I_k(t) - \varepsilon Q_k(t) \\
\frac{dR_k(t)}{dt} &= (\mu + \sigma) I_k(t) + \varepsilon Q_k(t) + \alpha S_k(t) - \delta R_k(t)
\end{aligned} \tag{2}$$

where α is the effective vaccination rate, q is the isolation rate, and σ is the treatment recovery rate. $Q(t)$ represents the proportion of the population under quarantine as a function of time. Q is based on the assumption that the isolatee de-isolates and resumes the original social relationship (the original connecting edge) immediately after recovery. The initial conditions of model (2) are:

$$\begin{cases} 0 \leq S_k(0), E_k(0), I_k(0), Q_k(0), R_k(0) \leq 1 \\ S_k(0) + E_k(0) + I_k(0) + Q_k(0) + R_k(0) = 1, (k = 1, 2, \dots, n) \end{cases} \tag{3}$$

2.2. Optimal controls

In this section, the optimal control theory will be used to discuss the optimal control problem for each control combination and compare them.

The control variables $u(t)$ and the Lagrangian function $L(x(t), u(t))$ for different control combinations are shown in **Table 1**, where $\alpha(t)$, $q(t)$, and $\sigma(t)$ are defined as $\alpha(t) = (\alpha_1(t), \alpha_2(t), \dots, \alpha_n(t))$, $q(t) = (q_1(t), q_2(t), \dots, q_n(t))$, $\sigma(t) = (\sigma_1(t), \sigma_2(t), \dots, \sigma_n(t))$. Define the control set $U = \{u(t), 0 \leq \alpha_k(t), q_k(t), \sigma_k(t) \leq 1, t \in [0, T]\}$ with $T > 0$ as the target moment and construct the objective function $J(u) = \int_0^T L(u(t)) dt$. The meaning of the objective function is the cost of the control measures, including the cost of implementing the control and the cost of the reduced social benefits resulting from contracting the disease, where the cost of the reduced social benefits resulting from contracting the disease is characterized by the number of infected persons. It is assumed that both types of costs are equally important and have the same weighting factor. The optimal control problem for model (2) under the seventh control combination is as follows:

Solving the optimal control problem involves finding an optimal control u^* such that $J(u) = \min_{u(t) \in U} J(u)$. For equation 2, there are seven combinations of vaccination, quarantine, and treatment. The optimal control problems under the other six control combinations can be considered as special cases when some of the control parameters of combination 7 are constants of zero.

Table 1. Control variables and Lagrangian functions \in

Combination	Control parameter	$u(t)$	$L(x(t), u(t))$
1	α	$\alpha(t)$	$\sum_{k=1}^n [I_k(t) + \frac{1}{2} A_k \alpha_k^2(t)]$
2	q	$q(t)$	$\sum_{k=1}^n [I_k(t) + \frac{1}{2} B_k q_k^2(t)]$
3	σ	$\sigma(t)$	$\sum_{k=1}^n [I_k(t) + \frac{1}{2} C_k \sigma_k^2(t)]$
4	α, q	$(\alpha(t), q(t))$	$\sum_{k=1}^n [I_k(t) + \frac{1}{2} A_k \alpha_k^2(t) + \frac{1}{2} B_k q_k^2(t)]$
5	α, σ	$(\alpha(t), \sigma(t))$	$\sum_{k=1}^n [I_k(t) + \frac{1}{2} A_k \alpha_k^2(t) + \frac{1}{2} C_k \sigma_k^2(t)]$
6	q, σ	$(q(t), \sigma(t))$	$\sum_{k=1}^n [I_k(t) + \frac{1}{2} B_k q_k^2(t) + \frac{1}{2} C_k \sigma_k^2(t)]$
7	α, q, σ	$(\alpha(t), q(t), \sigma(t))$	$\sum_{k=1}^n [I_k(t) + \frac{1}{2} A_k \alpha_k^2(t) + \frac{1}{2} B_k q_k^2(t) + \frac{1}{2} C_k \sigma_k^2(t)]$

To solve the optimal control problem (Equation 2) for the combination 7 as an example, the Hamiltonian function (Equation 4) needs to be defined first.

$$H = L(x(t), u(t)) + \sum_{k=1}^n [\lambda_{1k}(t) \dot{S}_k(t) + \lambda_{2k}(t) \dot{E}_k(t) + \lambda_{3k}(t) \dot{I}_k(t) + \lambda_{4k}(t) \dot{Q}_k(t) + \lambda_{5k}(t) \dot{R}_k(t)] \quad (4)$$

The adjoint variables, denoted as $\lambda_{1k}(t)$, $\lambda_{2k}(t)$, $\lambda_{3k}(t)$, $\lambda_{4k}(t)$, $\lambda_{5k}(t)$, are relevant for this function. According to Pontryagin's principle of great value, the optimal solution, denoted as O^* can be obtained. In this case, $O^* = \{S_1^*(t), E_1^*(t), I_1^*(t), Q_1^*(t), R_1^*(t), \dots, Q_n^*(t), R_n^*(t)\}$ is the solution of Equation 2 in the state of optimal control $u^*(t)$. Additionally, the optimal solution of the control variables can be determined by Equation 6, provided that the conditions $\theta_1^*(t) = \frac{1}{\langle k \rangle} \sum_k k P_k I_k^*(t)$, $\theta_2^*(t) = \frac{1}{\langle k \rangle} \sum_k k P_k E_k^*(t)$, and the boundary conditions (Equation 5) are satisfied. The proof of this conclusion is presented below.

$$\lambda_{1k}(T) = \lambda_{2k}(T) = \lambda_{3k}(T) = \lambda_{4k}(T) = \lambda_{5k}(T) = 0, k = 1, 2, \dots, n \quad (5)$$

$$\alpha_k^* = \min \left\{ \max \left\{ 0, \frac{S_k^*(t)(\lambda_{1k}(t) - \lambda_{5k}(t))}{A_k} \right\}, 1 \right\} \quad (6)$$

$$q_k^* = \min \left\{ \max \left\{ 0, \frac{I_k^*(t)(\lambda_{3k}(t) - \lambda_{4k}(t))}{B_k} \right\}, 1 \right\}$$

$$\sigma_k^* = \min \left\{ \max \left\{ 0, \frac{I_k^*(t)(\lambda_{3k}(t) - \lambda_{5k}(t))}{C_k} \right\}, 1 \right\}$$

PROOF: Following Pontryagin's principle of extreme value, the Hamiltonian function (Equation 4) is defined. The adjoint variables can be calculated by the system of differential equations (Equation 7).

$$\dot{\lambda}_{1k}(t) = -\frac{\partial H}{\partial S_k} \Big|_{O^*(t)}, \dot{\lambda}_{2k}(t) = -\frac{\partial H}{\partial E_k} \Big|_{O^*(t)}, \dot{\lambda}_{3k}(t) = -\frac{\partial H}{\partial I_k} \Big|_{O^*(t)} \quad (7)$$

$$\dot{\lambda}_{4k}(t) = -\frac{\partial H}{\partial Q_k} \Big|_{O^*(t)}, \dot{\lambda}_{5k}(t) = -\frac{\partial H}{\partial R_k} \Big|_{O^*(t)}$$

$$\frac{\partial H}{\partial \alpha_k} \Big|_{O^*(t)} = \frac{\partial H}{\partial q_k} \Big|_{O^*(t)} = \frac{\partial H}{\partial \sigma_k} \Big|_{O^*(t)} = 0 \quad (8)$$

$$\dot{\lambda}_{1k} = -\frac{\partial H}{\partial S_k} = \beta k (\Theta_1(t) + \theta \Theta_2(t)) (\lambda_{1k}(t) - \lambda_{2k}(t)) + \alpha_k(t) (\lambda_{1k}(t) - \lambda_{5k}(t)) \quad (9)$$

$$\dot{\lambda}_{2k} = -\frac{\partial H}{\partial E_k} = \frac{1}{\langle k \rangle} \beta \theta k P_k \sum_{k=1}^n [k S_k (\lambda_{1k}(t) - \lambda_{2k}(t))] + \eta (\lambda_{2k}(t) - \lambda_{3k}(t))$$

$$\dot{\lambda}_{3k} = -\frac{\partial H}{\partial I_k} = -1 + \frac{1}{\langle k \rangle} \beta k P_k \sum_{k=1}^n [k S_k (\lambda_{1k}(t) - \lambda_{2k}(t))] + q_k(t) (\lambda_{3k}(t) - \lambda_{4k}(t)) + (\mu + \sigma_k(t)) (\lambda_{3k}(t) - \lambda_{5k}(t))$$

$$\dot{\lambda}_{4k} = -\frac{\partial H}{\partial Q_k} = \varepsilon (\lambda_{4k}(t) - \lambda_{5k}(t))$$

$$\dot{\lambda}_{5k} = -\frac{\partial H}{\partial R_k} = \delta (\lambda_{5k}(t) - \lambda_{1k}(t))$$

The system of differential equations (Equation 7), which is satisfied by the adjoint variables, can be derived using the boundary conditions (Equation 5) and the control equations (Equation 8). Finally, the optimal solutions of the control can be obtained as Equation 10, Equation 11, and Equation 12, respectively.

$$\frac{\partial H}{\partial \alpha_k} \Big|_{O^*(t)} = A_k \alpha_k^*(t) - \lambda_{1k}(t) S_k^*(t) + \lambda_{5k}(t) S_k^*(t) = 0 \quad (10)$$

$$\alpha^* = \min \left\{ \max \left\{ 0, \frac{S_k^*(t) (\lambda_{1k}(t) - \lambda_{5k}(t))}{A_k} \right\}, 1 \right\}$$

$$\frac{\partial H}{\partial q_k} \Big|_{O^*(t)} = B_k q_k^*(t) - \lambda_{3k}(t) I_k^*(t) + \lambda_{4k}(t) I_k^*(t) = 0 \quad (11)$$

$$q^* = \min \left\{ \max \left\{ 0, \frac{I_k^*(t) (\lambda_{3k}(t) - \lambda_{4k}(t))}{B_k} \right\}, 1 \right\}$$

$$\frac{\partial H}{\partial \sigma_k} \Big|_{O^*(t)} = C_k \sigma_k^*(t) - \lambda_{3k}(t) I_k^*(t) + \lambda_{5k}(t) I_k^*(t) = 0 \quad (12)$$

$$\sigma^* = \min \left\{ \max \left\{ 0, \frac{I_k^*(t) (\lambda_{3k}(t) - \lambda_{5k}(t))}{C_k} \right\}, 1 \right\}$$

3. Numerical simulation

According to the complex network theory, the structure of a social network aligns with that of a scale-free network. The model is assumed to be based on a BA scale-free network with the nodes' degree distribution following a power law, constructed using an evolutionary generation approach. The degree distribution of the network is $P_k = ck^{-\gamma}$, where $c=11.6$, $\gamma=2.64$, $\sum_{k=1}^n P_k=1$, $n=188$, $\langle k \rangle=6.9$.

This section analyzes the advantages and disadvantages of different control combinations for fixed parameters. Set some parameters in the model to $\beta=0.5$, $\delta=0.01$, $\mu=0.01$, $\varepsilon=0.35$, $\eta=0.07$, $\theta=0.5$. The initial conditions are $\sum_{k=1}^n S_k(0)=0.9$, $\sum_{k=1}^n E_k(0)=0$, $\sum_{k=1}^n I_k(0)=0.1$, $\sum_{k=1}^n Q_k(0)=0$, $\sum_{k=1}^n R_k(0)=0$, with the initial number of infections being 10% of the total number of randomly selected individuals. Since randomly selecting initial infected individuals could lead to varying simulation results each time, the average of 100 simulation outcomes is taken as the final result. Set the cost weight coefficients in the objective function to $A_k=0.05$, $B_k=0.8$, $C_k=0.5$, and the objective time is set to $T=10$. The control intensity of the small compartment of each degree is averaged as the control intensity of the large compartment, like $\alpha(t)=\sum_{k=1}^n \alpha_k(t)/n$, $q(t)=\sum_{k=1}^n q_k(t)/n$, $\sigma(t)=\sum_{k=1}^n \sigma_k(t)/n$.

The numerical simulation results are shown in **Figure 2**, where combination 0 is the case without controls. The infected number demonstrates the effects of control measures. As shown in **Figure 2(a)**, vaccination alone can only keep the number of infected individuals at its initial level, while also maintaining a gradual decrease in the infection count over time. The effectiveness difference between quarantine and treatment, whether used alone or in combination, is not significant. In combinations with vaccination, the infected number consistently decreased, while in combinations without vaccination, it rebounded after a period of reduction. Mechanistically, vaccination takes longer to work and is expected to completely eliminate infectious diseases. Quarantine and treatment reduce the infected people for a short period of time, but only work on infected people and are difficult to completely eliminate infectious diseases.

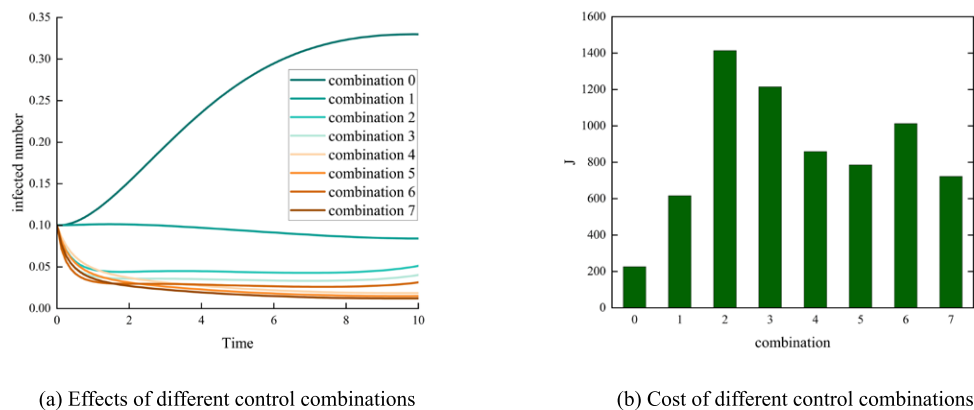


Figure 2. Effects and cost of different control combinations.

As shown in **Figure 2(b)**, vaccination alone is cheaper but less effective. The cost of combinations with vaccination is less than the cost of combinations without vaccination. The cost of combined control combinations is less than the cost of quarantine or treatment only, where the cost of treatment is less than the cost of quarantine.

The optimal control is shown in **Figure 3**. Vaccination is significantly higher than quarantine and treatment. Vaccination is reduced sharply at the beginning and then gradually reduced. Quarantine and treatment fluctuate in the absence of vaccination, but level off and decrease in the presence of vaccination. The combination of three controls is stronger than the combination of two controls, which is stronger than a single control.

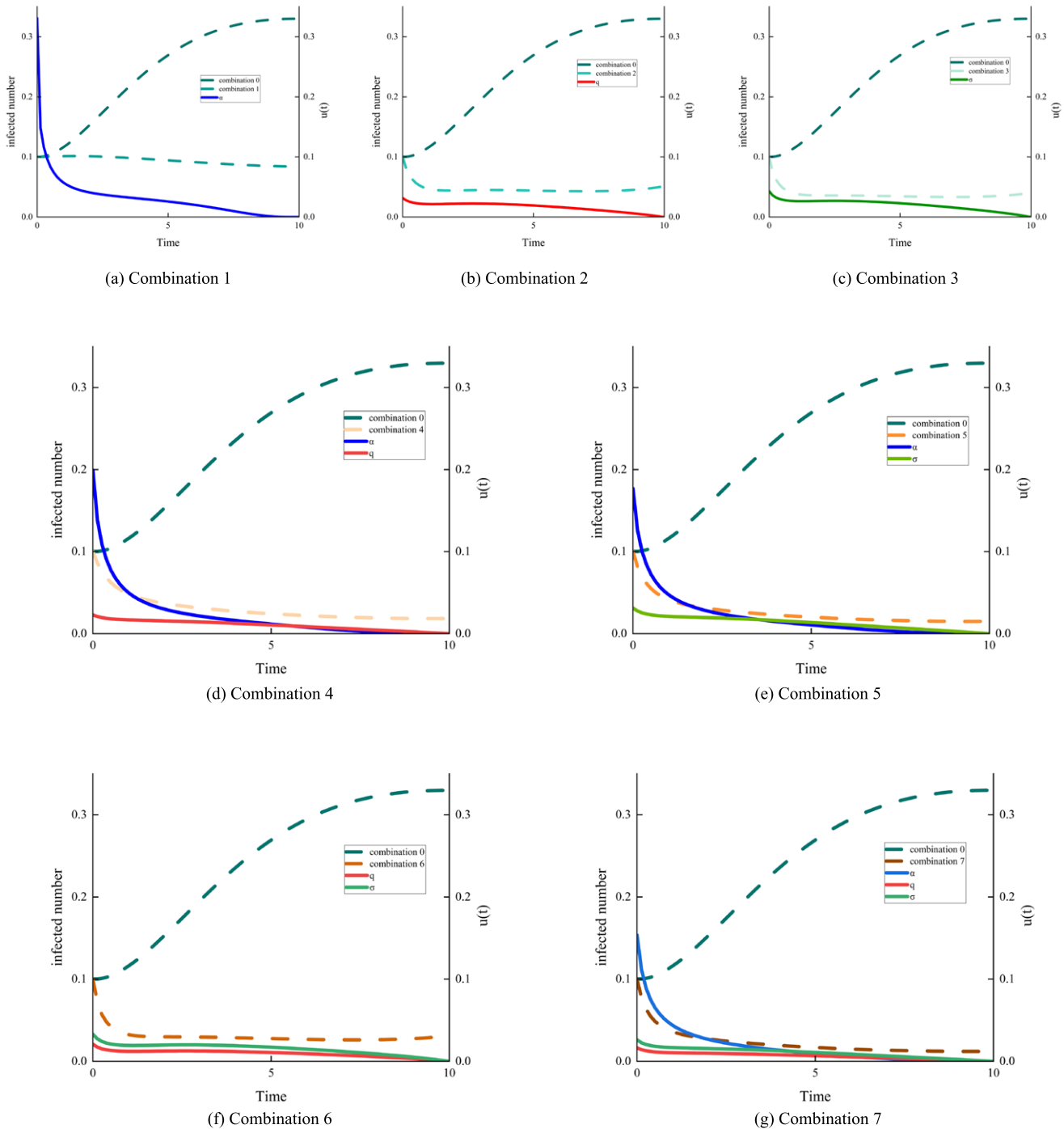


Figure 3. The infected number and the solution for optimal control

4. Conclusion

This paper analyzes the optimal control problem for SEIQRS models on complex networks. The three optimal controls of vaccination, quarantine, and treatment were solved. The effects of parameters on the effectiveness of control were studied. Theoretical results were corroborated with numerical simulations. The effects and costs of different combinations of controls were compared. From these analyses, the following conclusions were drawn.

Quarantine and treatment are more effective than vaccination for short periods of time. The effectiveness of quarantine and treatment, whether used alone or in combination, does not significantly differ. On the other hand, vaccination is effective in limiting the spread of infectious diseases and eliminating them altogether. However, vaccination alone is not effective in reducing the number of infected individuals for a short period of time.

The cost of control combinations is generally lower than the cost of implementing a single control. Combinations that involve vaccination have lower costs compared to those without vaccination. Moreover, the overall cost of quarantine and treatment is higher than the cost of vaccination.

Short-term vaccination is preferable over quarantine and treatment. Combinations involving vaccination exhibit smoother changes compared to combinations without vaccination.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Kermack WO, McKendrick AG, 1927, A Contribution to the Mathematical Theory of Epidemics. *Proceedings of the Royal Society of London, The Royal Society*, 115(772): 700–721.
- [2] Kermack WO, McKendrick AG, 1932, Contribution to the Mathematical Theory of Epidemics II: The Problem of Endemicity. *Proceedings of the Royal Society of London A: Mathematical, Physical and Engineering Sciences*, 1932(138A): 55–83.
- [3] Watts D, Strogatz S, 1998, Collective Dynamics of “Small-world” Networks. *Nature*, 393(6684): 440–442.
- [4] Pastor-Satorras R, Castellano C, Van Mieghem P, et al., 2015, Epidemic Processes in Complex Networks. *Reviews of Modern Physics*, 87(3): 925–986.
- [5] Liu G, Liu L, Jin Z, 2018, Dynamics Analysis of Epidemic and Information Spreading in Overlay Networks. *Journal of Theoretical Biology*, 2018(444): 28–37.
- [6] Holme P, Saramaki J, 2012, Temporal Networks. *Physics Reports*, 2012(519): 97–125.
- [7] Xia CY, Wang ZS, Zheng CY, et al., 2019, A New Coupled Disease-awareness Spreading Model with Mass Media on Multiplex Networks. *Information Sciences*, 2019(471): 185–120.
- [8] Jia N, Ding L, Liu YJ, et al., 2018, Global Stability and Optimal Control of Epidemic Spreading on Multiplex Networks with Nonlinear Mutual Interaction. *Physica A*, 2018(502): 93–105.
- [9] Fleming WH, Rishel RW, 1975, *Deterministic and Stochastic Optimal Control*. Springer Verlag, New York, 26–99.

Publisher's note

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

The Intrinsic Mechanism and Enhancement Pathways of Online Social Science Popularization Effectiveness

Zhicai Hou*, Bei Yuan, Yaoting Fu

East China University of Technology, Nanchang 344000, Jiangxi, China

**Author to whom correspondence should be addressed.*

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 recent years, social philosophy has emphasized that the popularization of social sciences is a crucial means to enhance citizens' social scientific literacy and ideological-moral standards, promoting comprehensive individual development and the progress of social civilization. As an important channel for such efforts, online social science dissemination plays a significant role in advancing its reach. However, the current effectiveness of online dissemination still faces numerous challenges. Therefore, this study analyzes the weight of factors influencing online social science popularization based on questionnaire data and identified issues. Furthermore, drawing on DeFleur's Interactive Process Model, a closed-loop framework is constructed, encompassing subject encoding, channel communication, audience decoding, and feedback regulation. This model reveals the interaction among subject control, channel algorithm optimization, and audience demand responsiveness. Based on the findings, solutions are proposed through three pathways: internal dynamics, external dynamics, and feedback regulation mechanisms. These include expanding the scope of popularization subjects via policy incentives, enabling targeted content delivery through technological empowerment, and establishing digital feedback mechanisms. The study aims to provide decision-making support for governments in optimizing resource allocation for social science popularization and setting technical standards for online dissemination, thereby contributing to rural revitalization and the improvement of citizens' scientific literacy.

Keywords: Internet; Big data; Analytic hierarchy process; Intrinsic mechanism; Pathways

Online publication: June 6, 2025

1. Introduction

According to the 50th Statistical Report on China's Internet Development by the China Internet Network Information Center (CNNIC), as of June 2022, China's Internet user base reached 1.051 billion, with an Internet penetration rate of 74.4%, including 58.8% in rural areas. The average weekly online time per user was 29.5 hours, mobile Internet usage accounted for 99.6%, and short video users numbered 962 million, representing

91.5% of the total user base, laying a robust foundation for online social science popularization. Current research indicates that advancements in information technology present both opportunities and challenges for social science dissemination: Domestic scholars highlight issues such as uneven content quality and insufficient dissemination efficiency in online platforms, while the international academic community emphasizes collaborative pathways integrating public engagement and technological empowerment, exemplified by insights from the U.S. National Academy of Sciences' evaluation framework for science communication.

Despite theoretical advancements, practical implementation faces contradictions between the proliferation of pseudo-scientific content on self-media platforms and the insufficient outreach capabilities of official channels. Enhancing the credibility of online content, optimizing algorithmic precision in information delivery, and establishing dynamic feedback mechanisms have emerged as critical strategies to strengthen the effectiveness of social science popularization.

2. Current challenges in online SSP effectiveness

2.1. Public cognitive deficits and social prioritization bias

Survey data reveal that only 10.08% of the public self-identify as “highly knowledgeable” in social sciences, while over 70% possess intermediate awareness. Structural imbalances stem from two dimensions: 56% of audiences hold educational qualifications below associate degrees, and societal prioritization skews toward STEM fields (social science activities account for <30% in many regions), with 42.86% dismissing social science knowledge as “unimportant”^[1]. Deeper contradictions lie in the inadequate scientific literacy of social science practitioners, 60% of academics engage in astrology-related activities, and 30% of highly educated groups endorse its scientific validity, reflecting the marginalization of social sciences.

2.2. Dual lag in communication efficacy and governance mechanisms

Over 70% of respondents rely on online channels, yet 23.53% question their credibility. Offline engagement remains low (21.29%). Governance deficiencies manifest in fragmented regulations: no national legislation exists, while localized policies (e.g., Hunan Province's guidelines) lack coordination. 63.03% of activities rely on individual initiatives with insufficient funding. Rigid dissemination formats exacerbate supply-demand mismatches: 61.62% demand enhanced engagement, yet innovative formats cover only 14.29%, resulting in 69.47% rating outcomes as “mediocre.”

2.3. Content misalignment and professional capacity gaps

While 79.83% of audiences prioritize practical knowledge, 68.35% of supplied content remains theoretical, with critical fields like legal studies (40.06%) and healthcare (52.66%) underrepresented. Rural areas face <35% coverage of economic management knowledge, and 65% of youth deem the content monotonous. Root causes include shortages of professional creators, absent demand-response mechanisms, and risk-averse content strategies constrained by ideological oversight^[2]. The “scenario-based popularization” model in Yuhuan City elevated participation by 30%, demonstrating reform potential.

2.4. Urban-rural popularization divide

Urban areas monopolize >80% of resources (lectures, exhibitions), while rural residents (42.3% of the population) endure scarcity. Entertaining self-media content dominates 80% of rural online engagement,

with short videos penetrating 76.5% of family chat groups. This entrenches a structural contradiction: “urban resource surplus versus rural demand deprivation.”

3. Analysis of factors influencing the effectiveness of online social science popularization

Online social science popularization, serving as a critical supplement to traditional approaches, urgently requires enhanced effectiveness. To identify influencing factors, this study collected 357 valid responses through a questionnaire designed with reference to the China Public Science Literacy Survey Report and existing research frameworks, covering three dimensions: participation behaviors, attitudes, and demands. The sample predominantly comprised adolescent students (66.39%), individuals aged 18–35 (83.19%), and highly educated groups (94.68%), necessitating caution regarding the generalizability of findings due to demographic concentration. Building on Guo Liang’s OLS model, which confirmed positive correlations among active learning, perceived importance, and credibility with popularization outcomes, this research further employs the analytic hierarchy process (AHP) to quantify the relative weights of these three factors and online dissemination methods on effectiveness, thereby providing empirical support for optimization strategies ^[3].

3.1. Indicator design

This indicator system integrates communication theory and empirical research, structured around four core dimensions—active online learning, perceived importance of social science popularization, online science communication credibility, and digital dissemination modes, which correspond to audience cognition-behavior patterns, content quality, and channel efficacy. Anchored in Lasswell’s “5W” model, the meso-level indicators emphasize dissemination channels, incorporating social media platforms as mainstream conduits through survey data while bridging traditional and emerging media ecosystems ^[4]. Specific platform functionalities are linked to theoretical constructs: Baidu Baike’s credibility underpins content quality, whereas WeChat and Weibo facilitate active learning behaviors. By synthesizing Bucchi’s public engagement with science model and the NASEM channel efficacy framework, the system enhances social media’s interactivity and scientific rigor in dissemination performance, ultimately forming a multidimensional, synergized framework (**Figure 1**).

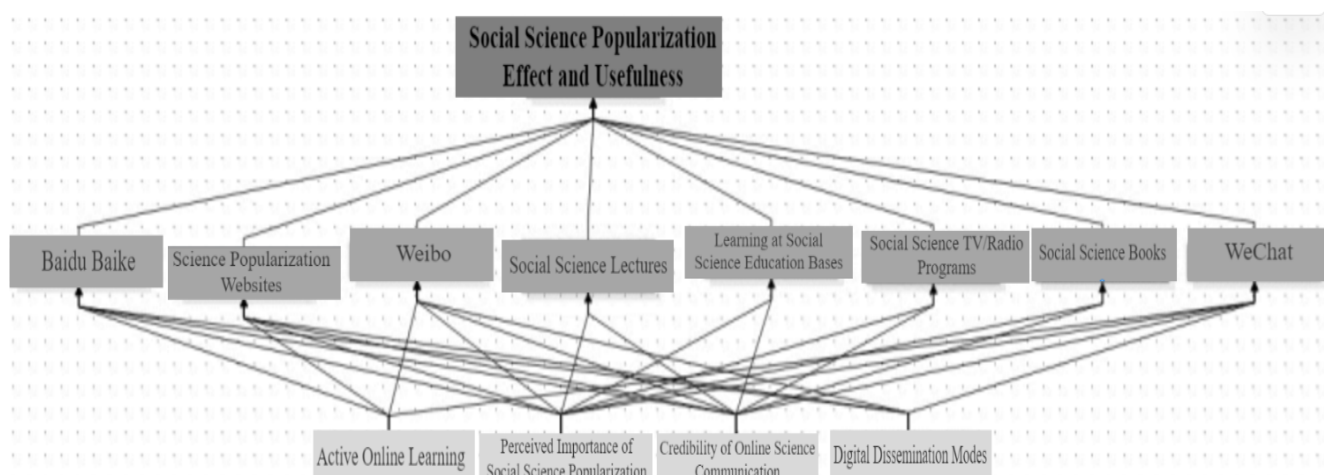


Figure 1. The relationship of the index system of the analytic hierarchy process

3.2. Construction of hierarchical structure model and judgment matrix

3.2.1. Establishing the hierarchical structure system

Based on the indicators selected in the previous section, we constructed the following hierarchical levels as shown in the table below (Table 1).

Table 1. Judgment system for the effect and usefulness of social science popularization

Decision-making objective	Middle layer	Relevant factors
Social Science Popularization Effect and Usefulness A	Baidu BaikeB ₁	
	Science Popularization WebsitesB ₂	
	WeiboB ₃	Active Online LearningC ₁
	Social Science LecturesB ₄	Perceived Importance of Social Science PopularizationC ₂
	Learning at Social Science Education BasesB ₅	Credibility of Online Science CommunicationC ₃
	Social Science TV/Radio ProgramsB ₆	Digital Dissemination ModesC ₄
	Social Science BooksB ₇	
	WeChatB ₈	

3.2.2. Construction of the hierarchical structure model

In the analytic hierarchy process (AHP), the authors employ the consistent matrix method to construct the judgment matrix. Specifically, rather than conducting collective comparisons of all involved factors simultaneously, this method systematically compares each pair of factors separately. This pairwise comparison approach significantly reduces computational errors that may arise from simultaneous multi-factor comparisons, thereby enhancing the precision of the results. The matrix is conventionally denoted as “A”, with its specific elements represented as “a_{ij}” (Table 2).

Table 2. Scaling methods for judging matrices a_{ij}

Scale	Meaning
1	It indicates that the two factors are of equal importance when compared
3	It indicates that, compared with the two factors, one factor is slightly more important than the other
5	It indicates that when comparing two factors, one factor is significantly more important than the other
7	It indicates that when comparing two factors, one factor is more strongly important than the other
9	It indicates that compared with the two factors, one factor is more important than the other
2,4,6,8	The median of the above two adjacent judgments
Reciprocal	Factor a _{ji} =1/a _{ij}

3.3. Hierarchical sorting and consistency checking

For the maximum eigenroot λ_{\max} in the judgment matrix, the eigenvector of λ_{\max} is normalized, which means that the total result of each element in the vector is 1, and the result after normalization is marked with the W symbol. The elements of W are sorted hierarchically, that is, the ranking weight of the relative importance of the elements of the same level to a factor at the next level.

Define conformance metrics $CI = \frac{\lambda - n}{n - 1}$

Among them:

$CI = 0$, with complete consistency;

CI is close to 0 and has satisfactory consistency.

The larger the CI , the more serious the inconsistency.

Then, the random consistency index RI is introduced to measure the CI size.

The consistency ratio calculation formula is defined: $CR =$ (Table 3). It is generally believed that when the consistency ratio $CR < 0.1$, the degree of inconsistency of the matrix is within an acceptable range, and then the consistency test is passed. The normalized eigenvector can be used as the weight vector, otherwise, the pair comparison matrix should be reconstructed to adjust a_{ij} .

Table 3. Random consistency index RI

n	1	2	3	4	5	6	7	8
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41

3.4. Determine the indicator weight

At the beginning of the calculation, the questionnaire survey method is adopted, through the masses to distribute questionnaires, score the indicators, and then take the weighted average. After sorting out the questionnaire data, AHP software is used to calculate the data results and carry out a consistency test to obtain the relevant weights. The analysis is as follows.

The middle layer includes eight indicators: Baidu encyclopedia, popular science website, microblog, listening to social science lectures, learning in a social science base, watching social science TV and radio programs, social science books, and WeChat. Relevant results are obtained according to importance, and the judgment matrix is shown as follows (Table 4).

Table 4. Weights under level A of decision-making objectives

Social science popularization effect and usefulness A	Baidu baike B_1	Science popularization websites B_2	Weibo B_3	Social science lectures B_4	Learning at social science education bases B_5	Social science TV/Radio programs B_6	Social science books B_7	WeChat B_8	W_i
Baidu Baike B_1	1	2	1/3	2	4	2	3	1/2	0.1437
Science popularization websites B_2	1/2	1	1/2	2	2	2	3	1/3	0.1108
Weibo B_3	3	2	1	1	6	2	3	1/3	0.1735
Social science lectures B_4	1/2	1/2	1	1	1	1/4	1/3	1/5	0.0512
Learning at social science education bases B_5	1/4	1/2	1/6	1	1	1/4	1/2	1/7	0.0379
Social science TV/Radio programs B_6	1/2	1/2	1/2	4	4	1	3	1/3	0.1108
Social science books B_7	1/3	1/3	1/3	3	2	1/3	1	1/4	0.0617
WeChat B_8	2	3	3	5	7	3	4	1	0.3103

The vector of the above judgment matrix is calculated, and then the vector is normalized to obtain the weight ratio of indicators at level A of the decision target, $W = (0.1437 \ 0.1108 \ 0.1735 \ 0.0512 \ 0.0379 \ 0.1108 \ 0.0617 \ 0.3103)$. According to the weight value obtained, $\lambda_{\max} = \sum_{i=1}^n \frac{(AW)_i}{nW_i} = C * W$ is calculated, where C is the judgment matrix and W is the weight vector.

$$C * W = \begin{bmatrix} 1 & 2 & 1/3 & 2 & 4 & 2 & 3 & 1/2 \\ 1/2 & 1 & 1/2 & 2 & 2 & 2 & 3 & 1/3 \\ 3 & 3 & 1 & 1 & 6 & 2 & 3 & 1/3 \\ 1/2 & 1/2 & 1 & 1 & 1 & 1/4 & 1/3 & 1/5 \\ 1/4 & 1/2 & 1/6 & 1 & 1 & 1/4 & 1/2 & 1/7 \\ 1/2 & 1/2 & 1/2 & 4 & 4 & 1 & 3 & 1/3 \\ 1/3 & 1/3 & 1/3 & 3 & 2 & 1/3 & 1 & 1/4 \\ 2 & 3 & 3 & 5 & 7 & 3 & 4 & 1 \end{bmatrix} * \begin{bmatrix} 0.1437 \\ 0.1108 \\ 0.1735 \\ 0.0512 \\ 0.0379 \\ 0.1108 \\ 0.0617 \\ 0.3103 \end{bmatrix} = 8.8054$$

The above matrix calculation results in the maximum eigenroot $\lambda_{\max}=8.8054$, $CI=(8.8054-8)/7=0.1151$, and the value of RI can be obtained from Table 4-3, which shows that $RI=1.41$, $CR=0.1151/1.41=0.0816$, CR less than 0.1, It shows that the selection of first-level index meets the requirements of consistency test.

According to the application of analytic hierarchy Process (AHP) in the A-level indicators of decision objectives and the consistency test of the correlation matrix, the index matrix of the middle layer is constructed and the consistency test is carried out according to the construction and consistency test of the first-level indicator matrix above, and the weight of the index of the middle layer is obtained. Take the middle layer, B₁ Baidu Encyclopedia, as an example, as shown in **Table 5**.

Table 5. Weights under level B1 of the middle Layer

Baidu BaikeB ₁	Active online learning	Perceived importance of social science popularization	Credibility of online science communication	Digital dissemination modes	Wi
Active online learning	1	1	1	1/2	0.2053
Perceived importance of social science popularization	1	1	2	2	0.3453
Credibility of online science communication	1	1/2	1	1	0.2053
Digital dissemination modes	2	1/2	1	1	0.2441

Weight ratio of indicators in the middle layer B1: $W_1 = (0.2053 \ 0.3453 \ 0.2053 \ 0.2441)$, $CR=0.0688$.

Similarly, the weight ratio of indicators under the middle layer B₂ level, $W_2 = (0.1227 \ 0.3085 \ 0.4294 \ 0.1394)$, can obtain $CR=0.0299$.

In the middle layer, the weight ratio of indicators under B₃ level, $W_3 = (0.2310 \ 0.1756 \ 0.4300 \ 0.1634)$, $CR=0.0768$.

In the middle layer, the weight ratio of indicators under B₄ level, $W_4 = (0.5000 \ 0.5000)$, $CR=0$.

In the middle layer, the weight ratio of indicators under B₅ level, $W_5 = (0.5000 \ 0.5000)$, $CR=0$.

In the middle layer, the weight ratio of indicators under B₆ level, $W_6 = (0.6667 \ 0.3333)$, $CR=0$.

In the middle layer, the weight ratio of indicators under B_7 level, $W_7 = (0.5000 \ 0.5000)$, $CR=0$.

In the middle layer, the weight ratio of indicators under B_8 level, $W_8 = (0.2760 \ 0.5055 \ 0.0701 \ 0.1483)$, $CR=0.0708$.

According to the above data, CR is less than 0.1, so it passes the consistency test.

Through the above calculation, the weight of relevant factors in the popularization effect and the usefulness of the social science of the decision goal are obtained (**Table 6**).

Table 6. Evaluation system index weights

Target label	Alternative plan	Weight
Social science popularization effect and usefulness A	Active online learning C_1	0.1049
	Perceived importance of social science popularization c_2	0.3492
	Credibility of online science communication C_3	0.4209
	Digital dissemination modes C_4	0.1249

The analysis results show that the credibility of network science popularization is the most important factor affecting the effectiveness of network science popularization, followed by the importance of social science popularization, network communication mode becomes the third important factor, and active network learning is the last.

4. The intrinsic mechanism of online social science popularization effectiveness

The preceding analysis identifies key factors influencing the effectiveness of online social science popularization and quantifies their relative weights, establishing a foundation for systematic problem diagnosis. To address existing challenges, it is imperative to elucidate the intrinsic mechanisms governing information dissemination, including the operational workflow, the roles of influencing factors across stages, and their interdependencies^[5]. Guided by DeFleur's Interactive Process Model, the effectiveness of online social science popularization emerges from a dynamic closed-loop system comprising "subject-channel-audience" interactions (**Figure 2**). This framework operates through three core mechanisms:

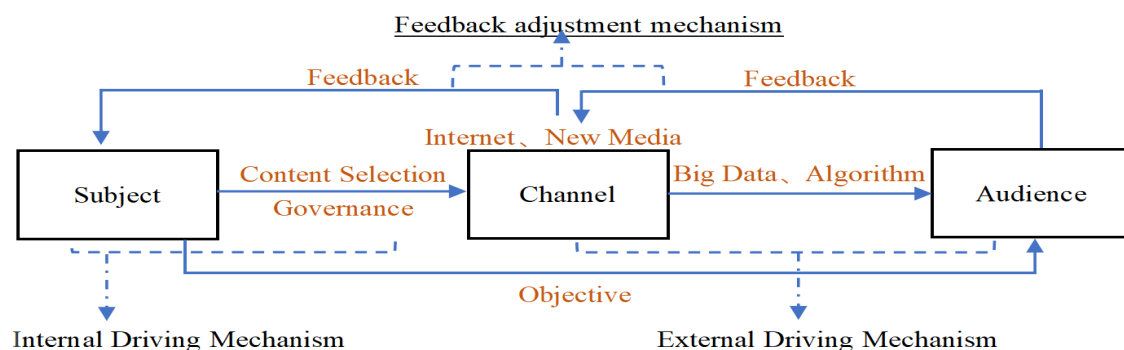


Figure 2. The internal mechanism model of the effectiveness of popularizing online social sciences

4.1. Subject encoding mechanism

Social science practitioners, as internal drivers, formulate policies and produce content. Content quality directly determines initial dissemination efficacy. Substandard content may trigger audience decoding barriers, causing communication attenuation.

4.2. Channel transmission mechanism

New media platforms (e.g., short videos, livestreams, official accounts) and algorithmic technologies serve as transmission media, governing content reach and timeliness. While big data push enhances targeting efficiency, it risks reinforcing information cocoons as systemic noise.

4.3. Audience feedback mechanism

As information decoders, audiences generate external momentum through engagement behaviors (e.g., clicks, comments). User behavior data flows back to content producers via channels, forming a dynamic regulatory loop. For instance, optimizing content push through big data analytics enables iterative improvements in dissemination efficiency.

These components create a reinforcing “production-dissemination-feedback” cycle. Channels function not only as conduits but also as critical noise filters. Ultimately, dissemination effectiveness hinges on the synergistic alignment of content quality, channel adaptability, and audience decoding capacity.

The efficacy of online social science popularization is propelled by coordinated internal and external mechanisms. Internally, the core lies in practitioners’ rigorous control over content credibility, with institutional prioritization directly determining resource allocation efficacy. Externally, the mechanism generates momentum through audience self-directed learning and channel compatibility, where high-quality content stimulates engagement, while algorithm-optimized new media channels (e.g., short videos, livestreams) amplify dissemination breadth and timeliness. These dual mechanisms establish a dynamic “production-dissemination-feedback” loop. By anchoring credibility as the foundation and innovating channel strategies to expand outreach boundaries, this framework achieves systemic enhancement of popularization effectiveness.

5. Pathways to enhance the effectiveness of online social science popularization

Guided by internal-external synergy mechanisms, a three-tier optimization framework should be established.

5.1. Internal optimization

Develop a multi-stakeholder collaboration mechanism to mobilize social science talent in universities and incentivize public participation through a “Certified Science Communicator” program^[6]. Strengthen policy support by refining online content review systems to regulate content production by influencers (e.g., key opinion leaders/content creators). Increase funding allocations, prioritizing investments in content creation and algorithm development. Innovate a “Centralized Coordination + Crowdsourced Creation + Intelligent Distribution” model to optimize content supply through data-driven screening.

5.2. External activation

Integrate mainstream platforms (e.g., Douyin, Bilibili) and leverage federated learning algorithms for cross-platform precision targeting. Address rural demand gaps by developing tailored content such as agricultural

technique short videos and livestreams, facilitating the penetration of science popularization resources through digital channels to replace traditional urban-centric dissemination.

5.3. Feedback regulation

Establish a dedicated department to implement a “Human-AI Dual-Track Feedback System.” This system captures real-time demands via user evaluation modules and big data analytics (e.g., viewing duration, preferences, occupations), enabling dynamic adjustments to content strategies. A closed-loop iterative mechanism—“Demand Identification → Precision Supply → Effectiveness Evaluation”—is thus formed to ensure continuous improvement ^[7].

Funding

Science Popularization Special Project of Jiangxi Provincial Social Science Foundation (Project name: The Intrinsic Mechanism and Enhancement Pathways of Online Social Science Popularization Effectiveness, Project number: 22KP12)

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Wang J, 2023, Research on Existing Problems and Solutions of Social Science Popularization under New Circumstances. Shanxi Science and Technology News, September 28, 2023, B06.
- [2] Dahlstrom MF, Scheufele DA, 2018, (Escaping) The Paradox of Scientific Storytelling. PLoS Biology, 16(10): e2006720.
- [3] Guo L, 2021, Research on Problems and Countermeasures of Social Science Popularization in H Province under “Internet+” Background, thesis, Hebei University of Science and Technology.
- [4] John D, 2022, Book Review: Routledge Handbook of Public Communication of Science and Technology. Public Understanding of Science, 31(5): 691–692.
- [5] Diane M, 2016, Nook Review: Routledge Handbook of Public Communication of Science and Technology. Technical Communication, 63(4): 383–384.
- [6] Luo J, 2021, Content Construction Mechanism of Innovative Network Social Science Popularization Visualization Models. Journal of News Research, 12(9): 23–25.
- [7] Tan X, 2023, Research on Informatization Issues and Strategies in Social Science Popularization. Office Operations, 2023(4): 104–106.

Publisher’s note

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

Investigating the Knowledge and Behavior of Road Users in Adherence to Traffic Ethics

Ajayi Oluwaseyi Ayodele, Yu Wang*, Guiliang Zhou, Umar Idris Muazu

School of Transportation Engineering, Huaiyin Institute of Technology, Jiangsu Province, China

**Corresponding author: Yu Wang, wangyu0033@hyit.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 aims to investigate road users' knowledge and behavior towards traffic ethics among university students in Qingjiangpu District, Huai'an, Jiangsu Province, China. The study helps to identify whether the concept of traffic ethics is effectively understood and applied by road users, focusing on students within the area. It also aims to identify the most commonly used mode of transportation among students in the city and assess their level of understanding of traffic ethics and the importance of adhering to them for road safety in the city. From the pilot questionnaire issued to 50 random students across the universities in this district, it can be concluded that most of the students who use a two-wheel vehicle (bicycle, electric bike, or motorcycle) have a mode of transportation, and this helps to sharpen the questionnaire and direction of this research. All the participants in this study are Chinese and international students within the age of 16 years and above (undergraduate and postgraduate), with 67 percent of respondents male and 33 percent female; 76 percent are domestic students while 23 percent are international students. An online questionnaire survey was created and conducted for effectiveness in reaching out to students in other institutions through QR codes to assess the questionnaire. A random sampling method is employed, and a definite sample size formula is used to determine the sample size of participants for the study. With over 22,000 students in the research site, through the use of a sample size of the known population, 380 participants were administered questionnaires, which included socio-demographic information and various questions about the knowledge of traffic ethics and behavior on the road. According to the findings, it can be seen that mobile phone addiction plays a big role in traffic safety amongst students and also the need for proper orientation about traffic ethics most especially at the point of road intersection, within and outside the institutional framework as areas where there is an institution or university is usually populated due to high number of students, staffs, university workers and other road users in the vicinity. The data from the questionnaire are analyzed using SPSS in descriptive statistics. The majority of participants are aware of traffic ethics, but become complacent due to the less frequent occurrence of major accidents on the road caused by negligence.

Keywords: Traffic; Ethics; Pedestrian; Intersection; University students; Traffic ethics; Motorcycle; E-bike; Bike lane

Online publication: June 6, 2025

1. Introduction

According to the crash analysis report from 2016, the World Health Organization (WHO) published that in its 2018 global status report on road safety, there are over 1.35 million deaths as a result of road traffic crashes and violations, and it is ranked the eighth leading cause of death worldwide ^[1-2].

Road accidents in China remain a huge worry, irrespective of the fast-growing pace in infrastructure and growth rate in the last couple of years, with traffic ethics playing an essential part in this situation. Regardless of endeavors to further develop road safety, the absence of adherence to ethical standards and traffic guidelines continues to add to the high frequency of accidents. This issue explanation expects to feature the relentless issue of road accidents in China because of a lack of traffic ethics, upheld by pertinent regulations.

As per the World Health Organization (WHO), China has one of the highest rates of road traffic fatalities internationally. In 2019, China revealed that there were 58,000 road traffic deaths, representing around 16% of worldwide road traffic fatalities. Fast urbanization and financial improvement have prompted a critical expansion in road traffic volume in China. With additional vehicles on the road, the risk of accidents rises, especially in thickly populated metropolitan regions and along significant transportation corridors. It forces critical monetary costs on China's general public and economy. As indicated by the World Bank, road traffic injuries and fatalities cost China an expected 1.2% of its Gross domestic product every year. These expenses incorporate clinical costs, property damage, lost efficiency, and the effect on the transportation and protection enterprises.

Weak road users, like pedestrians, cyclists, and motorcyclists, bear an unbalanced weight of road traffic wounds and fatalities in China. As per the WHO, pedestrians and cyclists represented almost 50% of all road traffic mortality in China in 2019. Large numbers of these fatalities are the aftereffect of impacts with engine vehicles, highlighting the need to focus on the safety of vulnerable road users.

Furthermore, as people become more obsessed and addicted to their mobile phone, likewise with almost all necessities of life all embedded in it, this has also become a big factor towards road safety, as most road users get easily distracted by it and find it difficult to take their eyes off their mobile device. It can be popularly seen in most cases as people walk on the road, head buried in their mobile device with less attention to road activities, which can be dangerous most especially at intersection points. It is not only common among pedestrians, but likewise drivers and cyclists, as the urge to ride and have access to their device at the same time can prove costly.

These keep on representing a significant danger to public wellbeing, with a lack of traffic ethics filling in as a huge contributing factor. Resolving this issue requires a thorough methodology that tends to the foundation and implementation as well as open mindfulness and instruction on the significance of ethical behavior on the road. By handling these difficulties, it can bring about progress toward decreasing the rate of road accidents and making transportation frameworks more secure for all road users.

As a result of the growing cases of road accidents amongst youths due to lack of adherence to traffic ethics and safety, this study is aimed at understanding the level at which students are ethically inclined with traffic ethics, rules and regulations, taking into consideration their behavior on the road.

Students are persons who are learning at every secondary, tertiary and institutional level, whether private and public that is at the university level. Students are believed to be intellectual, creative and intelligent in thinking and in action. Ability to think creatively and act accordingly are noted as some of the attributes of students ^[3].

They are also believed to be one of the most intellectual members of society, and the environment they reside in, and are expected to comport themselves professionally and appropriately in both society and the academic environment. Students' roles are not only confined to the classroom of learning but also beyond. Students have their place in society, which does not exclude them from society, which means there are expectations for students in society. It is important to develop roles, duties, and expectations of students to determine the area of struggle of these students ^[4].

It is popularly known that a university or institutional environment is usually busy and crowded as a result of the presence of a high number of students in the area, and precautions are usually considered of utmost priority for drivers, motorists, and pedestrians in the city. With the growing number of students and prospective students in the Qingjiangpu District of Huai'an, it is important to ascertain that students are well knowledgeable of traffic ethics to avoid crashes, collisions, and other forms of accidents within and outside the university. A good understanding of traffic ethics helps students to be able to recognize risks on the road resulting from speeding, distracted drivers, and aggressive maneuvering, and the ability to understand the possible consequences of such actions. In a nutshell, a good awareness of traffic ethics can prevent violations and crashes.

Cahyono also explained that students have four important roles, which are the expectations of society, namely the role of change agent, social control, iron stock, and moral power.

Change agents: Students should have the option to become influencers in light of the fact that the country's present condition could be improved, especially the numerous cultural and society-driven issues. Students ought to make changes to this. Notwithstanding, rolling out these improvements should be made in an organized and unrushed strategy, beginning from the smallest extension, most specifically oneself, then spreading persistently until it at long last arrives at the degree that is expected.

Social control: The fact is that students should have the option to become good examples in the public eye, in light of their insight and understanding, with their degree of schooling, the standards that apply around them, and their thought processes. Moreover, students ought to develop a feeling of social consideration. They should think often about the local area since they are an essential part of society. This worry has not just appeared from exhibits or rampaging. Yet, from their splendid contemplations, conversations, or giving moral and material support to the general public and the city, by making a genuine commitment.

Iron stock (extreme future): Students can become iron stock, implying that they are supposed to be mentally willed persons who have the capacity and respectable character, who can later supplant past ages. They are resourceful, of great importance, and the country's potential for what's in store. In satisfying the job of the iron stock, students can enhance themselves with an assortment of information, both from an expert and cultural viewpoint, and remember to find out about different mix-ups that have happened in past ages.

Moral power (model): Students play a part as an ethical power, implying that they are expected to have great ethics, since students serve as good examples in society. All students' conduct is usually noticed and evaluated by the community. This means students should be great at setting themselves up and living side by side in society.

Preferably, students ought to be good examples in the public eye, one of which is traffic ethics. Before diving into the knowledge of traffic ethics, people obviously should initially figure out the meaning of ethics. According to Simorangkir, ethics comes from the Latin *ethica*. *Ethos* in Greek means standards, values, rules, principles for a good way of behaving ^[5]. Ethics is an aspect of philosophy that discusses virtues and standards. With ethics, people can act unreservedly and can be represented because each activity is constantly brought into the world from a free choice by continuously being willing to assume a sense of ownership with their activities,

since there are clear explanations behind their activities ^[6].

As indicated by Bertens, ethics has three definitions as follows. To start with, “ethics” can be utilized in the feeling of: virtues and standards that become a rule for an individual or a gathering in managing their way of behaving. Second, “ethics” likewise implies: an assortment of moral standards or values. What is implied here is a set of rules. Third, “ethics” has the significance: the study of fortunate or unfortunate, right or wrong ^[7]. Ethics just turns into a science when ethical prospects (standards and values about what is viewed as great and terrible) are underestimated in a general public, frequently without acknowledging it, becoming material for reflection for a deliberate and calculated research. Ethics here similarly implies a moral way of thinking. As a rule, it is separated into two, which are general ethics and unique or special ethics. To begin with, general ethics is connected with how people pursue ethical choices, ethical hypotheses, and fundamental ethical rules that guide human activities, as well as benchmarks in deciding whether an activity is positive or negative. Second, unique or special ethics, which are the use of essential moral standards in everyday issues ^[8].

Studies have also shown that there are some basic factors that ultimately lead to road crashes and injuries, as they can be unique and distinct in different countries and regions ^[9]. This factor can be categorized into three sub-elements, which are the human, environment, and vehicular factors. The human factor entails the behavior, perfection, attitude, and compliance towards traffic regulations, and this has been the longest-standing factor that leads to road crashes in the world ^[10]. The knowledge, behavior, and attitude of road users with other human factors, have taken the leading role as the cause of road crashes in China. This further emphasizes the lack of patient behavior amongst drivers, cyclists, and other road users ^[11].

2. Literature review (Theoretical and conceptual framework)

There are certain areas where ethics has been well established and recognized, such as in medical ethics, business ethics, animal ethics, food ethics, research ethics, engineering ethics, and many others. However, human activities suffer from lots of ethical issues, which proves a need for investigation and study ^[12]. With this, it is very evident that traffic ethics is at which requires that as the moral standards in this regard have been overlooked, neglected, proving particularly regrettable and detrimental to human safety. Taking into account ethics in traffic safety, accidents or crashes are just a point of many areas they affect, such as the environment and the economy at large.

The use of any form of vehicle mode (cars, e-bike, bicycle, etc.) daily poses a significant risk and threat to safety amongst road users (drivers, cyclists, or pedestrians) with different mental and psychological states ^[13]. Proper assessment of the possible risks should be morally considered among road users ^[14]. From previous research in Yinzhou, Ningbo 2016, data collected from the traffic police office shows that over 37,654 traffic accidents were recorded, as 7,725 are as a result of non-motorist vehicles with 1,159 at intersection and 6,566 on road sections as the number is only limited to those incidents reported to the traffic police ^[15].

It can be inferred that age plays a significant role in road users’ attitudes and behavior on the road. Youths have been seen to be less concerned about traffic ethics and obedience towards safe driving, and they can also be said to be less sensitive to risk and underestimate the chances of any danger happening ^[16]. This can also be commonly seen in China as most youth feel too confident on the road and end up ignoring some basic traffic ethics.

The theoretical foundation involved in traffic ethics cannot be overemphasized, as it paves the way for a broader understanding of the subject matter. This involves the ethical theories, principles, and philosophical

perspectives involved in understanding ethical behavior and the various decision-making in traffic-related situations. Having a good understanding of ethical behavior involves the philosophical and principal perspectives that assist individuals, societies, and organizations to investigate what is morally right or wrong. There are various principles and theories by different philosophers over the years on ethical behavior, such as utilitarianism, consequentialism, deontology, ethical egoism, feminist ethics, ethical relativism, social contract theory, legal compliance theory, virtue ethics, and many more. This study will only focus on those principles that are related to the subject matter and also their application to traffic ethics. Below are some of the theories that contribute to traffic ethics.

2.1. Consequentialism

The regularizing significance of the association between acts and results is self-evident. This is a good way to start with the theory of consequentialism. On this methodology, people start by noticing that, through our demonstrations, people shape the world they are in. At the point when one is contemplating whether to do something, say, miss class without any pressing reason, the principal thought they presumably have concerns about what will occur assuming they skip and what will occur in the event that they do not.

Those who adopt the consequentialist strategy never move past this thought. That is what they trust, in sorting out what to do, all that ethically matters concerns what will be achieved. This is not to recommend that consequentialists are barely worried about what causally follows from the demonstration. Rather, the result that a demonstration achieves remembers everything for the total world history where the demonstration is performed. Worry for results, in this expansive sense, depletes the ethical area, as indicated by consequentialists.

Assume one faces a perilous sickness. Their primary care physician gives them three choices: (A) They can have a medical procedure with sedatives, which will effortlessly fix them. (B) They can have a medical procedure without sedatives, which will tortuously fix them. Or then again (C) They can sit idle, in which case they will die in a horrifying demise. What should they do? If they are having a similar outlook as a consequentialist, they are thinking, "It should be that I am effortlessly restored." And why would that be? Since (A) is better than (B), and (B) is better than (C).

In traffic decision-making, consequentialism could focus on results, for example, limiting mishaps or lessening traffic blockage. For instance, a driver might decide to go as far as possible to abstain from being late for a significant appointment, thinking that the advantages of showing up on time offset the expected dangers of speeding. In any case, according to a consequentialist viewpoint, this activity would possibly be thought of as ethical if it at last prompts improved outcomes, for example, no accidents happening subsequently.

2.2. Legal compliance theory

In China, legal compliance theory is an integral part of transportation, which focuses on the importance of adhering to traffic laws and regulations to ensure road safety and promote social harmony. Likewise, the guiding framework for traffic control and management, safety, policy amendments a practice, and public discourse on road safety and transportation governance. By concentrating on the importance of legal compliance, this theory helps to create a safer, more orderly, and sustainable transportation system for the benefit of its people.

Legal compliance theory stresses the commitment of all road users to submit to traffic laws and guidelines. It sets that adherence to laid out rules and guidelines is fundamental for guaranteeing smooth and methodical traffic movement, decreasing the chances of road mishaps, and safeguarding the freedoms and security of all

road users. The theory recognizes the power of traffic laws and guidelines as laid out by the public authority and upheld by policing. It highlights the significance of compelling implementation instruments to dissuade infringement and guarantee compliance with traffic rules.

It also perceives the job of public mindfulness and training in advancing legal compliance among street clients. It stresses the requirement for complete traffic wellbeing schooling programs pointed toward improving information on traffic laws, encouraging dependable way of behaving, and developing a culture of compliance and regard for the law. The theory highlights the social obligation of people and associations to contribute to the upkeep of traffic order and security. It accentuates the moral commitment of drivers, people on foot, cyclists, and other street users to focus on wellbeing, show thought for other people, and conform to traffic laws for the aggregate advantage of society.

Legal compliance theory recognizes the need to impose punishments and ramifications for infringement of traffic laws and guidelines. It advocates for quick and fair authorization of punishments to deter dangerous way of behavior, advance responsibility, and build up the significance of legal compliance. Likewise, it perceives the requirement for nonstop improvement in traffic laws, guidelines, and authorization components to address developing difficulties and guarantee the adequacy of traffic management efforts. It empowers continuous assessment, exploration, and transformation of arrangements and practices to upgrade street wellbeing and traffic effectiveness.

2.3. Understanding basic traffic ethics for motorists and cyclists

Adhere to traffic regulations: Cyclists and motorists should comply with all traffic regulations, including halting at red lights and stop signs, respecting pedestrians, and utilizing blinkers.

Shared lane: Cyclists reserve the option to utilize the lane very much like motorists, so they should be conscious and share securely.

Self-consciousness of environmental factors: Cyclists and motorists ought to know about their environmental elements consistently, really taking a look at mirrors and vulnerable sides prior to moving to another lane or making turns.

The use hand signals: Cyclists ought to make use of hand signals to demonstrate when they are turning or halting, and motorists ought to know about these signals and yield to cyclists when necessary.

Keep safe distance: Motorists should give cyclists something like 3 feet of room while passing, and cyclists ought to ride in an anticipated way to stay away from unexpected developments that could cause collision or accident.

Be patient and polite: Both cyclists and motorists ought to be patient and considerate to one another, giving each other the space and regard they deserve.

Wear appropriate gear: Cyclists ought to continuously wear a head protector and splendidly shaded dress to expand perceivability (recognizability), and motorists ought to constantly wear a safety belt and keep away from interruptions while driving.

Emergency Readiness: Both cyclists and motorists should be mentally ready for emergencies or unforeseen situations that might arise on the road, carrying important devices or gear for fixes.

2.4. Understanding basic traffic ethics for pedestrians

Fundamental traffic ethics for pedestrians are fundamental to ensure compliance for security and advancing smooth communications with other road users. Here are a few essential rules that pedestrians ought to comply with.

Comply with traffic signals and signs: Pedestrians ought to submit to traffic signals, signs, and crosswalk markings. This incorporates trusting that the walker signal will get through at intersections and just crossing roads at assigned crosswalks or pedestrian crossings.

Utilize assigned crosswalks: Pedestrians ought to utilize assigned crosswalks or person on foot crossings whenever the situation allows. Crossing at assigned areas raises drivers' awareness and lessens the risk of accidents.

Look left and right before crossing: Before crossing a road, pedestrians ought to look left and right to guarantee no cars are moving in the opposite direction. In any event, while crossing at assigned crosswalks, pedestrians ought to stay cautious and watch for vehicles that may not stop. It is important for pedestrians to be vigilant because not all drivers are in their right state of mind and might lose control at any point.

Keep eye contact with drivers: While crossing roads, pedestrians ought to attempt to visually engage with drivers to guarantee they have been seen directly in the eyes. This can assist with forestalling accidents brought about by miscommunication or misconception among pedestrians and drivers.

Remain apparent or visible to drivers: Pedestrians ought to make themselves noticeable to drivers, particularly in low-light circumstances or while walking around evening time. Wearing splendid or intelligent apparel and utilizing electric lamps or intelligent adornments can further create awareness and decrease the risk of accidents.

Avoid distraction: Pedestrians ought to abstain from utilizing electronic gadgets, for example, cell phones or earphones, while crossing roads or walking close to traffic. Interruptions can hinder attention to environmental factors and increase the risk of accidents.

Cross securely: Pedestrians ought to wait for a protected hole in traffic before crossing the road. While crossing different paths, they ought to cross each path in turn and check for traffic between paths.

Be aware of traffic movement: Pedestrians ought to be aware of the progression of traffic and try not to disturb the development of vehicles. This incorporates staying away from unexpected developments into traffic or crossing roads at hazardous areas.

Walk confronting traffic: In the event that walkways are inaccessible, pedestrians ought to walk confronting approaching vehicles. Strolling against the progression of traffic permits pedestrians to see moving toward vehicles and respond as needs be.

Watch for turning vehicles: Pedestrians ought to be wary while crossing roads where vehicles are turning. Drivers may not necessarily, in all cases, see pedestrians crossing or may turn without yielding, so pedestrians ought to be ready to pause and give way if necessary.

By following these essential traffic ethics, pedestrians can be assured of their own security and the wellbeing of others. Being mindful, watchful and having the thought for other road users are key rules that pedestrians ought to focus on while exploring traffic conditions.

One of the pivotal modes of urban road traffic in China is non-motorized vehicles, which seems to be the most adopted by students in this study, which also accounts for a great proportion of crashes, fatalities, and injuries in road traffic accidents. Although research and literature reviews on the behavioral patterns and ethics of non-motorized vehicle accidents are still quite inadequate, this shows the need for more study and research focusing on non-motorist as students are the best example of the use of this mode of transportation.

However, there are still lots of limitation to this study as from observation, most accidents are not reported to traffic police office as motorist prefer to manage and deal with the situation outside police involvement (likely minor accidents) which are still as a result of negligence, distraction or unawareness on the part of the road users.

The purpose of this study is not to accurately or perfection on the traffic ethics and behavior but to raise more awareness on the need for self-consciousness, awareness, mental preference and safety of other road users, most especially as there a growing increase in the use of bicycles, e-bike and other form of non-motorized vehicles on the bike lane.

Figure 1 shows a simulated traffic light at a road intersection with three vehicle lanes, a pedestrian lane, and a bike lane at the four cardinal directions of the intersection, as most major roads are designed. The green lines or curves show when road users have the right of way, while the yellow indicates the lanes can possibly have the right of way when the traffic light turns red. Due to movement across all the green lanes at this intersection with the interaction between all forms of road users requires adequate concentration and an eye for the safety of others. From observation, it can be mostly seen as a time where road users walk, ride, or drive a bit carefree, as it is their right of way, and this has led to a significant number of accidents over the years.

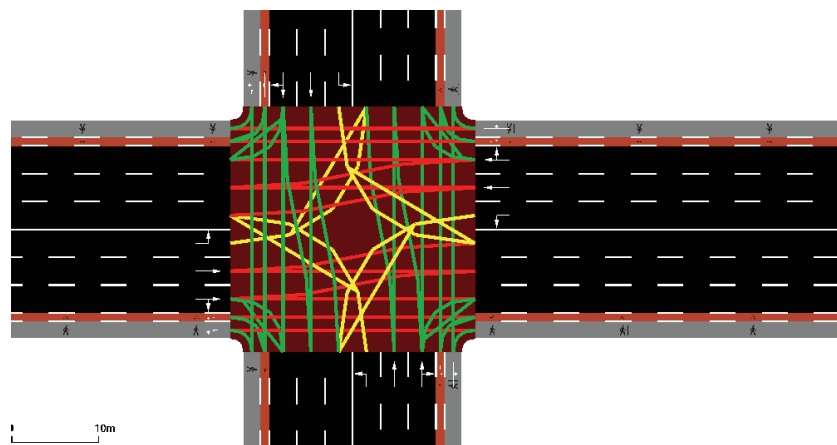


Figure 1. Picture of a simulation network at a point of traffic intersection

3. Materials and methods

In this study, a quantitative and qualitative descriptive method of research using an explanatory mixed method ^[17]. The data collection method is via Microsoft Forms, as the software is available to all participants. The population of this study will be university students in Qingjiangpu District Area, Huai'an City, Jiangsu Province in China.

3.1. Method of collecting data

Observation and a questionnaire were employed as data collection methods. This will be done by collecting data from the traffic ethical areas of road safety. The questionnaire contains 6 demographic questions and 11 traffic ethics questions on road safety, awareness, and traffic intersections. The aim is to assess the level at which students have a good understanding and knowledge of traffic ethics as regards safety and its importance to road behavior within the district. With about 22,000 students, both domestic and international students from different institutions within the district, a definite sample size formulae were employed to calculate the number of respondents for the study. A semi-structured online questionnaire was created, which helped to ensure reach to students in the institution, as a QR code is needed to access the questionnaire.

$$\text{Sample Size} = [z^2 * p(1-p)] / e^2 / 1 + [z^2 * p(1-p)] / e^2 * N]$$

Where:

N = population size

z = z-score

e = margin of error

p = standard deviation

$N = 22,000$, $z = 95\%$ or 1.96 , $e = 0.05$, $p = 0.5$

Sample size = $(1.96) * 0.5(1-.5)/(0.05)^2$

$1 + ((1.96)^2 * 0.5(1-0.5)/ (0.05)^2 * 22,000 = 378$ respondents

4. Results and discussion

4.1. Demographic findings

From the pie-chart and **Table 1** below, it can be seen that 39% percentage of the respondents are between the age group of 16–20 years, 44% are between the age group of 21–25 years, 14% are between the age group of 26–30 years and 3% are between 31 and above, 67% of the respondents are male while 33% are female, it can also be seen that 76% of the respondents are domestic students (Chinese students) while 24% of the respondents are international students, 58% of the respondents are undergraduate students and 42% are postgraduate; the data also show that 63% of respondents mostly use bicycle, 27% use e-bike/motorcycle, 7% use car while 3% makes use of public bus; 43% responds that they have received formal training on traffic safety and ethics, 46% responded no while 11% are not sure if they have received formal education or not.

Table 1. Demographic information of the respondents

Variable	Category	Frequency	Percentage
Age	16-20	148	39
	21-25	168	44
	26-30	5	14
	30 and above	11	3
Gender	Male	254	67
	Female	126	33
Nationality	Domestic student	287	76
	International students	93	24
Academic Level	Bachelor	220	58
	Postgraduate	160	42
Transport mostly used	Bicycle	239	63
	Car	27	7
	E-bike/Motorcycle	102	27
	Public Bus	12	3
Formal training on traffic ethics and safety	Yes	162	43
	No	175	46
	Maybe	43	11

From **Table 1** and **Figure 2**, 67% of the respondents are male, while 33% are female. 76% of the respondents are domestic students (Chinese students), while 24% of the respondents are international students. 58% of the respondents are undergraduate students and 42% are postgraduate students. It is also determined from the study that 63% of respondents mostly use bicycles, 27% use e-bikes/motorcycles, 7% use cars, while 3% make use of public buses. 43% responded that they have received formal training on traffic safety and ethics, 46% responded no, while 11% are not sure if they have received formal education or not.

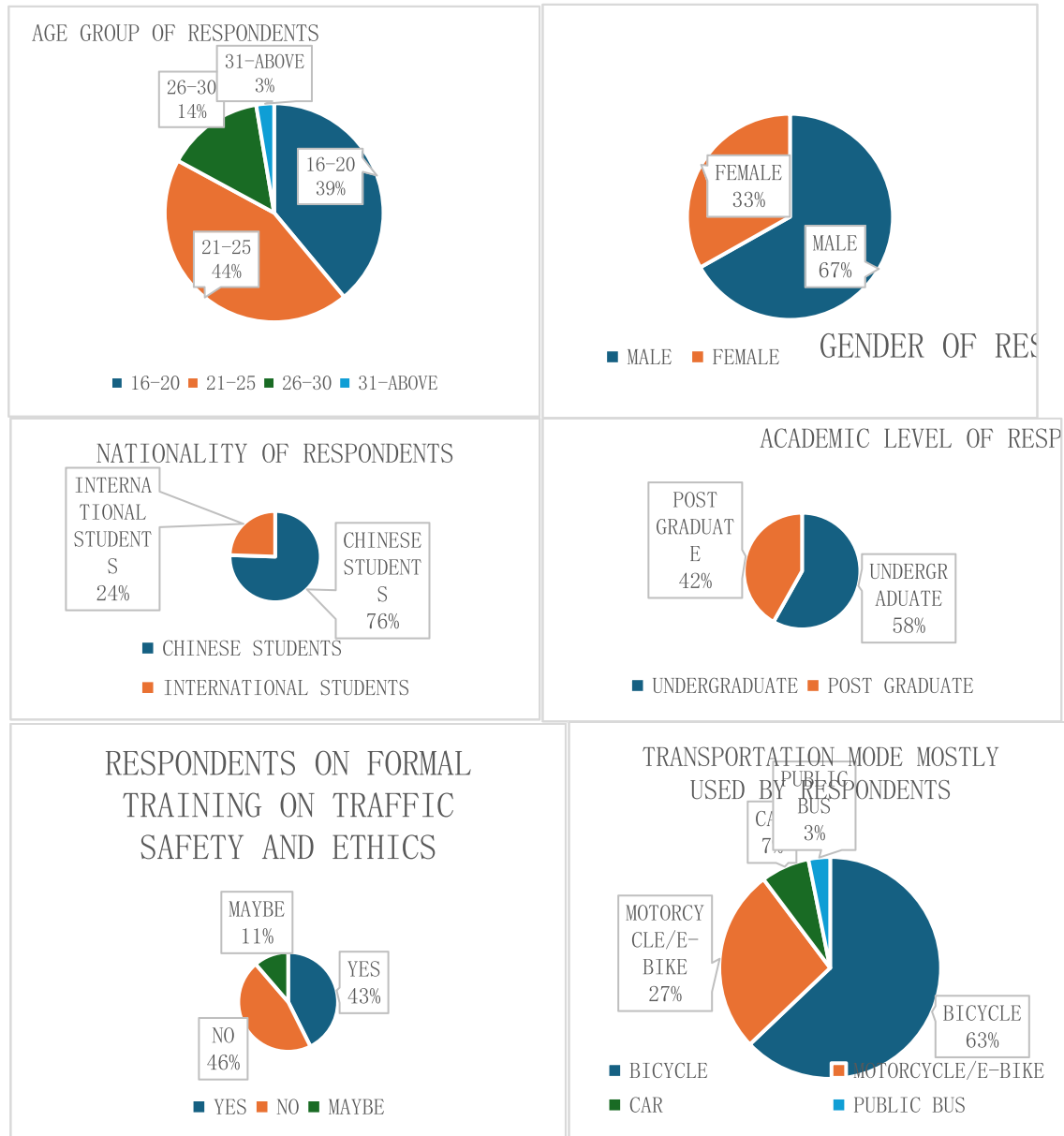


Figure 2. Pie chart of demographic information of respondents

Eleven questions were administered in this questionnaire to understand respondent compliance and knowledge of traffic ethics, with 360 respondents. Based on the first question, it can be observed that 35% of the respondents are not quite familiar with the traffic laws and regulations of the city, 52% believe they are somewhat familiar, 12% are certain that they are familiar with the traffic laws, while only 1% are not familiar.

This gives rise to a mean of 2.76 and a standard deviation of .673.

Table 2 shows the 380 respondents to the question on their familiarity to the traffic and regulation of the city as it can be deduced that most of the respondents do not have a comprehensive knowledge of the traffic laws guiding the city with a mean of 2.76 and standard deviation of 0.673 as it is slightly positively skewed.

Table 2. Analysis of the questionnaire using descriptive statistics

ANALYSIS USING DESCRIPTIVE STATISTICS												
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11
N	Valid	380	380	380	380	380	380	380	380	380	380	380
	Missing	0	0	0	0	0	0	0	0	0	0	0
Mean		2.76	3.24	2.28	2.46	2.88	3.18	3.39	3.27	3.39	3.14	3.16
Std. Error of Mean		.035	.039	.035	.036	.038	.037	.041	.042	.037	.039	.042
Median		3.00	3.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Mode		3	3	2	2	3	3	3	3	3	3	3
Std. Deviation		.673	.760	.679	.709	.742	.719	.804	.809	.717	.767	.819
Variance		.453	.577	.461	.503	.550	.517	.646	.655	.513	.588	.672
Skewness		.123	.082	-.112	.354	.393	-.366	-.129	-.220	.211	.397	-.357
Std. Error of Skewness		.125	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125
Kurtosis		-.491	.522	-.426	.597	.777	.497	.509	.269	.340	.882	.307
Std. Error of Kurtosis		.250	.250	.250	.250	.250	.250	.250	.250	.250	.250	.250
Range		3	4	3	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1	1	1
Maximum		4	5	4	5	5	5	5	5	5	5	5
Sum		1048	1230	867	936	1094	1208	1290	1241	1289	1192	1200
Percentiles	25	2.00	3.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00
	50	3.00	3.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
	75	3.00	4.00	3.00	3.00	3.00	4.00	4.00	4.00	4.00	3.00	4.00

On a scale of 1–5 (1: Never, 2: rarely, 3: Sometimes, 4: Often, 5: Always), it can also be seen from the statistical table and the histogram below that most respondents do not abide to the traffic ethic on the use of mobile phone while driving on the road with a mean of 3.24 and standard deviation of 0.76. It can be seen that a percent of respondent believes they do not use mobile phone while on the road, 11% of respondents agrees that they rarely do, 56% of respondents feel they sometimes, 27% of respondents believes they often does, while 5% truthfully think they always use their mobile phone on the road.

Experiencing an accident on the road is a common occurrence on the road in which can be as a result by traffic violations. From this study, 11% of respondents feel they never experience an accident from a traffic violation, 51% of respondents slightly agree, as they believe they also rarely experience this. 36% think they sometimes experience accidents from traffic violations, 2% of respondents beg to differ as they believe it is an often occurrence, while no respondent thinks it is an event that always happens. This results in a mean of 2.28 and a standard deviation of 0.679 from the analysis.

Experiencing behavior on the road considered unsafe/unethical, 6% of the respondents picked Never, 48% chose Rarely, 41% chose Sometimes, 4% believe it is an event that happens often, while 1% thinks it happens always, with a mean of 2.46 and a standard deviation of 0.709.

The use of protective gear as drivers or riders is considered one of the most important road safety guidelines to abide by. 2% truthfully accept that they do not use protective gears, 27% are of the opinion that

they rarely use protective gears, 57% reckon they do sometimes, 12% maintain they wear often while 3% feels they fully abide to wearing protective gears; with a mean of 2.88 and standard deviation of 0.742.

2% of respondents believe they do not get distracted while on the road, 12% feel they are rarely distracted, 50% think they do get distracted while on the road, 30% believe it happens often, while only 1% believe, due to some reasons, they are always distracted.

2% of respondents feel they are not bothered by checking both sides of the traffic at the intersection point, 7% rarely, 49% sometimes, 34% often and 8% always check the two sides of the traffic at the point of intersection, which results in a mean of 3.39 and standard deviation of 0.804.

Abiding by traffic signs and signals is quite important towards the safety of road users, as 2% never abide, 12% rarely abide, 48% sometimes abide, 33% of respondents often abide, while 5% always abide; with a mean of 3.27 and a standard deviation of 0.809.

3% of the respondents believe they never give a safe distance while driving on the road, 14% believe they rarely do, 50% sometimes do, 30% often give safe distance, while 3% reckon they always give safe distance; with a mean of 3.39 and a standard deviation of 0.717.

1% of respondents never park at designated areas/spaces, 13% rarely park at the right space, 62% sometimes, 18% often do, while 6% always, with a mean of 3.14 and a standard deviation of 0.767.

3% of the respondents chose never stop at a traffic light when no vehicle is in sight, 14% rarely, 50% responded that they sometimes, 30% often, while 3% always, with a mean value of 3.16 and a standard deviation of 0.819.

5. Conclusion, suggestion, recommendation, and limitation

5.1. Conclusion

Ethics plays a pivotal role in existence, as the knowledge of it in traffic and road safety cannot be overemphasized. The place of human error and negligence is ranked as one of the highest causes of road accidents, which results from a lack of adherence to traffic ethics and safety. From the study, it can be seen that there is a high level of negligence and distraction among road users, most especially the young adults, on whom the study focused on students who are the dominant force in society. It can also be observed from the study that most of the population of young adults and student makes use of bicycles and e-bikes as a means of transportation, which allows for more attention on the road path for bikes and bicycles. Research has also shown that most casualties from lack of adherence to traffic ethics and safety that results in accidents occurs at traffic light intersection, with most people being either impatient or not look at the both side of traffic before moving, even when it is their right of way. It can be seen in the image presented in the previous chapter illustrating the movement of traffic around road intersection.

5.2. Suggestion

There are lots of traffic and road signs that have been implemented over the years, which have become a pillar to ensure safety on the road. From this study, as result of the high record of accidents at traffic intersection points, and also from the responses of respondents from the study, it is believed the introduction of traffic sign/signals in the bike lane, few miles before the point of intersection can also help keep road users alert and attentive before they get to the traffic signal intersection (**Figure 3**). Also, it can be worded between the pedestrian crossing lane. Traffic signs in form of prohibition of the use of mobile phone at road intersection can

also be a useful traffic control and safety device to keep road users alert of any possible impending danger that might arise from any driver or motorist losing control, careless driving or drunk driving on the road as there lots of possible factors that can affect their behavior on the road.



Figure 3. Possible road signs to adopt

Furthermore, since most adult and real-life education are learnt in higher institution, as it can prove to be important that institution setup a mandatory orientation program in partnership with the local traffic authority in the area, as part of the welcome back to school activity for new students at the beginning of each academic year on traffic ethics education which will cover safety, laws and regulation in the city, and likewise a medium to introduce new updates, regulations and laws to students, statistics of road crashes and injuries in the past and the need to be more careful while on the road. Likewise, a survey test can be taken at this orientation to get feedback from students, which can prove to be an important decision-making tool for future traffic safety and control measures by the designated traffic office in the city. It is understood that most cities, provinces, countries have little or much differences in traffic regulations, as this will be an avenue to help them understand the differences that applies in the current city they are in; most especially for new students as a good number of them are international students from countries, provinces, cities or states with different road and traffic demand, regulation, safety and ethics. This annual traffic ethics education program will also provide an avenue for new traffic policies to be well-communicated with the students, as cities with institutions are highly populated due to the presence of students.

5.3. Recommendation

For further study, the idea of setting up a camera sensor that can detect cyclist in the bike lane using their mobile devices by sounding an alarm as a means of getting their attention ahead of the traffic intersection ahead. This can also prove to be an upgrade as the need to pay close attention to the bike lane is increasingly growing every day, with an increase in its users.

5.4. Limitations

There are various limitations to the study as some students were reluctant to fill out the questionnaire, thinking it could be implicating to them. Also, the lack of access to the local traffic police statistics on road crashes and injuries can also be said to be another limitation to the study.

Disclosure statement

The authors declare no conflict of interest. All data were gathered and analysed in compliance with ethical research guidelines. Participation in the study was voluntary, and all individuals provided informed consent prior to data collection. The researchers confirm that the study adheres to institutional and national research ethical rules and that no personal or identifying information about participants was shared.

Reference

- [1] World Health Organization, 2011, Global Plan for the Decade of Action for Road Safety 2011–2020. World Health Organization, Geneva.
- [2] World Health Organization, 2021, WHO Global Status Report on Road Safety. <https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries>
- [3] Siswoyo DKK, 2007, Ilmu Pendidikan. UNY Press, Yogyakarta.
- [4] Cahyono H, 2019, English Language Education STKIP Setia Budhi. The Role of Students in Society. *Journal of Community Service Setiabudhi*, 2019(1): 1.
- [5] Simorangkir, 2003, ETHICS: Business, Position and Banking. PT Rineka Create, Jakarta.
- [6] Keraf AS, 1991, Business Ethics Builds the Image of Business as a Noble Profession. Kanisius, Yogyakarta.
- [7] Bertens K, 2007, Etika. PT Gramedia Pustaka Umum, Jakarta.
- [8] Keraf S, 1998, Business Ethics: Demands and Relevance. Penerbit Kanisius, Yogyakarta.
- [9] Arosanyin GT, 1999, Casualties on Nigerian Roads. *Nigerian Journal of Economic and Social Studies*, 41(3): 489–504.
- [10] Peden M, Scurfield R, Sleet D, et al., 2004, World Report on Road Traffic Injury Prevention. World Health Organization, Geneva.
- [11] Ogunmodede TA, Adio G, Ebijuwa AS, et al., 2012, Factors Influencing High Rate of Commercial Motorcycle Accidents in Nigeria. *American International Journal of Contemporary Research*, 2(11): 130–140.
- [12] Hansson SO, 2017, Theories and Methods for the Ethics of Technology, in *The Ethics of Technology Methods and Approaches*, 1–14. Rowman and Littlefield, London.
- [13] SMIDS J, 2018, The Moral Case for Intelligent Speed Adaptation. *Journal of Applied Philosophy* 35(2): 205–221.
- [14] Goodall NJ, 2019, More than Trolleys: Plausible, Ethically Ambiguous Scenarios Likely to be Encountered by Automated Vehicles. *Transfers*, 9(2): 45–58.
- [15] Guo Y, Zhou J, Wu Y, et al., 2017, Evaluation of Factors Affecting e-bike Involved Crash and e-bike License Plate Use in China using a Bivariate Probit Model. *Journal of Advanced Transportation*, 2017(2142659): 12. <https://doi.org/10.1155/2017/2142659>
- [16] Nordfjaern T, Jorgensen S, Rundmo T, 2010, An Investigation of Driver Attitudes and Behavior in Rural and Urban Settlements in Norway. *Safety Science*, 48(3): 348–356.
- [17] Creswell JW, 2010, Research Design: Qualitative and Quantitative Approaches. SAGE Publications, London.

Publisher's note

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

Research on the Accuracy of Robot End Position Based on Joint Motion Error

Hualin Zheng^{1*}, Yang Liu¹, Yangqiu Xia², Xiaobing Hu³

¹School of Mechanical and Electrical Engineering, Southwest Petroleum University, Chengdu 610500, China

²National Machine Tool Production Quality Supervision Testing Center, Chengdu 610200, China

³School of Mechanical Engineering, Sichuan University, Chengdu 610065, China

**Author to whom correspondence should be addressed.*

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 robotic intelligent manufacturing engineering, the machining accuracy of workpieces is directly related to the end positioning accuracy of six-degree-of-freedom serial robots, so compensating for the latter is of great significance. This article proposes a method to improve the absolute positioning accuracy of a robot by correcting the joint angles of the robot without changing the parameters of the robot controller. Firstly, establish a forward kinematics model of the robot based on the spiral theory. Then, the motion errors of each joint of the robot are measured using a laser tracker, and the RBF neural network is trained to predict the motion errors of each joint of the robot. Finally, the predicted joint motion errors are compensated for the theoretical joint angles, thereby improving the accuracy of robot end positioning. The experimental results show that the precision of the robot's end position has been improved from 0.2456 mm to 0.0716 mm, verifying the effectiveness of this method.

Keywords: Robot; Joint motion error; Position accuracy; Compensation

Online publication: June 6, 2025

1. Introduction

The motion accuracy of robots is a key factor limiting their performance in high-precision industrial applications ^[1]. Among the important performance indicators of robots, repeatability and absolute positioning accuracy are the most commonly used metrics ^[2]. Currently, robots have achieved a relatively high level of repeatability, typically around 0.1 mm. However, the level of absolute positioning accuracy remains significantly lower, generally within the range of 2–3 mm ^[3]. In order for robots to be effectively applied in precision machining, it is essential to improve their absolute positioning accuracy. Therefore, studying and compensating for the end errors of robots holds significant theoretical importance and practical value.

Currently, there are two primary approaches to improving robot end positioning accuracy: online compensation and offline compensation ^[4-5]. While online methods can yield high compensation accuracy, they entail high cost, are sensitive to environmental factors (e.g., temperature, humidity, and noise), and lack generality. Offline methods

are more commonly used: they involve error modeling of the robot's kinematic parameters, measurement of the robot end pose using high-precision external instruments, parameter identification based on the error model, and correction of the identified errors in the robot controller to improve positioning accuracy ^[6]. For example, Filion et al. employed iterative least squares to identify kinematic parameters, improving end accuracy from 0.496 mm to 0.197 mm ^[7]. Wang et al. combined DH-based modeling with visual measurement and an Extended Kalman Filter (EKF) to estimate and compensate error parameters, achieving approximately 90% improvement in orientation accuracy, though encountering singularity issues ^[8-9]. Zhu et al. used the Levenberg-Marquardt (LM) algorithm to identify kinematic parameter errors of a dual-arm robot, significantly reducing the average positioning error after compensation ^[10]. Liu et al. applied the LM algorithm on a UR10 robot, reducing its maximum and average distance errors from 5.60 mm and 2.50 mm to about 0.50 mm and 0.30 mm, respectively ^[11].

2. Theoretical method

Unlike the D-H method, forward kinematic modeling using screw theory does not require establishing a coordinate system at each joint of the robot ^[14]. Instead, it only requires two coordinate systems: the base coordinate system {S} and the tool coordinate system {T}. Typically, the base coordinate system is connected to the robot's base, and the tool coordinate system is connected to the robot end. Additionally, a screw ξ is associated with each rotational joint ^[15]. **Figure 1** represents the twist model of the IBR robot. **Table 1** presents the position vectors of specified points on the robot's joint axes.

Figure 1. 3D model of the robot and its twist model

Table 1. Axis specified point position vector

Vector name	$p(o)$	$p(k)$	$p(r)$	$p(f)$	$p(p)$
Vector value	$\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$	$\begin{bmatrix} L_1 \\ 0 \\ H_1 \end{bmatrix}$	$\begin{bmatrix} L_1 \\ 0 \\ H_1 + H_2 \end{bmatrix}$	$\begin{bmatrix} L_1 + L_2 \\ 0 \\ H_1 + H_2 \end{bmatrix}$	$\begin{bmatrix} L_1 + L_2 + L_3 \\ 0 \\ H_1 + H_2 \end{bmatrix}$

All joints of the robot are rotational joints. $w_i \in R^3$ is the unit vector along the direction of the rotational axis, and $p_i \in R^3$ represents an arbitrary point on the axis. $\xi_i = (-w_i \times q_i, w_i)$ is defined as the screw coordinate of the joint, and $\hat{\xi}_i$ can be defined as the motion screw of joint i , $e^{\hat{\xi}_i \theta_i}$ is the screw motion of joint i .

$$e^{\hat{\xi} \theta} = \begin{cases} \begin{bmatrix} e^{\hat{w} \theta} & (I - e^{\hat{w} \theta})(w \times v) + \theta w w^T v \\ 0 & 1 \end{bmatrix}, w \neq 0 \\ \begin{bmatrix} I & \theta v \\ 0 & 1 \end{bmatrix}, w = 0 \end{cases} \quad (1)$$

Assuming the initial pose of the robot in the global coordinate system $oxyz$ is $g_{st}(0)$, and the unit screw of each rotational joint is ξ_i ($i = 1, 2, \dots, 6$), the ideal kinematic equation of the robot end can be expressed as:

$$g_{st}(\theta)_{ideal} = e^{\hat{\xi}_1 \theta_1} \cdot e^{\hat{\xi}_2 \theta_2} \cdot e^{\hat{\xi}_3 \theta_3} \cdot e^{\hat{\xi}_4 \theta_4} \cdot e^{\hat{\xi}_5 \theta_5} \cdot e^{\hat{\xi}_6 \theta_6} \cdot g_{st}(0) \quad (2)$$

2.1.2. Inverse kinematics

In inverse kinematics, given the robot end pose of the robot, the joint angles can be obtained by solving the Paden-Kahan subproblem. For the IRB robot in this study, which has a special configuration with multiple parallel joint axes, the inverse kinematics is decomposed into several Paden-Kahan subproblems and Paden-Kahan subproblems for solving [16]. Taking the robot shown in **Figure 1** as an example, inverse kinematics is solved using screw theory.

First, the values of θ_1 , θ_2 , and θ_3 are solved using the PG7 subproblem. According to screw theory, the point q located on the axis of rotation remains stationary regardless of the rotation angle, i.e.

$$e^{\hat{i} \dot{\theta}} q = q \quad (3)$$

Therefore, by multiplying both sides of equation (2) by $g_{st}(0)^{-1} f$ (where f is the intersection point of the last three joints), get:

$$e^{\hat{i}_1 \dot{\theta}_1} \cdot e^{\hat{i}_2 \dot{\theta}_2} \cdot e^{\hat{i}_3 \dot{\theta}_3} \cdot e^{\hat{i}_4 \dot{\theta}_4} \cdot e^{\hat{i}_5 \dot{\theta}_5} \cdot e^{\hat{i}_6 \dot{\theta}_6} \cdot f = g_{st}(\dot{\theta}) g_{st}(0)^{-1} f \quad (4)$$

It can be simplified as follows:

$$e^{\hat{i}_1 \dot{\theta}_1} \cdot e^{\hat{i}_2 \dot{\theta}_2} \cdot e^{\hat{i}_3 \dot{\theta}_3} \cdot f = g_{st}(\dot{\theta}) g_{st}(0)^{-1} f = p_1 \quad (5)$$

The right-hand side of the equation is a known quantity, denoted as P_1 . By solving the PG7 subproblem, the angles of the first three joints can be obtained. Similarly, the values of θ_4 , θ_5 , and θ_6 can be solved through the PG6 subproblem and the Pk1 subproblem, respectively.

Given the robot end pose of a six-degree-of-freedom robot, the inverse kinematics can yield 8 sets of inverse solutions, each corresponding to a different motion posture of the robot. Based on the principle of minimizing joint movement, the appropriate set of inverse solutions is selected in this study.

2.2. Identification of joint motion errors

2.2.1. Robot joint motion errors

As shown in **Figure 1**, all joints of the robot are rotational joints, and their motion errors mainly manifest as joint angle errors $\Delta\theta$, which represents the difference between the ideal joint angle θ and the actual joint angle θ' of each joint. These errors directly affect the robot's volumetric errors, causing the actual robot end pose to deviate from the ideal pose. During the robot's actual motion, the joint motion errors change as the corresponding joint rotation angle varies, meaning they are dependent on the magnitude of the joint rotation angles.

Although the motion errors of each joint are small, the cumulative errors from multiple joints can significantly increase the robot end pose error, especially in high-degree-of-freedom robots or complex motion paths. The impact of joint motion errors on the robot end volumetric errors is shown in **Figure 2**.

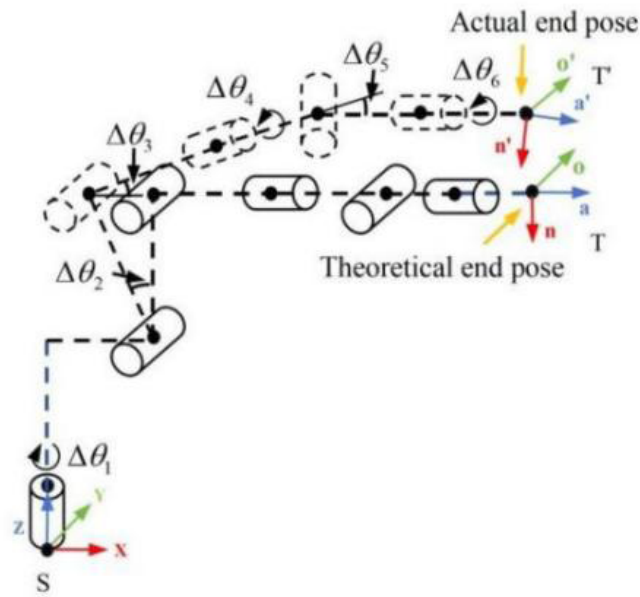


Figure 2. The influence of joint motion error on the end errors of the robot

2.2.2. Joint motion errors measurement using a laser tracker

There are many instruments for identifying robot joint motion errors, among which the laser tracker is a commonly used measurement tool. When using a laser tracker to measure joint motion errors, one joint of the robot rotates while keeping the other joints fixed. The rotating joint changes its angle incrementally, and the laser tracker continuously tracks the position of the robot end target ball in real time. After each movement, the robot returns to the zero position, as shown in **Figure 3**. In this setup, assuming the ideal position of any selected point within the robot's motion range in the robot's base coordinate system is $p_i (i=1,2,\dots,n)$, and its coordinates in the laser tracker coordinate system are , the following expression can be obtained:

$$p_i = Q^{-1} \cdot (p'_i - T) \quad (6)$$

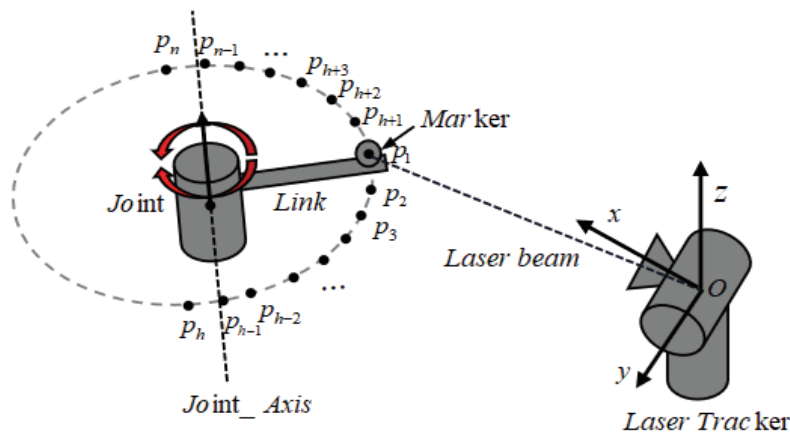


Figure 3. Measurement of joint motion errors using a laser tracker

where T is the translation vector, and Q is the rotation matrix between the robot coordinate system and the laser tracker coordinate system. A method for obtaining this matrix is proposed in reference ^[17]. By transforming the measurement points in the laser tracker coordinate system to the robot coordinate system, and knowing the ideal robot end position of the robot, the actual joint rotation angles can be solved through the rotation center.

3. RBF neural network for error prediction

The joint motion error data of the robot measured by a laser tracker consists of discrete points. A neural network is used to perform data fitting on this information. The joint angles are used as the input variables, and the motion errors are used as the output variables to train the neural network, enabling the prediction of motion errors corresponding to any given joint angle.

The Radial Basis Function (RBF) consists of three layers: the input layer, hidden layer, and output layer, as shown in **Figure 4** ^[18]. Its working principle involves using symmetric functions to convert multivariate problems into univariate approximation problems. At present, RBF networks are commonly used in fields such as numerical approximation and image processing.

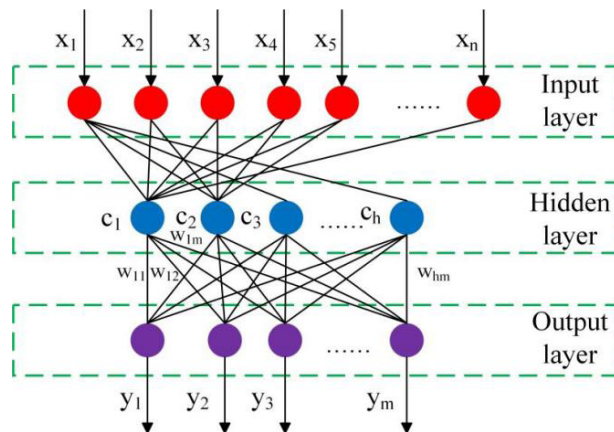


Figure 4. Schematic diagram of RBF neural network

The Radial Basis Function (RBF) neural network offers a variety of activation functions. In this study, the Gaussian function is employed as the activation function of the network. Its output expression is given as follows:

$$y_j = \sum_{i=1}^h w_j e^{\left(-\frac{\|x_k - c_i\|^2}{2\sigma^2}\right)} \quad (7)$$

In the above expression, $x = [x_1, x_2 \dots x_n]^T$ denotes the input vector, $y = [y_1, y_2 \dots y_m]^T$ represents the output, w_{ij} is the weight matrix, and $c = [c_1, c_2 \dots c_h]^T$ indicates the center of the hidden layer nodes. The term σ also represents the variance between the expected and actual outputs of the sample, which is defined as follows:

$$\sigma = \frac{1}{n} \sum_{j=1}^m \|d_j - y_j\|^2 \quad (8)$$

In this expression, $i=1,2,\dots,h$ denotes the number of hidden layer nodes, $i=1,2,\dots,m$ represents the number of network outputs, $k=1,2,\dots,n$ is the number of network inputs, and d corresponds to the expected output of the sample. In this study, joint angles are used as the input variables x and the corresponding joint motion errors as the output variables y to train the neural network, enabling the prediction of motion errors for arbitrary joint angles.

In summary, this study first establishes the robot's forward kinematic model based on screw theory. Then, joint motion errors are measured using a laser tracker, and an RBF neural network is trained to predict the motion error corresponding to any given joint angle. Next, a set of discrete points along the robot end trajectory is designed to obtain the ideal robot end poses. Using the inverse kinematic model, the corresponding ideal joint angles are calculated, and the predicted joint motion errors are compensated for in these angles to improve robot end positioning accuracy. Finally, a ball-bar instrument is employed to verify the enhancement in end positioning precision.

4. Experiment and analysis

This section validates the effectiveness of the robot end volumetric errors optimization compensation method through experiments. The test subject is an IRB1600 industrial robot (6 axes, 10 kg payload, 1450 mm working range, repeatability accuracy of ± 0.05 mm). The robot operates under a rated load of 0.02 kg, as shown in **Figure 5**. The robot parameters used for screw theory modeling are listed in **Table 2**.

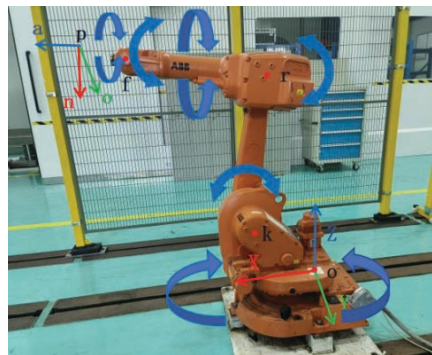


Figure 5. Industrial robot

Table 2. Robot parameters for screw theory modeling

Joint	$e^{\hat{\xi}_1\theta_1}$	$e^{\hat{\xi}_2\theta_2}$	$e^{\hat{\xi}_3\theta_3}$	$e^{\hat{\xi}_4\theta_4}$	$e^{\hat{\xi}_5\theta_5}$	$e^{\hat{\xi}_6\theta_6}$
ω	$[0 \ 1 \ 0]^T$	$[0 \ 1 \ 0]^T$	$[0 \ 1 \ 0]^T$	$[1 \ 0 \ 0]^T$	$[0 \ 1 \ 0]^T$	$[1 \ 0 \ 0]^T$
p	$\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$	$\begin{bmatrix} 0.15 \\ 0 \\ 0.4865 \end{bmatrix}$	$\begin{bmatrix} 0.15 \\ 0 \\ 1.1865 \end{bmatrix}$	$\begin{bmatrix} 0.75 \\ 0 \\ 1.1865 \end{bmatrix}$	$\begin{bmatrix} 0.75 \\ 0 \\ 1.1865 \end{bmatrix}$	$\begin{bmatrix} 0.815 \\ 0 \\ 1.1865 \end{bmatrix}$
v	$q \times w$	$q \times w$	$q \times w$	$q \times w$	$q \times w$	$q \times w$
θ	θ_1	θ_2	θ_3	θ_4	θ_5	θ_6

4.1. Joint motion error identification

Using the measurement method described in Section 2.2, the joint motion errors of the robot are identified. The robot is kept at its zero position, and starting from the first joint, a target point is selected every 5° within the robot's motion range. A laser tracker is used to measure the target ball position as the joint moves from the zero position to the target point. Each target point is measured three times. Once the data for the first joint target points are collected, the robot returns to the initial zero position and the measurements for the next joint are performed sequentially. The experimental setup is shown in **Figure 6**.

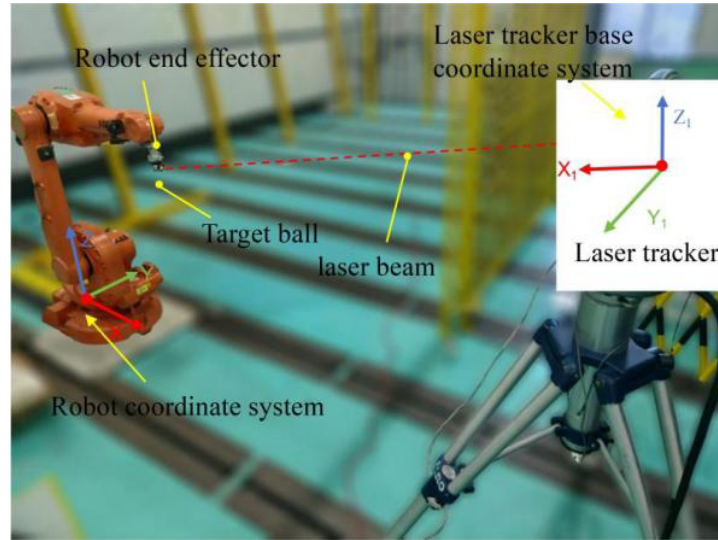


Figure 6. Laser tracker measures the motion error of each joint of the robot

The data measured by the laser tracker are trained using the RBF neural network from Section 2, and the training results are shown in **Figure 7**. By inputting the joint angles of the robot, motion errors for any given joint angle within the robot's motion range can be predicted.

As shown in **Figure 7**, the motion errors of joints 2 and 4 tend to increase as the joint angles increase, while the motion errors of joints 3 and 5 decrease as the joint angles increase. The motion errors of joints 1 and 6 stabilize as the joint angles increase.

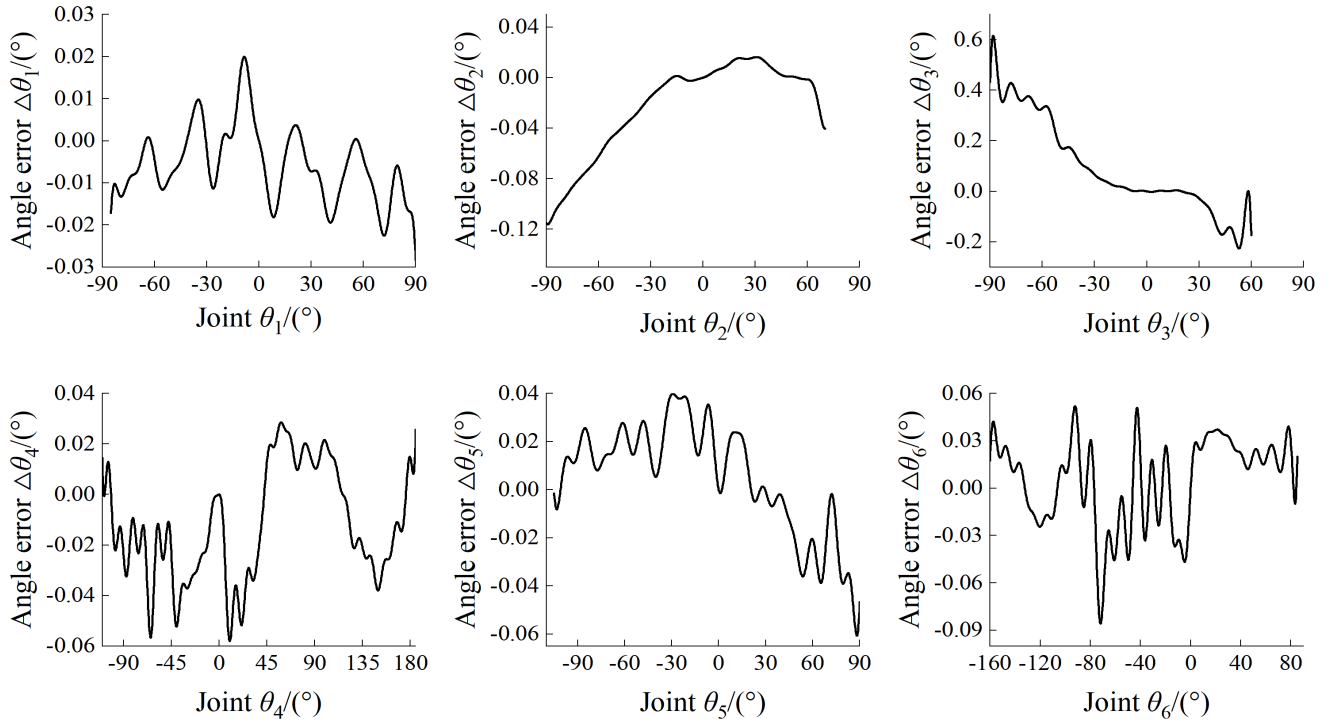


Figure 7. Distribution diagram of joint motion error

4.2. Verification of robot end position error compensation

To evaluate the effectiveness of joint motion error compensation on the robot end positioning accuracy, a ball-bar system was used to measure the end position error. First, a set of discrete points along the desired robot end trajectory was designed, as shown in **Figure 8**. Given the ideal pose at each trajectory point, the corresponding ideal joint angles were calculated using inverse kinematics. The ball-bar tool cup was mounted to the robot end, and the robot was programmed to follow a semicircular path in a 45° inclined plane through the predefined discrete points. The variation in ball-bar length at each point was recorded to assess the positioning accuracy. The experimental setup and the measured length variations are shown in **Figures 9(a)** and **9(b)**, respectively.

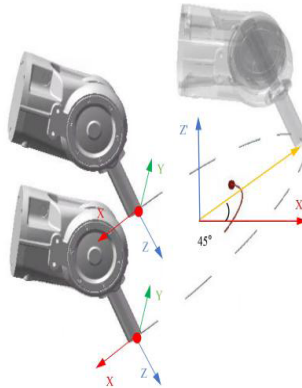
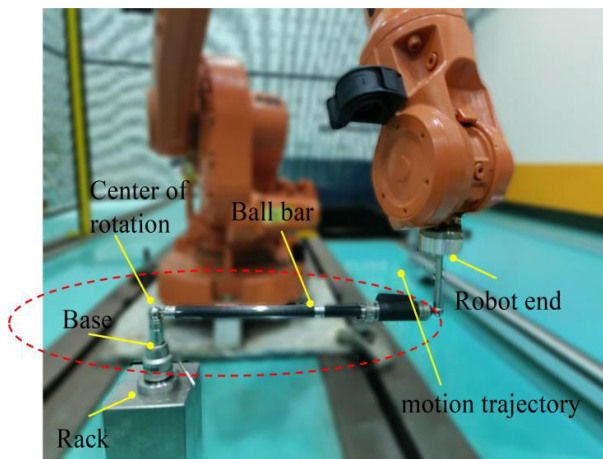
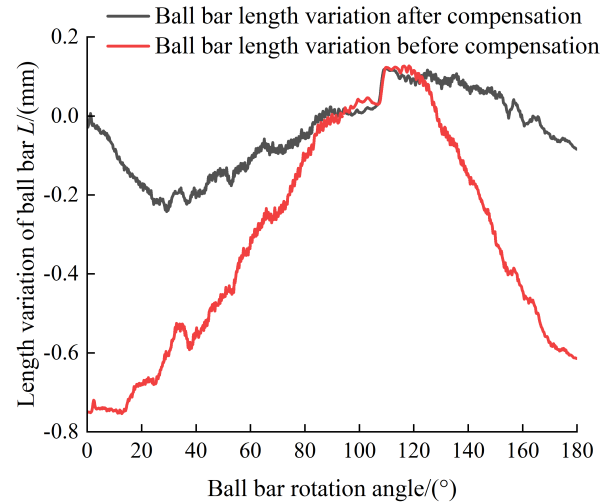


Figure 8. Design of discrete points for robot end trajectory



(a) Experimental setup



(b) Length variation of ball bar

Figure 9. Identification of robot end position accuracy with ball rod instrument

As shown by the compensation results in **Figure 9**, before error correction, the ballbar length varied by a maximum of 0.7582 mm with a mean of 0.2456 mm. After incorporating the identified joint motion errors into the robot's actual joint angles, the maximum length variation decreased to 0.2593 mm and the mean to 0.0716 mm. Consequently, the robot end positioning accuracy improved from 0.2456 mm to 0.0716 mm^[19].

5. Conclusion

This paper proposes a method to improve the absolute positioning accuracy of the robot end by correcting the joint angles of the robot without changing the parameters of the robot controller. The experimental results show that the end position accuracy of the robot has been improved from 0.2456 mm to 0.0716 mm after joint motion error compensation, which verifies the feasibility of the error compensation method proposed in this paper in robot position accuracy compensation.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Yang P, Guo ZG, Kong YB, 2020, Plane Kinematic Calibration Method for Industrial Robot Based on Dynamic Measurement of Double Ball Bar. *Precision Engineering*, 2020(62): 265–272.
- [2] Lv ZY, Wen XL, Cui WX, et al., 2021, Research on Pose Point Set Optimization for Kinematic Parameter Calibration of Industrial Robots. *Instrument Technique and Sensor*, 2021(7): 97–102 + 121.
- [3] Liu W, Liu S, Deng Z, et al., 2023, Research Progress on Positioning Error Compensation Technology of Industrial Robot. *Journal of Mechanical Engineering*, 59(17): 1–16.
- [4] Xue L, Yang YK, Li DS, et al., 2024, Identification and Online Compensation Method of Robot End Load Gravity Based on Laser Tracker. *Aviation Manufacturing Technology*, 67(5): 53–59.

- [5] Jiao JC, Tian W, Zhang L, 2022, Hierarchical Compensation Technology for Machining Error of Industrial Robots. *Computer Integrated Manufacturing System*, 28(6): 1627–1637.
- [6] Ding C, Zhao RH, Li L, et al., 2020, Research on the Accuracy of Robot End Position Based on Joint Angle Deviation. *Micro Nano Electronics and Intelligent Manufacturing*, 2020(3): 30–35.
- [7] Fillion A, Wang XL, Liu ZHF, et al., 2019, New Method for Robot Tool and Camera Pose Calibration. *Chinese Journal of Scientific Instrument*, 40(1): 101–108.
- [8] Pu ZW, Cao BS, Xie ZW, et al., 2023, Kinematic Calibration of a Space Manipulator Based on Visual Measurement System with Extended Kalman Filter. *Machines*, 2023(11): 409.
- [9] Mi X, Ku XC, Ma DY, et al., 2022, Singularity Analysis of 6R Articulated Robot. *Journal of Mechanical & Electrical Engineering*, 39(11): 1620–1626.
- [10] Zhu QD, Xie XR, Li C, et al., 2019, Kinematic Self-calibration Method for Dual-Manipulators Based on Optical Axis Constraint. *IEEE Access*, 2019(7): 7768–7782.
- [11] Liu Y, Zhuang ZH, Li YW, 2022, Closed-Loop Kinematic Calibration of Robots Using a Six-Point Measuring Device. *IEEE Transactions on Instrumentation and Measurement*, 2022(71): 1–12.
- [12] Judd RP, Knasinski AB, 1990, A Technique to Calibrate Industrial Robots with Experimental Verification. *IEEE Transactions on Robotics and Automation*, 6(1): 20–30.
- [13] Zhang L, Tian W, Zheng FW, 2020, Accuracy Compensation Technology of Closed-Loop Feedback of Industrial Robot Joints. *Transactions of Nanjing University of Aeronautics and Astronautics*, 37(6): 858–871
- [14] Zhang YJ, Cui J, Li Y, et al., 2023, Modeling and Calibration of High-order Joint-dependent Kinematic Errors of Serial Robot Based on Local POE. *Industrial Robot-The International Journal of Robotics Research and Application*, 50(5): 753–764.
- [15] Gao WB, Luo RQ, Jian, ZZ, 2021, Kinematic-Parameter Calibration for Modular Robots Based on the Local POE. *Jiqiren/Robot*, 43(1): 66–73.
- [16] Pardos-Gotor J, 2021, *Screw Theory in Robotics: An Illustrated and Practicable Introduction to Modern Mechanics*. CRC Press, Florida.
- [17] Zhang B, Wei ZZ, Zhang GJ, 2010, Fast Conversion Method Between Robot Coordinate System and Laser Tracker Coordinate System. *Journal of Instrumentation and Instrumentation*, 2010(9): 1986–1990.
- [18] Liu YC, Xiong YH, Yang HX, 2022, Fixed-time Sliding Mode Control of Multi-joint Robot Based on RBF Neural Network. *Control and Decision*, 37(11): 2790–2798.
- [19] Che YX, Yang XG, Gao F, 2017, Research on Kinematic Calibration Method of Three Degree of Freedom Serial Robot Arm Based on Ball Rod Instrument. *Mechanical Strength*, 39(6): 1315–1319.

Publisher's note

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

Study on the Development of Agricultural Modernization in the Southern Xinjiang Production and Construction Corps

Dongliang Guo¹, Dan Xiao¹, Shijie Xiang^{2*}

¹Tarim University, Aral 843300, Xinjiang, China

²Tarim Vocational and Technical College, Aral 843300, Xinjiang, China

**Author to whom correspondence should be addressed.*

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 development of agricultural modernization is an important approach that the country is unwaveringly advancing to boost rural revitalization, accelerate agricultural technological innovation, and seek well-being for the vast number of farmers. The Southern Xinjiang Production and Construction Corps, located in the remote northwest, has been committed to the orderly development of agricultural modernization and has achieved a series of outstanding results: continuously improving levels of agricultural mechanization, rapid development of digital agriculture, ongoing improvement of agricultural industrial structure, and increasing levels of green and sustainable agricultural development year by year. However, there are also problems of varying degrees in the process of agricultural modernization in the Southern Xinjiang Production and Construction Corps that require full attention. Against this backdrop, this article takes the lead in exploring the current status of agricultural modernization in the Southern Xinjiang Production and Construction Corps, then analyzes the issues faced by the agricultural modernization in the Southern Xinjiang Production and Construction Corps, and finally proposes a path for the agricultural modernization of the Southern Xinjiang Production and Construction Corps: improving the investment and maintenance mechanism for agricultural infrastructure construction; strengthening the support of agricultural talent and technical standards; enhancing the level of green development in modern agriculture; and improving the agricultural socialized service system.

Keywords: Agricultural modernization; Agricultural mechanization; Digital agriculture; Agricultural industrial structure; Southern Xinjiang Production and Construction Corps

Online publication: June 6, 2025

1. Introduction

The report of the 20th National Congress of the Communist Party of China on comprehensively advancing rural revitalization and adhering to the priority development of agriculture and rural areas has clarified the direction

and provided guidance for continuing to do well in the great work of rural revitalization. As a major grain-producing province in the country, the importance of agricultural development in Xinjiang is self-evident. The whole of Xinjiang is a chessboard, with the southern region being the key piece. To better play the role of the “key piece”, it is essential to continuously accelerate the process of agricultural modernization, refine and implement key tasks such as accelerating the modernization of agriculture and rural areas, and promote comprehensive rural revitalization with high-quality development.

2. The current status of agricultural modernization in the Southern Xinjiang Production and Construction Corps

2.1. The level of agricultural mechanization continues to improve

In recent years, the agricultural mechanization level of the Southern Xinjiang Production and Construction Corps has been in a continuously improving state of positive operation. In particular, there has been a significant growth trend in important indicators such as the rate of agricultural mechanization and the rate of cotton mechanical harvesting.

Among them, firstly, the rate of agricultural mechanization. In 2017, the agricultural mechanization rate of the Southern Xinjiang Production and Construction Corps reached 93.7%. By 2021, the agricultural mechanization rate had exceeded 95%, reaching 95.3%. Over the four years from 2017 to 2021, the agricultural mechanization rate of the Southern Xinjiang Production and Construction Corps increased by 1.6%. It is evident that in recent years, the Southern Xinjiang Production and Construction Corps has shown a trend of continuous improvement in the enhancement of agricultural mechanization rates, reaching new heights in the process of exploration and development^[1].

Secondly, the rate of mechanized cotton harvesting. In 2017, the mechanized cotton harvesting rate in the Southern Xinjiang Production and Construction Corps was 80%. By 2021, the rate had significantly increased to 94.2%. The growth over the four years was nearly 15%, reaching 14.2%. It is evident that the Southern Xinjiang Production and Construction Corps has shown an excellent development trend in improving the mechanized cotton harvesting rate. The mechanized harvesting advantage of the cotton industry has largely saved labor and resources, enhancing the modern competitiveness of the cotton industry in the Southern Xinjiang Production and Construction Corps, and contributing to the increasingly improved agricultural industrial structure.

In summary, the agricultural mechanization rate and cotton mechanical harvesting rate in the Southern Xinjiang Production and Construction Corps have shown a clear upward trend in important indicators. The level of agricultural mechanization is gradually improving, providing an effective guarantee at the mechanization level for the agricultural modernization of the Southern Xinjiang Production and Construction Corps.

2.2. The agricultural industrial structure is constantly improving

The orderly development of agricultural modernization in the Southern Xinjiang Production and Construction Corps is inseparable from the continuous improvement of the agricultural industrial structure. Over the years, the Southern Xinjiang Production and Construction Corps has established a superior operational system in the cotton industry, livestock industry, and other aspects, gradually advancing the modernization of the agricultural industrial structure of the corps^[2].

Among these, firstly, in terms of the development of the cotton industry, during the “13th Five-Year Plan” period, more than 10 new cotton varieties in the southern Xinjiang Production and Construction Corps have

been approved by the autonomous region, and the work of breeding new cotton varieties has been generally leading the average level of the autonomous region, with some cotton varieties even reaching an international leading level. It is evident that the cotton industry, after years of development, has become a dominant industry in the agricultural structure of the southern Xinjiang Production and Construction Corps, gradually showing the agricultural prosperity of “China’s cotton looks to Xinjiang, and Xinjiang’s cotton looks to the corps.”

Secondly, in terms of the development of the animal husbandry industry, the Southern Xinjiang Production and Construction Corps has gradually strengthened the role of agricultural science and technology support. This is evident in the scale and systematic development trends in dairy cow and pig farming, as well as in the production of beef and mutton. The milk products, pork products, and beef and mutton products produced by the Southern Xinjiang Production and Construction Corps supply the entire autonomous region and are even exported to neighboring provinces and cities, providing more security for the public to enjoy fresh and high-quality meat products.

In summary, the continuous improvement of the agricultural industrial structure in the Southern Xinjiang Production and Construction Corps is achieved based on the sustained enhancement of technological advantages. The Southern Xinjiang Production and Construction Corps leverages the brand influence and capital return of advantageous industries such as livestock and cotton to support other agricultural industries, perfecting the operational approach of “advantages compensating for disadvantages” and gradually optimizing the agricultural industrial structure of the Southern Xinjiang Production and Construction Corps.

2.3. The level of green and sustainable development in agriculture has been improving year by year

The level of agricultural green and sustainable development in the Southern Xinjiang Production and Construction Corps has shown a positive trend of increasing year by year, especially in the construction of an integrated protection mechanism for mountains, rivers, forests, fields, lakes, grasslands, and sands, and in the development of systematic governance activities for green agriculture, demonstrating a gradual development trend with increasingly significant results ^[3]. The Southern Xinjiang Production and Construction Corps continues to strengthen the synergy among various battalions, making considerable progress in reducing carbon emissions, reducing pollution, expanding green space areas, and developing green and low-carbon agriculture.

3. Issues faced by the agricultural modernization in the Southern Xinjiang Production and Construction Corps

3.1. The construction of agricultural infrastructure needs to be improved

For the agricultural modernization development of the Southern Xinjiang Production and Construction Corps, the key role of agricultural infrastructure construction is self-evident. However, the issue of the need for improvement in the agricultural infrastructure construction of the Southern Xinjiang Production and Construction Corps still objectively exists. Whether it is agricultural life-related facilities or agricultural productive facilities, there is space that urgently needs improvement ^[4].

The issues with the improvement of agricultural infrastructure construction are mainly reflected in the following aspects. Firstly, agricultural living facilities need to be improved. Living infrastructure covers a wide range and is closely related to the lives of the general public. At this stage, basic electricity and road construction still need further optimization and improvement. In particular, in relatively remote battalions, the

improvement of living infrastructure needs to be put on the agenda. Secondly, agricultural productive facilities also need to be improved. The strategic layout space for the construction of modern agricultural bases in the Southern Xinjiang Corps is relatively large, and the connection with big data and information technology is not very close. At the same time, the construction of agricultural productive facilities in many battalions is in a relatively random state, and the aging trend of productive infrastructure is common. Moreover, due to the relative lack of replacement mechanisms, the corresponding agricultural productive infrastructure cannot fully meet the actual needs of agricultural modernization in the Southern Xinjiang Corps.

3.2. The quality of agricultural practitioners needs to be improved

The development of agricultural modernization in the Southern Xinjiang Production and Construction Corps cannot be achieved without the effective support of agricultural practitioners. However, the significant issue of the need to improve the quality of agricultural practitioners has weakened the orderly operation of agricultural modernization in the Southern Xinjiang Production and Construction Corps.

The issue of the quality of agricultural practitioners needing improvement is mainly reflected in the following aspects. Firstly, the quality of grassroots technical talents in the agricultural field is uneven, the standards for talent cultivation are relatively vague, and they cannot be effectively implemented^[5]. Affected by this, the theoretical literacy of some grassroots technical personnel cannot be further optimized, and there is a lack of necessary information sharing and experience sharing among technical personnel from different farms, which also restricts the improvement of practical literacy. Secondly, the quality of the general agricultural practitioners also needs to be improved. A large number of practitioners are stuck in traditional agricultural concepts and are unwilling to continuously learn scientific agricultural knowledge. In addition, some practitioners who are aware of the need to improve their agricultural knowledge literacy do not have stable learning channels and opportunities, and can only be limited to traditional agricultural methods with lower production efficiency, which is not conducive to the basic implementation of agricultural modernization in the Southern Xinjiang Corps.

3.3. The agricultural socialization service system needs to be improved

The agricultural socialization service system of the Southern Xinjiang Production and Construction Corps needs to be improved, which also largely restricts the further operation of agricultural modernization, especially in terms of sales services and the construction of information service systems; there is much room for improvement^[6].

The issues with the agricultural socialization service system that need to be improved are mainly reflected in the following aspects. Firstly, the construction of the agricultural socialization sales service system needs to be improved. The existing “party building + e-commerce + cooperative” new model of agricultural sales in the Southern Xinjiang Production and Construction Corps is still in its infancy. Many companies have not established their own agricultural cooperatives, and the sales of their agricultural products still rely mainly on traditional methods, supplemented by online sales, with the sales service unable to keep up with the constantly developing pace of agricultural production. Secondly, the construction of the agricultural socialization information service system needs to be improved. The advantages of information services are self-evident; however, for some companies in the Southern Xinjiang Production and Construction Corps, information on agricultural product production, sales, and breeding science and technology is relatively lagging behind. This

not only fails to demonstrate the intended guiding role of information but also places the construction of the agricultural socialization information service system in a relatively lagging state.

4. The path selection for agricultural modernization in the Southern Xinjiang Production and Construction Corps

4.1. Improve the investment and maintenance mechanism for agricultural infrastructure construction

In response to the practical issue of the need to improve agricultural infrastructure construction, the Southern Xinjiang Production and Construction Corps needs to continuously improve the construction of agricultural infrastructure, structure an investment and maintenance mechanism, to address the adverse effects of these issues, and gradually advance the optimization and operation of agricultural infrastructure construction in the Southern Xinjiang Production and Construction Corps.

The specific implementation path is as follows. First, strengthen the construction of agricultural-related living facilities and agricultural production facilities, and improve the new infrastructure construction planning. On one hand, the Southern Xinjiang Production and Construction Corps, based on a macro strategic perspective, further optimizes and improves basic electricity and road construction, especially for relatively remote teams, incorporating the improvement of living-related infrastructure into the development schedule. On the other hand, the Southern Xinjiang Production and Construction Corps continuously strengthens the construction of agricultural production facilities. With the premise of having ample strategic space for the construction of modern agricultural bases, the corps continuously refines construction goals, highlights the value of modernization, and strengthens its connection with big data and information technology. Second, actively promote the scientific construction of the investment and maintenance mechanism for agricultural-related infrastructure, curb the relatively arbitrary state of agricultural production facility construction, and solve the problem of aging production infrastructure. The Southern Xinjiang Production and Construction Corps has established specialized investment and maintenance teams, set up regular inspection mechanisms, and immediately initiated a timely replacement system once old facilities are discovered. Depending on the difficulty of the replacement, they complete the work efficiently within 24 hours to 7 days.

4.2. Strengthening the support of agricultural talent technical standards

In response to the objective reality of the need to improve the quality of agricultural practitioners, the Southern Xinjiang Production and Construction Corps, starting from their own actual conditions, continuously strengthens the improvement of the overall literacy of ordinary agricultural practitioners and grassroots technical personnel, and reinforces the technical standards support for agricultural talent.

The specific implementation path is as follows. Firstly, in response to the uneven quality of grassroots technical talents, the Southern Xinjiang Production and Construction Corps continuously refines the technical standards for talent cultivation. This standardization of training drives the gradual improvement of the quality of rural grassroots technical talents and ensures its effective implementation in agricultural production. At the same time, technical personnel from different corps need to achieve information and experience sharing through a combination of “offline + online” methods, promoting the enhancement of practical literacy among grassroots technical talents. Secondly, the improvement of the literacy of ordinary employees also requires strengthening the support of agricultural talent technical standards. Helping employees break away from the misconception of

being confined to traditional concepts and engage in continuous learning of scientific agricultural knowledge. In addition, the Southern Xinjiang Production and Construction Corps continuously constructs stable learning channels and opportunities for employees, expanding their knowledge horizons, and flexibly applying new knowledge and concepts to effectively enhance the comprehensive literacy of ordinary employees.

4.3. Enhancing the level of green development in modern agriculture

In response to the practical issue of the need to improve the level of green development in agriculture, the Southern Xinjiang Production and Construction Corps has pooled efforts and adopted multiple measures, taking agricultural pollution control and ecological protection work implementation as entry points to continuously enhance the level of green development in modern agriculture.

The specific measures mainly focus on: First, strengthening agricultural pollution control. Based on their own actual conditions, the Southern Xinjiang Production and Construction Corps effectively curb the vague awareness and random behavior of some grassroots people towards agricultural pollution prevention and control, strengthen the scientific construction of real-time and traceable mechanisms for agricultural pollution control, to prevent sporadic and hidden agricultural pollution, and enhance the level of green agricultural development. Second, strengthening ecological protection work. The Southern Xinjiang Production and Construction Corps participates in various aspects, adheres to a scientific and powerful cognitive attitude, innovates ecological protection measures, highlights the timeliness and advancement of protection, so that any ecological damage in the Southern Xinjiang Production and Construction Corps can be dealt with in a timely manner.

5. Research conclusion

For the Southern Xinjiang Production and Construction Corps, the orderly development of agricultural modernization is of great significance to the nation and its people. At this stage, the Southern Xinjiang Production and Construction Corps has achieved remarkable results in the work of agricultural modernization. However, there are still objectively existing issues that constrain further progress in agricultural modernization, such as the need for improvement in agricultural infrastructure construction, the need to enhance the quality of agricultural workers, the need to increase the level of agricultural green development, and the need to improve the agricultural socialized service system. Therefore, the Southern Xinjiang Production and Construction Corps must adopt multiple measures, including investing in and maintaining the agricultural infrastructure, strengthening the support of agricultural talent and technical standards, improving the level of modern agricultural green development, and perfecting the agricultural socialized service system. Only by doing so can the Southern Xinjiang Production and Construction Corps truly promote the realization of sustainable development in agricultural modernization.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Pan SL, Xia WH, Huo Y, et al., 2022, Analysis of the Current Situation of Agricultural Science and Technology Extension Services in Southern Xinjiang. *Cooperative Economy and Technology*, 2022(8): 36–37.
- [2] Wang XL, Luo JD, Liu YJ, et al., 2021, Research on the Cultivation of Agricultural Electrification Professionals from the Perspective of Demand in the Southern Xinjiang Region. *China Modern Educational Equipment*, 2021(7): 118–120.
- [3] Liang B, Lu X, Zhang Z, et al., 2021, Research on the Path of Cultivating and Developing Agricultural Strategic Emerging Industries from the Perspective of Agricultural Modernization: A Case Study of the Xinjiang Production and Construction Corps. *Agricultural Economics*, 2021(4): 3–6.
- [4] Li X, Li P, Pan H, et al., 2019, A Review of the Coordinated Development of the “Four Modernizations” in the Southern Xinjiang Production and Construction Corps. *Rural Economy and Technology*, 30(23): 175–177.
- [5] Li X, Zhang CH, 2019, Research on the Coordinated Development of the “Four Modernizations” in the Southern Xinjiang Production and Construction Corps Based on the Coupling Coordination Degree Model. *Journal of Tarim University*, 31(4): 85–95.
- [6] Wang CX, Tang Lv, Liang K, 2017, Research on the Development of Modern Agriculture in the Corps Driven by the “Internet Plus” — Based on the Investigation of the 105th Regiment of the Sixth Division of the Corps. *Rural Economy and Technology*, 28(3): 158–160.

Publisher’s note

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

Visual Language and Emotional Expression of Film and Television Art Explored in Depth

Qi Zhang*

Communication University of China, Nanjing 211172, China

**Author to whom correspondence should be addressed.*

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: Visual language is the core expression of film and television art, which constructs a unique art form through basic elements such as picture, color, light and shadow, composition, and so on. These elements together constitute the visual language system of film and television art, making it an important medium for emotion transmission. In film and television works, visual language is not only a narrative tool but also a carrier of emotion, the importance of which lies in its ability to transcend the limitations of language and directly touch the audience's heart. Through the clever use of visual language, film and television works can evoke the audience's emotional memory, stimulate their thinking and reflection, so as to realize the deep dialogue between art and mind. The artistic value of this kind of emotional expression lies not only in its infectious power but also in its profound insight into human nature and society.

Keywords: Film and television art; Visual language; Emotional expression

Online publication: June 6, 2025

1. Basic elements of visual language and their emotional expression

1.1. Images and emotional conveyance

Picture is the basic unit of visual language, and its static and dynamic expression directly determines the effect of emotion transmission. Static images can maximize the depth and delicacy of emotion by framing a certain moment ^[1]. For example, in the movie "The Shawshank Redemption", the picture of the protagonist Andy standing in the rain with open arms conveys the emotional impact of freedom and hope through static framing. Dynamic images, on the other hand, show the fluidity and complexity of emotions through movement and change. For example, the classic shot of Jack and Rose flying on the bow of the ship in "Titanic" pushes the emotions of romance and passion to the climax through dynamic picture design. Whether static or dynamic, the picture conveys rich emotional connotations in silence.

Picture composition is an important tool for emotional transmission, and its design can imply the audience's emotional direction through visual guidance. Symmetrical composition often conveys the emotion

of stability and harmony. For example, in *The Grand Budapest Hotel*, director Wes Anderson creates a fairytale-like, dreamy atmosphere through symmetrical composition. Asymmetrical composition, on the other hand, can create the emotional implication of tension and uneasiness, for example, in *The Shining*, director Kubrick strengthened the distortion and fear of the character's psyche through the tilted composition. The emotional implication of the picture composition is not only the embodiment of visual aesthetics, but also the bridge of emotional communication between the director and the audience ^[2].

1.2. Emotional symbolism of color

Color is one of the most emotionally expressive elements of visual language, and its symbolism has been widely used in film and television works. Color psychology research shows that different colors can trigger different emotional responses. For example, red usually symbolizes passion and danger, while blue represents calmness and melancholy. In the movie "*Moulin Rouge*", the director creates a passionate and dangerous emotional atmosphere by using a lot of red, which echoes the love theme of the movie. In *Blue Valentine*, blue becomes the main color throughout the film, suggesting the loneliness and depression of the character's heart. The emotional symbolism of colors not only enriches the expressive power of film and television works but also provides the audience with a deeper emotional experience.

The design of color contrast and harmony can further strengthen the effect of emotional expression. The use of contrasting colors can create a strong visual impact. For example, in *Angels Love Beauty*, the director creates a vibrant and fantastical emotional atmosphere through the contrast of red and green. The use of harmonious colors can convey a calm and warm emotion, for example, in the "*Hay Street Diary*", the director shows the warm and delicate emotional relationship between the sisters through the soft color tone ^[3]. The emotional effect of color lies not only in its own symbolic meaning, but also in its organic combination with other visual elements.

1.3. Emotional shaping of light and shadow

Light and shadow is an important means of shaping emotional atmosphere in visual language, and their contrast between light and dark can directly affect the audience's emotional experience. Bright light usually conveys hope and positive emotions, for example, in *The Sound of Music*, the director uses bright natural light to show the characters' love and yearning for life. On the other hand, dark light can create a depressing and fearful emotional atmosphere. For example, in *Seven Deadly Sins*, the director enhanced the suspenseful and horrifying atmosphere of the movie by using dim light and shadow design. The contrast between light and shadow is not only a visual effect, but also an important tool for emotional expression.

Light and shadow changes are often closely related to emotional transitions in film and television ^[4]. For example, in *The Godfather*, the director shows the psychological transformation of the protagonist Michael from simple to complex through the gradual change of light and shadow. At the beginning of the film, Michael's face is illuminated by bright light, symbolizing his inner purity and ideal, while at the end of the film, his face is covered by shadow, implying his inner darkness and coldness. The emotional portrayal of the changing light and shadow not only enhances the narrative tension of the movie but also provides a deeper emotional resonance for the audience.

1.4. Emotional guidance of composition

Composition is an important way to guide the audience's emotions in visual language, and its balanced and

unbalanced design can directly affect the audience's emotional experience. Balanced composition usually conveys the emotion of stability and harmony. For example, in *Roman Holiday*, the director shows the romance and beauty between the characters through balanced composition. Unbalanced compositions, on the other hand, are able to create emotional hints of tension and uneasiness. For example, in *Psycho*, director Hitchcock strengthened the character's psychological fear and anxiety through tilted compositions. The emotional guidance of composition is not only a reflection of visual aesthetics, but also an important way of emotional communication between the director and the audience ^[5].

The visual focus design in the composition can further strengthen the effect of emotional expression. By focusing the audience's attention on a specific area, the director is able to convey a specific emotional message. For example, in "*Truman's World*", the director puts Truman in the center of the screen to imply his inner loneliness and confusion. In *Schindler's List*, the director creates a strong emotional impact by placing the girl in red in the black and white picture. The visual focus design in the composition not only enhances the expressive power of the movie but also provides the audience with a deeper emotional experience.

2. Deep integration of visual language and emotional expression

2.1. Visual symbols and emotional metaphors

Visual symbols are important carriers for conveying emotions in film and television art, and their symbolism often transcends the picture itself and directly refers to the deeper emotional core. For example, in the movie "*The Boys' Adventure*", the tiger, as a visual symbol, not only represents the wildness of nature, but also symbolizes the hero's inner fear and desire for survival. Through this symbol, the movie presents the relationship between human beings and nature, rationality, and instinct in a metaphorical way, triggering the audience to think about the nature of human nature ^[6]. The symbolism of the visual symbols not only enriches the emotional level of the film but also provides the audience with a diversified space for interpretation.

The use of visual metaphor in emotional expression further deepens the artistic value of film and television works. Metaphors enable the audience to feel the inner world of the characters more intuitively by visualizing abstract emotions. For example, in *Her*, the director explores the emotional alienation and loneliness between people in modern society through the metaphor of a virtual operating system. The skillful use of visual metaphor not only enhances the emotional tension of the movie but also provides the audience with deeper emotional resonance.

2.2. Visual rhythm and emotional fluctuations

Visual rhythm is an important tool for emotional expression in movie and television art, and its fast and slow changes directly affect the audience's emotional experience. Fast visual rhythm usually conveys the emotion of tension and excitement, for example, in *Mad Max: Fury Road*, the director creates a tense and exciting atmosphere through fast editing and camera switching, which makes the audience feel as if they are in the midst of a crazy chase. The slow visual rhythm can convey the emotion of calmness and contemplation, for example, in *Star Trek*, the director shows the vastness of the universe and the insignificance of human beings through the slow camera movement and long shots, which triggers the audience to think about the meaning of life.

The coordination of visual rhythm and narrative rhythm is the key to emotional expression. In *Inception*, the director brings the audience into a progressive dream world through the perfect combination of visual

rhythm and narrative rhythm. Through the rapid visual rhythm and complex narrative structure, the movie creates an emotional atmosphere of tension and confusion, making the audience think and explore continuously in the process of watching the movie ^[7]. The deep combination of visual rhythm and emotional fluctuation not only enhances the narrative tension of the movie but also provides the audience with a deeper emotional experience.

2.3. Visual space and emotional experience

Visual space plays an important role in film and television art, and its open and closed design directly affects the audience's emotional experience. Open space usually conveys the emotion of freedom and hope, for example, in *Forrest Gump*, the director shows Forrest Gump's positive attitude towards life and unlimited possibilities through the vast fields and boundless sky. Closed space, on the other hand, can create a depressing and fearful emotional atmosphere. For example, in *Room*, the director shows the despair and helplessness of the mother and son imprisoned in a small room. The emotional contrast between open and closed spaces not only enriches the emotional level of the movie but also provides the audience with diversified emotional experiences.

The combination of changes in visual space and the depth of emotional experience further enhances the artistic expression of the movie and television works. In *Parasite*, the director shows the solidification of social class and the psychological changes of the characters through the upward and downward movement of space. Through the darkness of the basement and the brightness of the mansion, the film presents the gap between the rich and the poor and human greed in a visual way, triggering the audience to think about social issues. The change of visual space is not only a means of narrative, but also an important tool for emotional expression ^[8].

3. Innovative exploration of visual language and emotional expression

3.1. Emotional expression in cross-media visual language

The art of film and television does not exist in isolation, it has a profound connection and integration with other visual art forms such as painting and photography. The composition, color, and light treatment of a painting provide rich visual inspiration for film and television. For example, in the movie "Love Van Gogh", the director combines Van Gogh's paintings with the narrative of the movie through the form of hand-painted oil paintings to create a unique visual style, which not only pays tribute to the master artist, but also deepens the theme of the movie through the emotional expression of the paintings. The use of light and shadow and instantaneous capture in the art of photography also provides a new way of emotional expression for film and television works. For example, in *The Grand Budapest Hotel*, director Wes Anderson draws on the symmetrical composition and color matching in photography to create a nostalgic and dreamy visual atmosphere, so that the audience can feel the delicate flow of emotions in their visual enjoyment.

The emotional innovation of cross-media visual language breaks the limitations of traditional film and television expression and opens up new possibilities for emotional transmission. For example, in *City of Love*, the director creates an audiovisual experience full of romance and passion by combining the stage elements of the musical with the movie narrative. This cross-media innovation not only enriches the visual language of the movie but also provides the audience with a more diversified emotional experience ^[9]. The emotional expression of cross-media visual language is not only the inheritance of traditional art, but also the expansion and breakthrough of modern film and television art.

3.2. Emotional expansion of technology and visual language

The rapid development of digital technology provides unlimited possibilities for the emotional expression of visual language. Through computer-generated images (CGI), virtual reality (VR), and other technologies, film and television works can create more realistic and shocking visual effects. For example, in *Avatar*, director James Cameron constructed a fantastical Pandora planet through CGI technology, making the audience feel the emotional theme of harmonious coexistence between humans and nature in visual shock. The use of digital technology not only enriches the expression of visual language but also provides a broader stage for emotional expression.

The new possibilities of technological means in emotional expression have further expanded the boundaries of film and television art. For example, in *Top Player*, the director brings the audience into an imaginative virtual world through the combination of VR technology and movie narrative, so that the audience can feel the emotional changes of the characters in the immersive experience. In addition, the use of artificial intelligence technology also provides new ideas for film and television creation. For example, in *Blade Runner 2049*, the director explores the emotional boundaries between humans and machines through the visual elements generated by AI, triggering the audience's profound thoughts on human nature and technology. The innovation of technical means not only enhances the expressive power of visual language but also provides richer possibilities for emotional transmission ^[10].

3.3. Cultural differences and emotional expression in visual language

The difference in visual language in different cultural backgrounds profoundly affects the emotional expression of movie and television works. For example, in Eastern culture, red symbolizes joy and good fortune, while in Western culture, red is more related to danger and passion. In the movie *Hero*, director Zhang Yimou uses the color red to not only show the traditional aesthetics of oriental culture but also convey the complexity of the character's inner feelings. In *Moulin Rouge*, the director shows the romance and freedom of Western culture through the warmth and passion of the color red. Cultural differences not only shape the diversity of visual language but also provide richer cultural connotations for emotional expression.

The influence of cultural factors on emotional expression further deepens the artistic value of the movie and television works. For example, in *Parasite*, the director visualizes the gap between the rich and the poor and human greed through the class culture and spatial design unique to Korean society, triggering the audience's deep reflection on social issues. And in *Finding Dory*, the director demonstrated the emotional themes of family and memory through the cultural elements of the Mexican Day of the Dead, making the audience feel the warmth and power of emotions in cultural resonance. The integration of cultural elements not only enriches the expression of visual language but also provides a more profound cultural heritage for emotional expression.

4. Artistic philosophical reflections on visual language and emotional expression

4.1. The artistic nature of visual language and emotional expression

As a carrier of emotional expression, the essence of visual language lies in conveying emotions and thoughts through visual elements. Whether it is the composition of the screen, the use of color, or the design of light and shadow and spatial layout, the visual language tells the story and conveys the emotion in silence. For example, in the movie *Blade Runner 2049*, the director creates an emotional atmosphere of loneliness and detachment through cold colors and futuristic visual design, so that the audience feels the struggle and confusion of the characters through the visual impact. Visual language is not only a narrative tool but also a bridge for emotional

expression. Its artistic essence lies in visualizing the abstract emotions, so that the audience can feel the inner world of the characters more intuitively ^[11].

The philosophical significance of emotional expression in artistic creation lies in its profound insight into human nature and society. Artistic creation is not only the embodiment of technology, but also the exploration of human emotions and thoughts. For example, in *The World of Truman*, the director explores the philosophical proposition of freedom and truth through the deep combination of visual language and emotional expression, triggering the audience to think about reality and illusion. The artistic essence of emotional expression lies not only in its aesthetic value but also in its profound revelation of human emotions and thoughts.

4.2. Emotional resonance between the audience and the visual language

The audience's emotional interpretation of visual language is the key to the success of film and television art. Visual language can trigger the audience's emotional resonance through its unique way of expression. For example, in *The Shawshank Redemption*, the director conveys the emotional theme of hope and freedom through bright colors and open screen composition, so that the audience can feel the inner strength of the characters in their visual enjoyment. The audience's interpretation of the visual language is not only an understanding of the emotions of the movie, but also a projection and reflection of their own emotions.

The interactive mechanism between visual language and the audience's emotions is the core of emotional expression in film and television art. Through the skillful design of visual elements, the director is able to guide the audience's emotional direction. For example, in *The Shining*, the director creates an emotional atmosphere of tension and fear through the tilted composition and depressing colors, so that the audience can feel the psychological distortion of the characters through the visual impact. The interactive mechanism between visual language and the audience's emotions not only enhances the emotional expression of the movie but also provides the audience with a deeper emotional experience.

4.3. Aesthetic value of visual language and emotional expression

The unique position of visual language in aesthetics lies in its ability to convey emotions and thoughts through visualization. Whether it is the compositional design of the screen or the use of color and light, visual language tells stories and conveys emotions in silence. For example, in *The Grand Budapest Hotel*, the director creates a nostalgic and dreamy visual atmosphere through symmetrical composition and soft color matching, so that the audience can feel the emotional theme of the film in their visual enjoyment. The aesthetic value of visual language lies not only in the presentation of its visual effect but also in its profound expression of emotions and thoughts.

The contribution of emotional expression to the aesthetics of film and television art lies in its deepening of the artistic value of the movie through emotional transmission. For example, in *Haijie Diary*, the director shows the warm and delicate emotional relationship between the sisters through the soft color tone and delicate screen design, so that the audience can feel the emotional power of the film in their visual enjoyment. The aesthetic value of emotional expression lies not only in the effect of its emotional transmission but also in its profound insight into human nature and society.

5. Conclusion

The artistic and philosophical thinking of visual language and emotional expression reveals the core value of

film and television art. Visual language, as a carrier of emotional expression, conveys emotions and thoughts through its unique way of expression; the audience's emotional resonance with visual language is the key to the success of film and television art; the aesthetic value of visual language and emotional expression lies not only in the presentation of its visual effect, but also in its profound insight into human nature and society. The artistic and philosophical thinking of visual language and emotional expression is not only a deep understanding of film and television art, but also an exploration and revelation of human emotions and thoughts. In the future, visual language and emotional expression will continue to play a unique and important role in movie and television creation, bringing audiences a richer and deeper emotional experience.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Wang YY, 2020, Essential Elements for a Successful Family Film—Take 102 NOT OUT as an Example. Proceedings of the 2nd International Conference on Literature, Art and Human Development (ICLAHD 2020).
- [2] Steffens J, 2020, The Influence of Film Music on Moral Judgments of Movie Scenes and Felt Emotions. *Psychology of Music*, 48(1): 3–17.
- [3] Kim JH, 2016, Research on the Emotional Expressions in Director Miyazaki Goro's Animation Movie: Based on Kokuriko-zaka Kara. *The Korean Journal of Animation*, 12(3): 40–57.
- [4] Chun HS, Zhang BT, 2014, Prediction of Emotion using Color Distribution of Movie Scene. *Journal of KIISE: Computing Practices and Letters*, 20(8): 467–471.
- [5] Kandel E, 2012, *The Age of Insight: The Quest to Understand the Unconscious in Art, Mind, and Brain, from Vienna 1900 to the Present*. Random House Publishing Group, New York.
- [6] Huang X, 2023, Research on Emotional Expression Strategies of Microfilm Advertising under the Perspective of Media Context Theory, thesis, Nanchang University.
- [7] Liu CH, 2023, Study on the Plain Narrative and Reality Tension of Microfilm, thesis, Shanghai Normal University.
- [8] Yan QY, 2023, Research on Microfilm Empathy Based on Narrative Transmission Theory, thesis, East China Normal University.
- [9] Cai ZQ, 2023, Research on Characterization in Microfilm, thesis, Harbin Normal University.
- [10] Cheng MJ, 2023, Analyzing the Emotional Expression of Microfilm “Poverty Alleviation Father and Son”, thesis, Harbin Normal University.
- [11] Chen T, 2023, Study on Emotional Expression in the Creation of Affectionate Microfilm “My Grandma”, thesis, Harbin Normal University.

Publisher's note

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

Digital Inclusive Finance Empowering Rural Revitalization in China: A Case Study of Fujian Province

Jinyu Lu*

New Huadu Business School, Minjiang University, Fuzhou 350108, Fujian, China

*Corresponding author: Jinyu Lu, 3078533545@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: Digital inclusive finance has emerged as a transformative force in China's rural development, providing broad-based financial services through digital technology and thus contributing to the country's rural revitalization strategy. This paper examines the theoretical mechanisms by which digital inclusive finance can empower rural revitalization and analyzes China's progress in building digital financial infrastructure and adoption in rural regions. The study further presents Fujian Province as a case study, highlighting specific programs and platforms, such as Gutian County's "Minfu" inclusive finance service network and Longyan's "e-Longyan" digital finance platform, that illustrate the successful integration of digital finance with rural revitalization initiatives. Empirical evidence from Fujian shows that digital finance has improved access to credit for farmers and micro-entrepreneurs, supported agricultural modernization and rural industries, and spurred rural e-commerce and entrepreneurship. Comprehensive development of digital inclusive finance, coupled with supportive policies, can play a vital role in narrowing the urban-rural divide and achieving China's rural revitalization goals.

Keywords: Digital inclusive finance; Gutian County; Agricultural development; Financial technology; Rural credit; China

Online publication: June 6, 2025

1. Introduction

Rural revitalization has become a central pillar of China's development strategy in the post-poverty alleviation era. First proposed in 2017, the rural revitalization strategy aims to comprehensively address the "three rural issues" — agriculture, rural areas, and farmers — by promoting prosperity in rural industries, improving ecological livability, enriching rural culture, enhancing effective governance, and raising the living standards of rural residents. Achieving these objectives requires not only traditional policy support and investment but also innovative financial inclusion to ensure rural communities have access to the capital and services needed for sustainable development. In this context, inclusive finance — broadly defined as a financial system

that provides affordable and effective financial services to all segments of society, especially the poor and underserved — is regarded as a crucial enabler for rural economic and social progress. The concept of inclusive finance was highlighted by the United Nations in 2005, which called for building financial systems that serve all social strata, particularly low-income populations. In China, the government has increasingly emphasized inclusive finance as a means to support rural development and poverty reduction.

With the rapid advancement of financial technology (fintech) over the past decade, digital inclusive finance has emerged as a new paradigm for delivering financial services in rural areas. Digital inclusive finance refers to the use of digital technologies, such as mobile internet, big data analytics, cloud computing, and online platforms, to broaden the reach of financial services in an inclusive manner. Unlike traditional finance, which often struggled to serve dispersed rural populations, digital finance can overcome geographic barriers at lower cost and offer innovative products tailored to small-scale users. By leveraging fintech, digital inclusive finance expands the coverage of financial services, deepens usage among those previously excluded, and diversifies financial products available to rural households and micro-enterprises. China's State Council issued a Development Plan for Inclusive Finance (2016–2020), which underscored building a multi-tiered, digitally-enabled inclusive financial service system across urban and rural areas. In recent years, the rise of mobile payment platforms, online lending, and e-commerce in China's countryside has provided a fertile ground for integrating digital finance with rural economic activities.

Existing research suggests that digital inclusive finance can significantly contribute to rural revitalization through multiple channels ^[1–2]. Theoretically, digital finance alleviates the longstanding bottlenecks in rural finance, such as information asymmetry, high transaction costs, and lack of collateral, thus enabling greater credit access and investment in rural industries ^[3–4]. By harnessing technology, digital finance reduces the cost of delivering loans and payments, making it viable for financial institutions to serve small farmers and businesses. It also uses alternative data to build credit profiles for rural borrowers, which helps overcome information gaps and collateral constraints. Furthermore, digital finance platforms can connect rural producers to markets and to wider financial markets, thereby integrating rural economies into the broader value chain. Through these mechanisms, digital inclusive finance is expected to boost rural incomes, encourage entrepreneurship, and facilitate structural upgrades in the rural economy — all key aspects of revitalization. However, empirical analysis is needed to substantiate these effects and to understand any pitfalls or regional variations ^[5].

This paper aims to provide a comprehensive analysis of how digital inclusive finance empowers rural revitalization in China, with a particular focus on Fujian Province as a case study. Fujian offers an illustrative example as an eastern province with both prosperous coastal cities and less-developed mountainous rural areas, making it a microcosm of regional disparities. Fujian has actively pursued digital finance innovations for rural development, and its experience can yield insights for other regions.

2. Theoretical framework: Digital finance and rural revitalization

2.1. Concept of digital inclusive finance

Inclusive finance is rooted in the idea of offering financial services to all members of society, especially marginalized groups. In China, inclusive finance has been promoted as a means to support farmers, small businesses, and impoverished communities by improving their access to credit, savings, insurance, and payment services. Digital inclusive finance extends this concept by utilizing digital technology to achieve greater

scale and efficiency. It encompasses services like mobile payments, internet banking, micro-loans via online platforms, crowdfunding, digital insurance, and other fintech solutions targeted at traditionally underserved populations. A key feature of digital inclusive finance is its universality — everyone (rich or poor, urban or rural) can potentially enjoy financial services via digital channels, as long as they have connectivity. Another feature is lowered cost and risk: fintech applications can automate processes and use data-driven algorithms, which reduces the cost of serving small clients and improves risk management. For example, digital credit platforms can algorithmically assess loan applications from farmers by analyzing data from their sales or even smartphone usage, thus partially substituting for physical collateral. Digital finance also offers convenience — rural clients can access services on mobile apps without traveling long distances to bank branches, which is particularly valuable in remote villages. These characteristics position digital inclusive finance as a catalyst for bridging the urban-rural financial services gap.

In the Chinese context, one widely used measure of digital financial inclusion is the Peking University Digital Financial Inclusion Index (PKU-DFIIC), which tracks the development of digital finance across regions since 2011 ^[6]. Studies using this index have documented a remarkable expansion of digital financial services in China over the past decade. This expansion has been facilitated by near-ubiquitous mobile internet coverage and the innovation drive of tech firms (e.g., Ant Group's Alipay and Tencent's WeChat Pay) in providing payment and lending products. By 2019, China had become one of the world's most advanced digital finance markets, with hundreds of millions of users conducting transactions and obtaining credit online. Yet, within China, the development was uneven — coastal and urban regions led in the adoption of digital finance, while some inland and rural areas lagged. Governments at various levels have thus sought to actively promote digital finance infrastructure in rural areas as part of the rural revitalization efforts.

2.2. Mechanisms linking digital finance to rural revitalization

Digital inclusive finance can empower rural revitalization through several interrelated mechanisms, corresponding to the multifaceted goals of the revitalization strategy.

2.2.1. Enhancing rural industries and entrepreneurship

A core component of revitalization is industrial prosperity in rural areas (e.g., modern agriculture, rural tourism, agribusiness). Digital finance provides critical support by broadening credit access for farmers, cooperatives, and rural entrepreneurs. Fintech lending platforms and digital microcredit services increase the volume of credit available in rural regions, often through innovative products with low thresholds. Research by Li et al. finds that digital finance's technological advantages enable a wider coverage of borrowers and improved loan quality, which in turn promotes the development of rural industries ^[7]. By lowering financing costs and expanding channels, digital finance helps overcome the chronic issue of rural enterprises being credit-constrained. This fosters entrepreneurship and business expansion. For instance, digital inclusive finance has effectively provided reliable funding and convenient services for innovative start-ups and family businesses in rural areas that traditionally lacked collateral and credit history. With more capital flowing into rural industry, communities can invest in higher value-added activities, upgrade agricultural production, and develop local enterprises, driving rural economic diversification.

2.2.2. Improving household income and consumption

Ultimately, rural revitalization aims to improve the livelihood and affluence of farmers' increasing incomes and

consumption levels ^[8]. Digital inclusive finance contributes here by raising the income-generating capacity of rural residents. It does so via micro-mechanisms like easing formal credit constraints on farm households (so they can invest in better seeds, equipment, or sideline businesses), and facilitating migrant workers or returnees to start small ventures back in their hometowns. Empirical evidence shows that digital financial inclusion has helped narrow the urban-rural income gap by empowering rural residents to earn more. One study, for example, finds that greater penetration of digital finance is associated with higher rural household income and a reduction in income inequality between cities and the countryside. As incomes rise, households are able to increase their consumption, which further stimulates the rural economy. Digital payments also make transactions easier, encouraging rural consumers to participate in e-commerce and broader markets. Li et al. demonstrate that digital finance directly boosts rural consumption and that rural revitalization mediates this effect, meaning digital finance and revitalization efforts together create a virtuous cycle of income and consumption growth ^[7].

2.2.3. Facilitating e-commerce and market linkages

Digital finance is tightly interwoven with the growth of rural e-commerce, which is a driving force for rural revitalization by connecting farmers to urban markets. E-commerce platforms combined with mobile payments allow farmers and rural artisans to sell products nationally ^[9]. This brings farmers closer to the market, promoting entrepreneurship and employment. The availability of digital payment infrastructure (QR codes, mobile wallets) in rural villages lowers barriers for farmers to participate in online business. Notably, China's rural e-commerce sales have surged from just ¥180 billion in 2014 to ¥2.17 trillion in 2022 — an indicator of how rapidly digital finance-backed online commerce has expanded. By the end of 2022, over 17.3 million online businesses operated in rural areas, ranging from local specialty sellers to livestream marketers. Such entrepreneurship contributes to rural revitalization by creating jobs, increasing farmers' share of the value chain, and spurring allied services (logistics, packaging) in townships. Digital finance underpins this ecosystem by providing secure payment solutions and often offering sellers micro-loans or insurance. It also helps smooth consumption for rural households, as mobile payment users tend to spend more and have better access to consumer credit. In fact, surveys in China show that by 2019, nearly half of the residents in small cities and rural areas used mobile payments as their primary payment method, reflecting the deep penetration of fintech in daily rural life.

3. Case study — Fujian province: Digital finance empowering rural revitalization

Fujian, located on China's southeast coast, has been an active player in digital inclusive finance, driven by both provincial policy and grassroots innovation. Known for its mountainous terrain (over 80% of Fujian's land area is mountains and hills) and significant rural population, Fujian has a strong imperative to leverage financial inclusion for development. The province's experience illustrates how digital finance can be harnessed in different rural contexts — from poorer inland counties to relatively affluent peri-urban areas — and what outcomes can be achieved. The study focuses on two representative cases: Gutian County in Ningde City, where a pioneering inclusive finance service model was established, and Longyan City, which has built a comprehensive digital finance platform as part of a national pilot. The study also discusses the overall progress and remaining issues in Fujian's rural financial inclusion.

3.1. Gutian County: “Minfu” inclusive finance service network

Gutian County is a primarily agricultural county in northeastern Fujian (under Ningde City), traditionally known for its edible mushroom industry. It was once a poverty-stricken area but has seen significant improvements, partly thanks to innovative financial inclusion efforts. In 2016, a Rural Finance Innovation Project in cooperation with the United Nations Development Programme (UNDP) and Chinese authorities led to the establishment of the “Minfu Center” in Gutian. The Minfu Center is essentially an inclusive financial service network that links together the government, banks, cooperatives, and farmers on a common platform. It was part of a UNDP-backed pilot to build an inclusive financial system at the county level in China, and Gutian was chosen for its unique characteristics and needs.

The Minfu Center model works by incubating and supporting farmer cooperatives and then connecting them with formal financial institutions for credit delivery ^[10]. Specifically, the center helped standardize local cooperatives (e.g., those for mushroom farmers), improving their governance and creditworthiness, and acted as a hub through which banks could channel wholesale loans to cooperative members. This arrangement tackled the problem of banks being reluctant to lend to scattered small farmers by using cooperatives as aggregation points and credit guarantors. Over time, the network expanded to cover the county, townships, and villages, forming a three-tier financial service system that integrates services and information flow from the grassroots to the county level. Farmers could get loans, make deposits, or buy insurance through village service stations connected to the Minfu network, without having to travel to town. The center also provides financial education to farmers and promotes credit consciousness.

The outcomes in Gutian have been impressive. According to UNDP reports, the Minfu Center boosted local farmers’ revenues significantly. By introducing modern finance into the mushroom industry, it enabled annual production of 50 million mushroom tubes and increased farmers’ income by nearly ¥200 million in aggregate. These gains came from farmers being able to expand cultivation (with loans for inputs), adopt better techniques, and market their products more widely. In 2022, Gutian’s success led to its selection as a pilot site for a new initiative titled “Leveraging Sustainable Finance, Accelerating Rural Revitalization.” Under this initiative, a Digital Brain platform was deployed in Gutian — essentially a big-data credit information system — which enabled local financial institutions to issue ¥234 million in new credit within less than a year to rural beneficiaries, including micro, small, and medium enterprises, women-owned businesses, and smallholder farmers. This reflects a scaling-up of the earlier model using more advanced digital tools to reach a broader range of rural clients.

Gutian’s case shows how a combination of institutional innovation and digital technology can solve the last-mile problem of rural finance. By networking various stakeholders (government, banks, cooperatives) and using digital credit data, Gutian has effectively extended financial services into the rural economy, supporting its pillar mushroom industry and related sectors. This, in turn, has been integral to its rural revitalization — poverty levels fell and Gutian became known nationally as the “Mushroom County”, contributing to both local livelihoods and food security. Gutian’s approach has been recognized as a model for sustainable, green, and inclusive rural development aligned with the Sustainable Development Goals. It demonstrates that digital inclusive finance is not just about apps and websites, but also about institutional frameworks on the ground that ensure fintech serves the real needs of farmers.

3.2. Longyan: “e-Longyan” digital finance platform

While Gutian is a county-level example, Longyan illustrates a city-level initiative under a government-driven pilot. Longyan, located in western Fujian, is a prefecture-level city with a large rural hinterland and is part of the old “Central Soviet” revolutionary base areas. In 2019, Longyan was designated as a National Pilot Zone for Inclusive Finance Reform (focused on old revolutionary base area revitalization). This designation spurred an ambitious experiment in building a comprehensive digital financial services platform to serve local enterprises and residents. The result was the “e-Longyan Digital Inclusive Finance Service Platform” launched by the People’s Bank of China Longyan branch in collaboration with the local Financial Supervision Bureau, Data Management Bureau, and a state-owned big data company.

The e-Longyan platform is essentially a one-stop online financial services “supermarket” that aggregates data and services for credit matchmaking. It pools real-time data from 18 government departments (45 categories, over 2000 data points) — including social security records, housing provident fund, land and property registrations, utility payments (water, electricity), tax records, etc. — to construct a rich credit profile for individuals and businesses in the region. On the platform, 33 banks, 13 government guarantee institutions, and 3 insurance companies have onboarded, collectively offering over 600 financial products (mostly loan and credit products) for users. The system is interoperable with higher-level systems: it connects with the national “Xinyidai” platform and Fujian Province’s “Jinfu Cloud”, ensuring that credit information and financing done through e-Longyan are recognized beyond the city. Effectively, e-Longyan serves as a data-driven intermediary: small firms or farmers can apply through the platform, and the system will match them to appropriate financial products from participating institutions, while sharing necessary verified data with the lenders. This greatly reduces the paperwork and time for loan approval — many steps are automated, and risk control algorithms incorporate the multi-source data.

The benefits of e-Longyan became quickly evident. For example, a flower farmer in a township of Longyan (Mr. Lü, mentioned in a news report) needed financing to expand his flower nursery; through the e-Longyan platform, he applied to a local bank online and obtained a 500,000 yuan loan approval in one day. Such speed and convenience were unheard of in the past when rural loan applications might take weeks and require multiple in-person visits. The platform has special sections like a “Supply Chain Finance” zone, a “New Citizen” products zone (for rural migrant workers settling in cities), and a “Credit Recovery” zone (for those with temporary credit difficulties), showing its inclusive design. It also introduced instant credit products (with names like “Xing Flash Loan”, “Smart Quick Loan”, etc.) that can be approved in seconds based on data analytics. Additionally, e-Longyan digitized collateral management — it linked with the property registry so that things like land or house collateral registration could be done online, enabling “cloud” processing of mortgage registrations, which is particularly beneficial for rural property owners.

The Longyan case underscores the role of government-facilitated platforms in boosting inclusive finance. It shows that when local governments proactively organize data and participants, the synergy can drastically improve financial access for rural communities. The “e-Longyan” model is being watched as a template that could be replicated in other regions to build integrated county-level or city-level financial service platforms for rural revitalization. One of the keys to its success is the trust and collaboration between agencies — the financial regulator, various government departments, and banks agreed to share data under proper safeguards, which addressed the information problems that typically plague rural finance.

4. Conclusion

China's experience to date demonstrates that digital inclusive finance is a powerful enabler of rural revitalization, capable of unlocking new opportunities for communities that were long underserved by traditional finance. The theoretical underpinnings highlight that by reducing transaction costs and information barriers, digital finance expands credit access, boosts incomes, and links rural populations to broader markets — all essential for revitalization. The practical developments nationwide, such as the surge in rural e-commerce and widespread adoption of mobile payments, provide evidence that rural China is increasingly connected to the digital economy.

The case study of Fujian Province offers concrete insights into how policy and innovation can converge to make this a reality. Gutian County's Minfu Center illustrates a successful model of institutional innovation combined with digital tools to support agriculture and lift incomes, while Longyan's e-Longyan platform showcases the role of government-orchestrated data platforms in catalyzing inclusive lending at scale. These examples resulted in tangible economic improvements — from hundreds of millions in new agricultural revenue to tens of thousands of small loans disbursed in minutes — thereby contributing to the objectives of rural revitalization in Fujian.

For digital inclusive finance to truly empower all of rural China, efforts must continue to ensure it is inclusive in breadth and depth. That means extending the digital finance revolution to the poorest and remotest villages, educating users to make sound financial decisions, and safeguarding against new risks that technology may bring. The policy measures recommended — improving infrastructure, education, risk-sharing, coordination, and integration with development programs — provide a roadmap to enhance the effectiveness and resilience of digital finance initiatives. It is equally important to monitor outcomes and iterate policies, as the field of fintech is rapidly evolving (e.g., the rise of AI credit scoring or blockchain in agriculture finance could offer new tools, but also new regulatory questions).

In conclusion, digital inclusive finance should be viewed as both a means and an end in China's rural revitalization. It is a means to achieve broader goals — thriving industries, improved livelihoods, cultural and ecological progress — by financially empowering those driving rural development. And it is an end in itself as part of modernization: a rural society where everyone has access to affordable financial services is inherently more equitable and resilient. Fujian's case confirms that with thoughtful implementation, digital finance can significantly accelerate rural revitalization, turning the once “financially excluded” into active participants in development. As China continues on this path, sharing these lessons and models will be valuable for other developing regions seeking to harness digital finance for inclusive growth. The journey is ongoing, but the evidence thus far is encouraging that digital inclusive finance, under the right policies, can indeed help realize the vision of a prosperous, thriving countryside in the digital age.

Funding

Innovation and Entrepreneurship Training Program of Minjiang University, “Zhilian City—Exploring the New Mode of Digital Rural Revitalization” (202410395041X)

Disclosure statement

The author declares no conflict of interest.

References

- [1] Wang J, 2023, Digital Inclusive Finance and Rural Revitalization. *Finance Research Letters*, 2023(57): 104157.
- [2] Zhang H, Fan H, Cheng Z, 2025, Social Network of Digital Inclusive Finance and Urban-rural Income Gap. *Applied Economics*, online publication, 1–18.
- [3] Yan Y, Chen L, Zhou Z, et al., 2025, Digital Financial Inclusion and Agricultural Modernization Development in China—A Study Based on the Perspective of Agricultural Mechanization Services. *Humanities and Social Sciences Communications*, 12(1): 1–11.
- [4] Xu Y, Peng Z, Sun Z, et al., 2022, Does Digital Finance Lessen Credit Rationing? — Evidence from Chinese farmers. *Research in International Business and Finance*, 2022(62): 101712.
- [5] Liu Y, Luan L, Wu W, et al., 2021, Can Digital Financial Inclusion Promote China’s Economic Growth? *International Review of Financial Analysis*, 2021(78): 101889.
- [6] Stage II, 2019, The Peking University Digital Financial Inclusion Index of China.
- [7] Li W, Zhang L, Pu M, et al., 2025, Digital Inclusive Finance, Rural Revitalization and Rural Consumption. *PloS One*, 20(1): e0310064.
- [8] Fan S, Jiang M, Sun D, et al., 2023, Does Financial Development Matter the Accomplishment of Rural Revitalization? Evidence from China. *International Review of Economics & Finance*, 2023(88): 620–633.
- [9] Liao Y, Wu G, Huang J, 2023, The Impact of Rural E-Commerce Environment Development on Orchard Expansion from the Perspective of Tele-coupling: The Case of Pinghe County in Southeast China. *Land*, 12(11): 1991.
- [10] Cheng QW, Lin WH, 2018, Environmental Management of Countryside under Background of Rural Revitalization Strategy: A Case Study of Fengting Village in Gutian County of Ningde City. *Acta Agriculturae Jiangxi*, 30(10): 132–136.

Publisher’s note

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

Research on the Path of International Communication of Chinese Excellent Traditional Culture Empowered by Digital Technology

Cheng Wang*

School of Marxism, Yili Normal University, Yining 835000, Xinjiang, China

**Author to whom correspondence should be addressed.*

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 rapid development of digital technology provides new opportunities for the international dissemination of Chinese excellent traditional culture, but it also faces the challenges of cultural translation distortion, technological platform dependency, cross-cultural acceptance obstacles, and operational mechanism defects. Based on the dual perspectives of technology availability and cultural memory theory, this paper systematically analyzes the internal logic of digital technology-enabled cultural international communication, revealing the semantic loss in the digital translation of traditional culture, the communication bias caused by the algorithmic preference of technological platforms, as well as the value conflict in cross-cultural contexts. The study proposes a four-dimensional synergistic path of “content-platform-strategy-mechanism”: building a cross-cultural narrative system through innovative content production, breaking through the ecological dependency of communication by relying on independent technology platforms, optimizing precise communication strategies based on intelligent algorithms, and perfecting institutional safeguards to cultivate the momentum of sustainable development. The study provides strategies for solving the core problems of translation distortion and platform dependence in “culture going overseas”, and has important theoretical and practical value for enhancing the effectiveness of Chinese culture’s international dissemination and strengthening the country’s cultural soft power.

Keywords: Chinese excellent traditional culture; Digital technology; International communication

Online publication: June 6, 2025

1. Introduction

Digital technology has redefined the subject and space-time of cultural communication, providing a wide range of communication subjects and a broad communication space for the dissemination of Chinese excellent traditional culture^[1]. Short videos, virtual reality, artificial intelligence, and other technical means have not only reconfigured the presentation of cultural content but also changed the audience’s acceptance habits. However,

in this process, the distortion of the digital translation of traditional culture, the algorithmic hegemony of the Western technological platform, and the value conflict in the cross-cultural context constrain the effective dissemination of Chinese culture. How to use digital technology to break through the existing communication barriers and build a communication path with both cultural depth and international adaptability has become an important issue to be solved. This paper focuses on the core issue of digital technology empowering the international dissemination of Chinese traditional culture, analyzes the internal logic of technology-driven transformation of communication paradigm and transformation of cultural modernity, reveals the main dilemmas faced by the current situation, and puts forward a systematic implementation path.

2. The Internal logic of digital technology empowering the international communication of Chinese excellent culture

2.1. Technological inevitability: Digital media reconstructs the paradigm of cultural communication.

Cultural communication is a process of interaction and interaction between self-interpretation and other reading, self-modeling and other modeling ^[2]. The rapid development of digital technology is profoundly reshaping the basic paradigm of cultural communication. From the perspective of technological determinism in communication science, digital media has reconstructed the underlying logic of traditional cultural international communication through three dimensions. Firstly, 5G, cloud computing and other technologies have broken through time and space constraints, so that Dunhuang mural paintings, cultural relics of the Forbidden City, and other cultural resources can be instantly shared globally through the digital twin technology, which is evidenced by the 210% year-on-year increase in the number of visits to the “Digital Dunhuang” project overseas in 2023. Secondly, VR/AR and other immersive technologies effectively reduce cultural discounts through multi-sensory interactions, such as Henan TV’s “Luoshen Shui Fu” with the help of underwater digital photography technology, so that viewers around the world intuitively feel the Chinese aesthetic mood of “fluttering like a shock”. Furthermore, the UGC model of social media has broken the shackles of one-way traditional cultural communication. The #chineseculture topic on TikTok has accumulated 5.8 billion times of broadcasts, and the contents of calligraphy and Chinese dress created by users have formed a fissile spread. This technology-driven transformation of the communication paradigm has not only changed the presentation of cultural content but also reconfigured the power relationship between “communicator-media-audience”, providing new possibilities for the international dissemination of Chinese culture. Digital media are becoming the technical infrastructure for dissolving cultural barriers and realizing dialogue among civilizations.

2.2. Cultural necessity: Digitalization is a key fulcrum for the modern transformation of traditional culture

In the context of globalization, the modern transformation of China’s excellent traditional culture urgently needs digital technology as a strategic fulcrum. This necessity is mainly reflected in three dimensions. Firstly, digitalization has injected new vitality into traditional culture, for example, the Palace Museum has digitized 1.86 million pieces of its collection through the “Digital Cultural Relics Library”, which has enabled dusty cultural relics to be reborn in the form of AR and 3D, and the proportion of young visitors in 2023 has increased to 62%. Secondly, digital media have reconstructed the participation mechanism of cultural inheritance. Blockchain technology has been applied to the field of non-genetic inheritance, and the woof-making technique

in Suzhou has formed a traceable inheritance genealogy through digital evidence, which solves the problem of geographical limitation of the traditional master-apprentice system. More critically, digitization has given traditional culture the discourse ability to cope with cultural hegemony. The success of Li Ziqi's YouTube channel proves that cultural expression based on digital narrative can break through the communication barriers of Western-centrism, and his "One Thing, One Life" series of videos has been viewed more than 200 million times on international platforms, which has successfully constructed a Chinese agrarian civilization symbol with contemporary significance. Its "One Thing, One Life" video series has received over 200 million views on international platforms, successfully constructing a symbol system of Chinese farming civilization with contemporary significance. This kind of digital transformation is not a simple superimposition of technology, but a contemporary expression of traditional cultural values through digital language, so that it can maintain its authenticity while acquiring a modern form for globalization and dissemination.

3. Realistic challenges of international communication of Chinese excellent traditional culture empowered by digital technology

3.1. Cultural decoding dilemma: Digital translation loss of traditional values

Culture is the soul of a country; however, due to human subjectivity and other reasons, cross-cultural communication faces huge cultural differences^[3]. In the process of traditional cultural digital communication, the cross-media translation of value symbols faces significant semantic loss. This decoding dilemma is mainly reflected in three levels. First, there is technical distortion in the digital presentation of traditional aesthetics, such as the calligraphic art of "flying white" strokes lost in digital rendering of the ink rhyme level, and the color reproduction of the Tongjing paintings of the Forbidden City's Burnout Studio only reaches 82% after digitization (Technical Report of the Palace Museum 2023). Second, the mechanical translation of philosophical concepts has led to the deep dissolution of culture, with 17 ambiguous expressions appearing in the AI's multi-language translation of the word "Ren" in the Analects of Confucius (data from Peking University's Center for Linguistic Computing), seriously weakening the philosophical integrity of the concept. What is more noteworthy is that the digital reconstruction of ritual scenes faces emotional transmission barriers. In the VR presentation of the Naxi Dongba ritual in Yunnan, 68% of overseas users were unable to understand the nature worship connotation of the ritual (Tencent Culture and Tourism 2024 research data). This loss of translation not only results in the superficial mutation of cultural symbols, but also leads to the deep loss of the value kernel. As pointed out by the Digital Culture Research Center of the China Academy of Art, "In the current digital communication, about 43% of non-heritage projects suffer from the phenomenon of diminishing cultural information." This loss is further amplified by the algorithmic recommendation mechanism in cross-cultural communication, forming the "funnel effect of cultural communication."

3.2. Technological hegemony constraints: The risk of dependence on communication channels

Currently, the international dissemination of Chinese culture faces a severe technological platform dependence dilemma. Data show that more than 90% of China's cultural content going overseas relies on Western platform channels such as Meta, Google, and YouTube (Communication University of China International Communication Research Institute 2024 report). This dependence leads to a triple risk. Firstly, algorithmic bias causes attenuation of communication efficacy; YouTube's average recommendation weight for Chinese cultural content is only 63% of that of similar content in Europe and the United States (Tsinghua University's

Intelligent Communication Laboratory monitoring data). Secondly, platform rule changes bring sudden communication disruptions; the banning of TikTok Indonesia in 2023 led to a 72% plunge in Chinese cultural communication in that country in a single month. More profoundly, there is the risk of losing data sovereignty. The cultural consumption database built by overseas platforms through user profiles is forming a “monopoly of cultural interpretation” in the digital age. Taking the dissemination of opera as an example, the artificial intelligence editing system of overseas platforms based on the preferences of Western audiences automatically deletes 83% of the programmed movements in Peking Opera performances (according to the research data of the China Academy of Opera and Music Arts), which leads to a serious fragmentation of cultural expression. This phenomenon of “algorithmic domestication” forces communicators to passively adapt to the logic of the platform, resulting in the alienation of communication by “cutting the feet to fit the shoes.” The National Center for Industrial Information Security Development and Research warns that “before establishing an autonomous communication system, every 10% increase in dependence on overseas platforms will result in a 7.2% decrease in the autonomy of cultural communication.”

3.3. Reception context conflict: Adaptation challenges in cross-cultural communication

Chinese excellent traditional culture faces a deep-seated acceptance context barrier in the process of international communication. This cross-cultural adaptation problem is highlighted in three aspects. First, cultural misinterpretation caused by differences in values, for example, the acceptance of dragon totems by audiences in the Middle East is only 32% (Chinese Culture Overseas Awareness Survey Report 2023), and some countries have even requested video modifications to traditional dragon dance performances. Secondly, deep-seated differences in aesthetic habits have resulted in communication failures. The average viewing time for Western audiences of the Chinese realistic landscape paintings in the British Museum’s digital exhibition was less than 1/3 of that of figurative oil paintings (data from the Center for the Study of Art at the University of London). More complex are the institutional environment constraints. After the implementation of the EU Digital Services Law, Chinese traditional opera videos containing historical war scenes have been taken down by 27% (data monitored by China Foreign Culture Group). This contextual conflict is amplified by algorithms in digital communication, creating “cultural filter bubbles” — overseas social platforms automatically block 87% of non-native cultural content based on user preferences (Oxford University Internet Institute 2024). According to the Center for Intercultural Communication Research at Beijing Foreign Studies University, “Only 41% of Chinese cultural symbols in current digital communication are able to cross the contextual barriers in their entirety to achieve effective communication.” This acceptance barrier not only affects the breadth of communication but also leads to a flattened interpretation of deeper cultural values.

3.4. Shortcomings in the operation mechanism: Ecological deficiencies in sustainable communication

Currently, the international communication system of Chinese culture is facing serious sustainable development challenges. Such ecological defects are mainly manifested in three dimensions. First, the problem of the fault line of composite talents is prominent, and surveys show that there is a 78% shortage of professionals who have cultural literacy, digital technology, and international communication ability at the same time (data from the China Institute for Cultural Industry Development in 2024). Secondly, the vulnerability of the business model is remarkable, and the average investment return cycle of digital cultural products is as long as 3.7

years, far exceeding that of other digital content industries (statistics of the Institute of Cultural Economy of Tsinghua University). Even more critical is the lack of an evaluation system. 83% of the existing indicators for evaluating communication effects still remain in superficial data, such as the number of clicks and retweets (Global Communication Monitoring Report of the Foreign Language Bureau of China), and there is a lack of quantitative tools for deeper impacts, such as cultural identity. Such a flawed mechanism has led to communication programs being characterized by “three highs and three lows”: high government investment and low social participation; high short-term activity and low sustainable operation; high hardware construction and low content development. The National Institute for Strategic Communication at Peking University warns that “if a market-oriented operation mechanism cannot be established within the next three years, the sustainability of the existing communication model will drop by 40%.” This ecological imbalance is constraining the long-term development momentum of digital cultural communication.

4. Implementation path of international communication of Chinese excellent traditional culture empowered by digital technology

4.1. Innovate content production and build a cross-cultural digital narrative system

The construction of an internationally adaptable digital narrative system requires a breakthrough in the traditional content production mode. Firstly, establish an intelligent grading mechanism for cultural symbols. Through the big data analysis of more than 2,300 traditional cultural elements, they can be divided into three categories: core symbols (such as calligraphy, festivals and other elements with cultural genetic significance, which need to be kept original), adaptive symbols (such as food, clothing and other elements that can be localized), and discreet symbols (such as religious totems and other elements that need to be interpreted in a special context). The practice of the China Academy of Art shows that projects using this grading system can reduce the rate of cultural misinterpretation by 58%. Secondly, develop intelligent contextual translation systems. Tsinghua University’s “Wenxin” cross-cultural communication platform is able to automatically optimize the presentation of content through deep learning of cultural contextual features from 75 countries. For example, the digital dissemination of *The Analects of Confucius* focuses on the philosophical discourse of “The Benevolent One Loves Others” for European and American audiences, while the ethical practice of “What You Do Not Want for Yourself” is emphasized for Southeast Asian audiences. The system has already supported the intelligent adaptation of 17 languages. Finally, in terms of narrative mode innovation, a three-dimensional presentation of cultural communication is realized through “three-dimensional integration.” In the spatial and temporal dimension, historical scenes are restored with the help of AR technology; in the sensory dimension, multimodal technology is integrated to enhance the experience; in the cultural dimension, the modern translation of traditional elements is promoted. This integrated narrative effectively breaks through the limitations of a single form of communication, forming a synergistic effect of time and space travel, sensory immersion, and cultural resonance. At present, there is an urgent need to cultivate three types of new subjects: cultural digital creative workshops, transnational content co-creation platforms, and intelligent narrative laboratories, in order to systematically improve content production capacity.

4.2. Building technical platforms and creating an autonomous and controllable communication ecology

The construction of an autonomous and controllable international communication technology platform

system is a strategic initiative to break through the current plight of channel dependency. The construction of this platform ecology needs to be synergistically promoted at three levels: at the infrastructure level, the construction of a “cloud platform for culture going to the sea” should be accelerated. The “Chinese Culture International Dissemination Cloud” led by the Foreign Languages Bureau of China has preliminarily realized four core functions: multimodal content library (integrating 4K/8K, VR/AR and other formats), intelligent distribution system (supporting 83 languages for automatic adaptation), cross-border copyright management (based on blockchain’s certificate of authentication), and data monitoring center. At the technical tool level, the focus is on developing lightweight creation suites. The “Cultural Digital Toolbox” launched by Tencent Research Institute contains three modules: low-code non-legacy digitization tools (enabling local cultural institutions to complete 60% of digitization work on their own), AI-assisted creation system (providing a library of more than 2,000 traditional cultural IP elements), and cross-platform distribution assistant (one-click synchronization to 15 international mainstream platforms). The AI-assisted creation system (providing a library of more than 2,000 traditional cultural IP elements) and cross-platform publishing assistant (one-click synchronization to 15 international mainstream platforms). After the Dunhuang Research Institute applied the tool, the efficiency of digital content output was increased by three times. At the standard system level, there is an urgent need to establish technical standards for cultural digitization. The Chinese Culture Digitization Technical Standards System, directed by the Ministry of Industry and Information Technology, has formulated 47 industry standards, covering key areas such as data collection (e.g., precision requirements for 3D scanning of cultural relics), content annotation (specification of metadata for cultural elements), and platform interfaces. The core technologies that need to be broken through urgently include: intelligent generation algorithms for cultural content, cross-cultural context understanding engines, distributed digital asset management systems, and other key areas.

4.3. Optimizing communication strategies to reach target audiences with intelligence and precision

To realize the precise delivery of Chinese culture international communication, it is necessary to build a data-driven intelligent communication system. At the audience insight level, a globalized cultural consumption database should be established. The “Overseas Audience Portrait System” jointly constructed by the Palace Museum and Tsinghua University has accumulated 120 million pieces of cultural consumption behavior data, and subdivided the audience into 32 cultural preference clusters through machine learning. According to the data, Southeast Asian youth groups accept 78% of digital cultural and creative products, while the European and American intellectual class favors in-depth cultural documentaries. Based on this, the “intelligent navigation system for cultural communication” has been developed, increasing the accuracy of content matching by 65%. At the channel operation level, it is necessary to implement platform differentiation strategies. For YouTube’s long video platform, it adopts the mode of “cultural IP + storytelling narrative” (e.g. the average retention rate of the international version of “If National Treasures Could Talk” reached 81%); for short video platforms such as TikTok, it develops the interactive format of “Challenge + AR effects” (the #ChineseCulture Challenge received more than 100 million views); and for professional community platforms such as Reddit, it focuses on the construction of cultural knowledge maps. At the level of effect optimization, it is necessary to break through the traditional communication evaluation paradigm. The “Cultural Communication Index” developed by Peking University’s Institute of New Media Research (INMR) is an evaluation system based on four dimensions:

awareness (25%), emotion (35%), participation (20%), and transformation (20%). The application of the index found that the “cultural dialog” mode combined with local KOLs scored 2.3 times higher than traditional communication in terms of emotionality, and that VR experiential content brought 180% higher participation than print content.

4.4. Improving the safeguard mechanism and cultivating the kinetic energy for long-term cultural development

Building a sustainable development system for the international dissemination of Chinese culture requires systematic institutional innovation. In terms of talent cultivation, it is necessary to establish a composite talent echelon of “culture + science and technology + international communication.” The newly established cross-discipline of “digital cultural communication” at Beijing Foreign Studies University has already sent 327 professionals to the industry through the training mode of “three-tutor system” (cultural scholars, technologists, and instructors of international communication practice). Data show that the cultural communication effectiveness of projects led by such composite talents is 2.8 times higher than that of traditional projects. At the level of financial guarantee, it is necessary to innovate the market-oriented operation mechanism. China Culture Industry Investment Fund set up a “cultural overseas special”, using the “government guidance + market operation” mode, and has incubated 47 digital culture projects with international competitiveness, with an average return on investment of 1:5.3. Shanghai Cultural Property Rights Exchange launched the “digital cultural assets.” The Shanghai Cultural Property Rights Exchange (SCPRX) has launched the “Digital Cultural Asset Trading Platform”, which has increased the efficiency of cultural IP financing by 70%. The key is to establish a profit model for the whole industry chain of “creation, dissemination, and derivative development”, and to reduce the excessive dependence on government funds. In terms of the evaluation system, it is necessary to break through the limitations of quantitative assessment. Tsinghua University and the Ministry of Culture and Tourism jointly built the “cultural communication big data laboratory”, developed a deep communication effect assessment model containing 12 dimensions, including cultural awareness, emotional recognition, and behavioral transformation. In the future, people should focus on building three major support platforms: an international cultural digital copyright service center, a cross-border cultural big data trading platform, and a digital cultural communication innovation base, so as to provide sustained momentum for the high-quality export of Chinese culture to the sea.

5. Conclusion

Currently, the technologically empowered Chinese excellent traditional culture has become recognizable in the global daily visibility, both in breadth and depth^[4]. Cultural communication in the digital era is essentially a dual dialogue involving technological logic and cultural values, and only by making good use of technological empowerment under the premise of maintaining cultural authenticity can effective cross-cultural communication be realized. Overseas dissemination of Chinese excellent traditional culture needs to adhere to the basic stance of rooting in Chinese culture, adapt to the mainstream ideology and culture of the society, combine with the current situation of China’s specific practical development, adhere to the people-oriented communication concept, and adhere to the logical direction of building a community of human destiny^[5]. The ecological construction of autonomous and controllable platforms and intelligent communication strategies

proposed in the article have shown remarkable results in practice, such as the “Digital Dunhuang” project, which has increased the participation of overseas users by 210%, and the TikTok Cultural Challenge, which has created 5.8 billion plays and other successful cases. In the future, it is necessary to pay more attention to the construction of cultural identity under the emerging technological scenarios, such as the meta-universe and the competition for cultural discourse power in the globalized digital governance system.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Li M, Wang YJ, 2023, Digital Mechanism and Trends in the Dissemination of Chinese Excellent Traditional Culture. *People’s Forum*, 2023(2): 104–106.
- [2] Zhao XJ, 2024, Exploring the Overseas Spread of Chinese Culture from a Modern Perspective. *China Culture News*, November 4, 2024, 3.
- [3] Wang FE, 2024, The Path of Object Narrative in the Dissemination of Chinese Excellent Traditional Culture in the Age of Digitalization. *Gansu Social Science*, 2024(6): 60–69.
- [4] Zhang ZZ, He K, 2025, Everyday Visibility: A Global Common Path for the Dissemination of Chinese Excellent Traditional Culture in the Age of Smart Media. *China Publishing*, 2025(5): 19–25.
- [5] Liu RJ, Liao H, 2023, Value Implications, Logical Points and Practical Approaches of Overseas Communication of Chinese Excellent Traditional Culture. *Journal of Ethnicity*, 14(11): 118–124 + 169.

Publisher’s note

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

An Analysis of the Impact of Outdoor Adventure Education on Adolescents' Psychological Resilience

Yanyun Fei¹, Tong Wei¹, Lingjie Xiao²

¹Hunan Agricultural University, Changsha 410128, Hunan, China

²Hunan University of Technology, Changsha 412007, Hunan, China

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 rapid development of society and the increasing intensification of competition, adolescents face huge psychological pressure. Psychological resilience is crucial for the healthy growth of adolescents. It is an important quality that enables them to maintain a positive and optimistic attitude when facing adversity and difficulties. Outdoor adventure education is an emerging educational model. By guiding adolescents to participate in various outdoor activities, it can shape excellent character, strengthen teamwork ability, and enhance the ability to solve problems independently, effectively improving adolescents' psychological resilience and promoting their all-around development. Therefore, this article briefly analyzes the impact of outdoor adventure education on adolescents' psychological resilience, hoping to provide some valuable references for readers.

Keywords: Outdoor adventure education; Adolescents; Psychological resilience

Online publication: June 6, 2025

1. The concept and significance of psychological resilience

Psychological resilience is a complex and multi-dimensional concept. Generally, it is defined as an individual's ability to actively cope with and grow in the face of difficulties and challenges. It is not only a psychological trait but also a dynamic psychological maturation process, involving multiple levels such as cognition, behavior, and emotion. Individuals with strong psychological resilience can often face various challenges in life and learning with an optimistic and positive attitude, thus achieving all-around development.

For adolescents, enhancing psychological resilience plays an important role in their future study and development. Adolescence is an important stage of individual physical and mental development and also a critical period for enhancing psychological resilience. During this stage, adolescents often face huge pressures, such as academic pressure, growth pressure, and interpersonal relationship pressure. Having strong psychological resilience can help them better cope with these challenges, avoid the occurrence of mental health problems, and lay a solid foundation for their future all-around development ^[1].

2. The characteristics and advantages of outdoor adventure education

2.1. Exploratory feature

Outdoor adventure education emphasizes learning and experiencing in the natural environment, allowing adolescents to acquire knowledge during the process of exploration and practice. This educational model can not only effectively stimulate students' exploration interest, fully mobilize their enthusiasm and initiative, but also cultivate their exploration and practical abilities, and strengthen their spirit of exploration and innovation.

2.2. Challenging feature

Outdoor adventure education usually has a certain degree of challenge and excitement. Adolescents often need to overcome their own fears and timidity and constantly challenge the limits of their physical and mental abilities. Through outdoor education, adolescents can not only develop qualities such as courage, strength, and perseverance but also enhance their self-confidence ^[2].

2.3. Cooperative feature

In outdoor adventure education, adolescents often need to cooperate and communicate with others to complete tasks. This can not only cultivate adolescents' teamwork and communication skills but also enable them to learn to respect, share, and help each other.

2.4. Natural feature

The main implementation location of outdoor adventure education is in the natural environment. While receiving education, adolescents can also feel the charm of nature. This can not only enhance adolescents' awareness of environmental protection but also make them respect nature and cherish life.

3. Analysis of the impact mechanism of outdoor adventure education on adolescents' psychological resilience

3.1. Cognitive restructuring

Cognitive restructuring mainly refers to the process in which an individual adjusts their cognitive structure and emotional state by changing their understanding and evaluation of an event when facing difficulties or challenges. The challenges and difficulties in outdoor adventure education can effectively strengthen adolescents' cognitive restructuring ability. When facing difficulties and challenges, adolescents need to constantly try various methods and means, change their ways of thinking and behavior patterns, in order to successfully solve problems and better cope with challenges ^[3]. This experience can not only cultivate adolescents' innovation and problem-solving abilities but also promote the development of their critical thinking, enabling them to learn to view and solve problems from multiple perspectives. At the same time, the experience of outdoor adventure education can also help adolescents build self-confidence, enhance their self-efficacy, and further improve their psychological resilience.

3.2. Emotion regulation

Emotion regulation mainly refers to the process by which an individual adjusts their emotions to adapt to the environment when suffering from strong emotional stimuli. Outdoor adventure education can effectively enhance adolescents' emotional regulation ability. In outdoor adventure education, adolescents often face many

challenges and difficulties ^[4]. They need to learn to control their negative emotions, keep a calm mind, actively change their thinking, and try various methods and means to solve problems. Such educational experiences can continuously cultivate adolescents' emotion regulation ability, enabling them to learn to manage their emotions and thus improve their psychological resilience.

3.3. Self-efficacy

Self-efficacy is an individual's belief in their ability to successfully complete a task or achieve a goal. Through outdoor adventure education, adolescents' self-efficacy can be effectively improved. In outdoor activities, adolescents need to overcome their fears and uneasiness, and constantly try and strive to achieve a certain goal. This experience can enhance their self-confidence, make them trust their own abilities and values more, and thus further improve their psychological resilience ^[5].

3.4. Social support

Social support mainly refers to the spiritual or material help an individual receives from others when in trouble. In outdoor adventure education, adolescents often need to complete tasks through teamwork. During this process, adolescents need to cooperate and encourage each other to jointly face difficulties and challenges. This experience can help them learn how to build good interpersonal relationships and also enable them to seek help in a timely manner when facing difficulties ^[6]. At the same time, teachers, coaches, etc., in outdoor adventure education can also provide professional guidance and education for adolescents, helping them better learn outdoor knowledge and skills and successfully cope with various challenges, thus further improving their psychological resilience.

3.5. Problem-solving ability

Problem-solving ability mainly refers to an individual's ability to use the knowledge and skills they have learned, constantly try and innovate, and successfully solve problems when facing difficulties. Outdoor adventure education can effectively cultivate adolescents' problem-solving ability. In outdoor education activities, adolescents often face various problems ^[7]. They need to learn to analyze problems, develop solutions, take action, and evaluate the results. This experience can effectively cultivate adolescents' problem-solving ability, promote the development of their innovative thinking, and thus further strengthen their psychological resilience.

4. The specific impact of outdoor adventure education on adolescents' psychological resilience

4.1. Emotional stability

There are often various challenges and problems in outdoor adventure education. By participating in it, adolescents can improve their emotional management ability when facing various pressures and difficulties, and learn how to keep a calm mind and not be easily influenced by external factors. This stable emotion can not only help adolescents better cope with various challenges in study and life but also promote their all-around development ^[8].

4.2. Self-confidence

The successful experiences in outdoor adventure education can effectively enhance adolescents' self-efficacy and self-confidence ^[9]. Through continuous efforts and attempts, adolescents can gradually overcome their fears, uneasiness, and other emotions and complete tasks. This experience can make adolescents evaluate themselves positively, trust their own abilities more, and thus face various challenges in life and learning with a positive, optimistic, and confident attitude.

4.3. Stress resistance

In the current social context, adolescents face huge pressures. Outdoor adventure education can effectively improve adolescents' stress resistance, enabling them to adjust their mental state, emotions, and behaviors in a timely manner when facing pressures and difficulties, and find effective solutions and coping strategies, thus promoting their all-around development ^[10].

4.4. Adaptability

Outdoor adventure education can effectively strengthen adolescents' adaptability. Adolescents often need to have strong adaptability to quickly integrate into new environments. By participating in outdoor adventure education, they can become more familiar with and adapt to different environments and task requirements, and at the same time, improve their innovation and adaptability.

4.5. Social skills

The implementation of outdoor adventure education can significantly improve adolescents' social skills and teamwork ability. In outdoor activities, adolescents often need to rely on the strength of the team to complete relevant tasks. This requires them to communicate and interact with others, share their experiences and insights, and thus gain the understanding and support of others ^[11]. This experience can enable adolescents to learn how to build good interpersonal relationships, which is not only conducive to their better integration into society in the future but also promotes their all-around development.

5. Application strategies of outdoor adventure education in improving adolescents' psychological resilience

In order to give full play to the role of outdoor adventure education and improve adolescents' psychological resilience, a series of effective measures can be taken. Here, this article briefly expounds on the following aspects.

5.1. Curriculum design

In terms of curriculum design, targeted outdoor adventure education plans can be developed for adolescents according to their age characteristics and actual needs, so as to strengthen their psychological resilience. Specifically, outdoor adventure education activities can be divided into three levels: primary, intermediate, and advanced, and specific activity contents and difficulties can be designed according to the actual needs of different levels ^[12]. At the same time, attention should be paid to the fun of the activities to effectively stimulate the enthusiasm of adolescents.

5.2. Activity implementation

During the implementation of outdoor adventure education activities, it is necessary to do a good job in the organization and management of the activities to ensure their smooth progress. Specifically, adolescents can be divided into several groups with similar abilities and the same number. They are required to carry out outdoor adventure activities through teamwork, and each group is assigned tasks to be completed through teamwork. At the same time, it is also necessary to do a good job in guiding and instructing the activities to help adolescents master outdoor knowledge and skills more quickly.

5.3. Safety assurance

In terms of safety assurance, attention should also be paid to the safety of activities to ensure the personal safety of adolescents when participating in outdoor activities ^[13]. Specifically, a series of measures can be taken to strengthen activity safety assurance, such as formulating emergency plans and safety management mechanisms, equipping activities with professional and safe equipment, and emergency rescue equipment. At the same time, strengthen the supervision and guidance of activities, promptly discover problems of adolescents, and provide them with scientific and professional guidance. In addition, it is also necessary to conduct safety education and training for adolescents, strengthen their safety awareness, and help them master self-rescue knowledge and skills to improve their self-protection ability.

5.4. Teacher training

Teachers are important organizers and participants in outdoor adventure education activities and play an important role in strengthening adolescents' psychological resilience ^[14]. Therefore, teacher training should be strengthened to improve teachers' professional qualities and comprehensive abilities, so as to give full play to the role of outdoor adventure education. Specifically, teachers can be organized to participate in outdoor adventure professional training and communication activities to broaden their horizons and strengthen their qualities and abilities. At the same time, teachers can also be encouraged to participate in various adventure projects to enrich their practical experience and improve their professional abilities.

5.5. Evaluation and feedback

Evaluation and feedback are key links in outdoor adventure education activities. Therefore, attention should be paid to the evaluation and feedback of outdoor adventure education activities, timely understand the educational effects and problems faced by the activities, and take effective measures to solve them. Specifically, methods such as electronic questionnaires and face-to-face interviews can be used to collect the feedback, opinions, and suggestions of adolescents, and based on this, gradually optimize the activity forms and contents ^[15]. At the same time, quantitative evaluation and comparative analysis of the educational effects of the activities should also be carried out to provide important references and bases for the future development of outdoor adventure education.

6. Conclusion

In conclusion, in the new era, attention should be paid to outdoor adventure education, and adolescents should be actively guided to participate in it, so as to continuously strengthen their psychological resilience, shape excellent character, enhance self-confidence and self-efficacy, and lay a foundation for promoting the all-round development of adolescents.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Li Y, 2024, Research on the Impact of Outdoor Adventure Education on Psychological Resilience. Proceedings of the 1st National High-quality Development Seminar on Outdoor Adventure and Leisure Sports, the 2nd National Seminar on the Construction of “Leisure Sports” First-class Undergraduate Majors in Colleges and Universities, and the 2nd Academic Conference on Leisure Sports of Capital Higher Education Institutions, 494–508.
- [2] Jiang LP, 2024, The Wonderfulness after “Letting Go” in the “Game Tribe”—Taking the Outdoor Game “Adventure Island” for Senior Kindergarten Class as an Example. *Education Vision*, 2024(12): 21–23.
- [3] Du J, Zheng GF, 2023, Research on the Impact of Outdoor Adventure Education Courses on the Development of College Students’ Life Efficacy and Leadership. Abstracts of the 13th National Sports Science Congress — Written Communication (School Sports Sub-committee), 232–233.
- [4] Sun SH, 2023, An Overview of the Themes, Methods, and Theories of Outdoor Education Research for Adolescents in China, thesis, Shanghai Normal University.
- [5] Zhou ZJ, 2021, From Elites to the Public: The Evolution of Outdoor Education in British Primary and Secondary Schools (Early 17th Century-1990s), thesis, East China Normal University.
- [6] Wang C, 2021, An Analysis of Outdoor Education in Primary and Secondary Schools in Singapore, thesis, Hainan Normal University.
- [7] Wang C, 2020, The Value Connotation and Development Strategies of Outdoor Education in Primary and Secondary Schools in Singapore. *Comparative Study of Cultural Innovation*, 4(27): 184–186.
- [8] Fu QS, Wang D, 2019, A Review of the Natural Education Functions of Forest Campsites. *Forestry Economics*, 41(12): 32–36.
- [9] Wang YY, 2019, The Promotion of Western Adventure Games and Its Enlightenment to Preschool Education in China. *Educational Observation*, 8(38): 69–71 + 92.
- [10] Yan X, 2017, A Review of the Benefits of Outdoor Adventure Education. *Sport*, 2017(21): 150–151.
- [11] Wang D, 2017, Research on the Demand for the Educational Functions of Campsites Based on the Kano Model, thesis, East China Normal University.
- [12] Qian JW, 2016, Research on the Construction of the Theoretical System and Practice of Outdoor Education in China, thesis, Beijing Sport University.
- [13] Zhao X, 2015, International Experiences and Enlightenments of Outdoor Education for Adolescents. *China Youth Study*, 2015(4): 115–119.
- [14] Li XM, 2013, Research on the Construction of the Outdoor Education Practice System for Junior High School Students in Urban Areas of Shenyang, thesis, Shenyang Sport University.
- [15] Shi DD, 2013, Discrimination and Definition of Concepts Related to Outdoor Sports, thesis, Shenyang Sport University.

Publisher’s note

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

Data Analysis of the Types of War in Ancient China

Lin Wang^{1*}, Junqing Liu²

¹Guangxi Financial Vocational College, Nanning 530007, Guangxi, China

²Guangxi Water Conservancy and Electric Power College, Nanning 530023, Guangxi, China

**Author to whom correspondence should be addressed.*

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: Through data analysis of four different types of wars, four conclusions can be drawn. Firstly, during the period of division, there are more wars competing for agency power. Secondly, under the unified system, there were many peasant uprising wars. During the period of unification, the state had more power to protect the people. Fourthly, few countries can withstand two types of wars simultaneously.

Keywords: Type of war; Splitting; Great unification

Online publication: June 6, 2025

1. Overview of ancient Chinese wars

This article defines the types of wars and conducts data analysis, without discussing the specific process of wars. Therefore, the analysis is based on wars in the chronology. Through a reexamination of the wars recorded in the book, a total of 3753 wars occurred in 19 different historical periods from the 26th century BC to 1911 AD, as shown in **Table 1**.

In terms of the total number of wars, the Ming Dynasty had the most wars, with 574; Next is the Qing Dynasty, which recorded a total of 424 wars; The third largest historical period is the Spring and Autumn period, with a total of 382 recorded wars.

From the perspective of the average annual number of wars (note: the average annual number of wars only counted the frequency of wars from the Spring and Autumn Period to the Qing Dynasty), the Eastern Jin Dynasty had the highest frequency of wars, with an average of 2.64 times per year, followed by the Sui Dynasty with an average of 2.44 times per year, followed closely by the Yuan Dynasty with an average of 2.35 times per year, and the Ming Dynasty also had an average of 2.1 times per year. From the above analysis, it can be seen that the 272 years of the Eastern Jin Dynasty were the most turbulent period in Chinese history.

Table 1. Statistics of the number of wars in different periods in China

Historical stage		Number of wars		Historical stage		Number of wars	
1	Legendary Era — Five Emperors	5	11	The Northern and Southern Dynasties		153	
2	Xia, Shang, and Western Zhou	46	12	Sui Dynasty		88	
3	The Spring and Autumn Annals	382	13	The Tang dynasty		192	
4	Warring States	229	14	Five Dynasties and Ten Kingdoms		73	
5	Qin dynasty	9	15	Northern Song, Liao, Jin, and Western Xia		254	
6	The Western Han Dynasty	121	16	Southern Song, Jin, and Mongolian		293	
7	The Eastern Han Dynasty	277	17	Yuan dynasty		207	
8	three countries	71	18	The Ming dynasty		574	
9	The Western Jin Dynasty	83	19	Qing dynasty		424	
10	The Eastern Jin Dynasty	272		Total		3753	

Note: Source: Chronology of Chinese Wars in Various Dynasties by the Compilation Group of “Chinese Military History”^[1]

2. Definition of war types

Under the general state system, it can be divided into three groups: the ruling class, the ruled class, and the foreign aggressors. Using the discourse of agency theory, it is expressed that the ruled class is the principal, the ruling class is the agent, and the foreign aggressors are a third-party force. Yoram Bazel has a detailed discussion on this topic^[2]. This article improves the principal-agent relationship: the public is the principal, the central government is the direct agent responsible to the principal, and local governments are indirect agents responsible to the central government. Therefore, in the entire social relationship, there are four groups: principals, direct agents, indirect agents, and external enemies^[3].

According to the above conditions, wars in Chinese history can be divided into four categories: First, wars between the agricultural civilization of the Central Plains and the nomadic tribes or other foreign tribes in the north. These wars have the nature of defending the country and are direct agents providing safe services to the principal. This type of war is usually recorded in the chronology with the names of foreign enemies, such as the Xiongnu, Western tribes, Turks, etc.

The second is the war fought by different military forces for direct agency rights. In the Chu Han War between Xiang Yu and Liu Bang, during the Three Kingdoms period, Wei, Shu, and Wu attacked each other to compete for the highest ruling power, that is, direct agency power^[4].

The third is the extreme measures taken by the principal to replace the direct agent through violent means. From the perspective of the principal-agent theory, these wars have the nature of the principal supervising the agent.

The fourth is other types of wars, mainly including wars between direct agents and indirect agents, and wars fought by agents to maintain order^[5].

3. War data analysis

During the legendary era from the 26th century BC to the 22nd century BC, there were a total of 5 recorded

wars, which, according to the classification criteria in this article, were all wars over proxy rights. In the battles of Huangdi and Chiyao, both sides aimed to defeat each other and gain control of their territories, becoming agents of the local people^[6-7].

During the Xia, Shang, and Western Zhou dynasties from 2070 BC to 771 BC, there were a total of 46 wars, including 15 wars against foreign enemies, 30 wars over proxy rights, and 1 peasant uprising. This indicates that the wars during this period mainly came from the ruling class's struggle for agency rights.

During the Spring and Autumn Period (769–476 BC), there were a total of 382 wars, including 43 against foreign enemies, 335 battles for proxy rights, and 4 other wars. There were no peasant uprisings. During the Warring States period (475–221 BC), there were a total of 229 wars, including 1 resistance against foreign enemies, 226 struggles for agency rights, and 2 peasant uprisings^[8].

The Spring and Autumn Period and the Warring States Period were the periods before the formation of a unified Chinese history. During this period, different military forces sought to seize more land and population, becoming agents of more people. This kind of competition can be achieved by providing better services and attracting more people to join, but the means of competition continue to deteriorate and transform into war. Therefore, the wars during this period were mostly wars over proxy rights. This phenomenon of competing for agency rights was not improved until Emperor Qin Shi Huang unified China. However, under the unified system, another type of war emerged^[9-10].

The Qin Dynasty (220–207 BC), which unified China, lasted for 13 years and had a total of 9 wars, including 4 wars against foreign enemies and 5 wars of peasant uprisings. During the Western Han Dynasty (206–24 AD), there were a total of 121 wars, 63 battles against foreign enemies, 22 battles for agency rights, 32 peasant uprisings, and 4 other types of wars. During the Eastern Han Dynasty (25–220 AD) in 195 AD, there were a total of 277 wars resisting foreign enemies 120 times, competing for agency rights 70 times, staging 40 peasant uprisings, and engaging in 47 other types of warfare.

In the short 13 years of the Qin Dynasty, there were 5 peasant uprisings, while in the Spring and Autumn Period and Warring States Period of 549, there were only 2 uprisings. The transformation of this type of war also reveals a shift in the system. The most common type of war during the Han Dynasty was the invasion of foreign enemies, indicating that the raids of northern nomadic tribes became a major threat to society at that time. The number of proxy wars in the Eastern Han Dynasty was 70, which was three times more than the 22 wars in the Western Han Dynasty, indicating that the rule of the Eastern Han Dynasty was not as stable as that of the Western Han Dynasty^[11-12].

During the Three Kingdoms period (220–265 AD), there were a total of 71 wars, including 7 wars against foreign enemies, 48 wars for proxy rights, 11 peasant uprisings, and 5 other wars. During the Western Jin Dynasty (265–316 AD), there were a total of 83 wars, including 23 wars against foreign enemies, 23 wars for proxy rights, 14 peasant uprisings, and 23 other wars. During the Eastern Jin Dynasty (317–420 AD), there were 272 uprisings, 41 defenses against foreign enemies, 184 struggles for agency rights, 26 peasant uprisings, and 21 other uprisings. During the Southern and Northern Dynasties (421–580 AD), there were a total of 153 uprisings, including 25 against foreign enemies, 102 struggles for agency rights, 23 peasant uprisings, and 3 other uprisings. The Three Kingdoms, Two Jin, Southern and Northern Dynasties lasted for 350 years, marking the second period of division in China after the first unification. This state of national division has led to various forces eager to obtain more agency rights and constantly fighting and suppressing them^[13].

During the Sui Dynasty (581–617 AD), there were a total of 88 wars, including 3 against foreign enemies,

7 disputes for agency rights, 58 peasant uprisings, and 10 other wars. During the Tang Dynasty (618–906 AD), there were a total of 192 wars, including 124 wars against foreign enemies, 14 wars over proxy rights, 17 peasant uprisings, and 37 other wars. The Sui and Tang dynasties were the second period of great unification in China. Against the backdrop of great unification, wars for proxy rights significantly decreased, and foreign invasion became the most important threat. The phenomenon of peasant uprisings, where principals expressed dissatisfaction to proxies, ranked second^[14–15].

During the Five Dynasties and Ten Kingdoms period (907–959 AD), there were a total of 73 wars, including 6 battles against foreign enemies, 37 battles for agency rights, 3 peasant uprisings, and 27 other wars. This is the second period of transition from unification to division. In just 52 years, there have been 37 proxy power struggles and 27 other types of wars, which are internal wars within the ruling class.

During the Northern Song, Liao, Jin, and Western Xia dynasties (960–1127 AD), there were a total of 254 wars, including 127 battles against foreign enemies, 24 battles for agency rights, 20 peasant uprisings, and 83 other wars. During the Southern Song, Jin, and Mongol dynasties (1128–1279 AD), there were a total of 293 wars, including 180 wars against foreign enemies, 29 wars over agency rights, 50 peasant uprisings, and 34 other wars^[16–17].

During the Yuan Dynasty (1280–1368 AD), there were a total of 207 wars, including 19 wars against foreign enemies, 36 wars over proxy rights, 138 peasant uprisings, and 14 other wars. The Yuan Dynasty was the first unified dynasty ruled by ethnic minorities, which greatly reduced the risk of foreign invasion. However, it issued multiple policies that went against public opinion, and the society's principals were extremely dissatisfied with the agents, leading to a large number of ruled people expressing their dissatisfaction in the form of war and demanding changes to the agency agreement^[18].

During the 275-year period of the Ming Dynasty (1368–1643 AD), there were a total of 574 wars, including 302 wars against foreign enemies, 7 wars over agency rights, 236 peasant uprisings, and 29 other wars. During the Ming Dynasty, foreign enemies became the biggest threat, and peasant uprisings also became an important threat to the country. Two types of wars put the Ming Dynasty in crisis. From the perspective of development trend, the Ming Dynasty had wars to resist foreign invasion from its establishment to its downfall, while peasant uprisings mostly existed in the second half of the period. It is worth noting that during the entire Ming Dynasty, there were only 7 wars for proxy rights, indicating that the central rule of the Ming Dynasty was relatively stable^[19–20].

During the Qing Dynasty (1644–1911 AD), there were a total of 424 wars, including 55 battles against foreign enemies, 45 battles for agency rights, 250 peasant uprisings, and 74 other wars. The Qing Dynasty was a dynasty that integrated agricultural civilization and nomadic civilization well, ranking third in the number of foreign invasions, mostly by later Western powers.

Disclosure statement

The author declares no conflict of interest.

Reference

- [1] Chinese Military History Compilation Group, 2002, Chronology of Wars in the past Dynasties of China by the Compilation Group of Military History of China (Vol. 1 and 2). People's Liberation Army Press, Beijing.

- [2] Bazel J, 2002, *Theory of the State*. Shanghai University of Finance and Economics Press, Shanghai.
- [3] Bloxham J, 2018, *Ancient Greece and American Conservatism*. Bloomsbury Academic, London.
- [4] Gilpin R, 1988, The Theory of Hegemonic War. *The Journal of Interdisciplinary History*, 18(4): 591–613.
- [5] Rhodes PJ, 1987, Thucydides on the Causes of the Peloponnesian War. *Hermes*, 1987(2): 154–165.
- [6] Dickins G, 1911, The True Cause of the Peloponnesian War. *The Classical Quarterly*, 1911(4): 59–62.
- [7] McNeill W, 2020, *Arnold Toynbee Biography*. Shanghai People's Publishing House, Shanghai.
- [8] Kagan D, 2019, *The Outbreak of the Peloponnesian War*. East China Normal University Press, Shanghai.
- [9] Hanson VD, 2013, *The Unique War*. Shanghai People's Publishing House, Shanghai.
- [10] Yan SX, 2009, *World Ancient History*. China Renmin University Press, Beijing.
- [11] Pamlois, 2009, *Political, Social, and Cultural History of Ancient Greece*. Shanghai Sanlian Bookstore, Shanghai.
- [12] Evra SV, 2014, *The Causes of War*. Shanghai People's Publishing House, Shanghai.
- [13] Gilpin R, 2007, *War and Change in World Politics*. Shanghai People's Publishing House, Shanghai.
- [14] Morgenthau HJ, 2006, *Interstate Politics*. Peking University Press, Beijing.
- [15] He YG, 2017, Exploring Thucydides' Theory of the Causes of the Peloponnesian War. *Historical Research*, 2017(6): 126–139.
- [16] Qi YF, 2018, An Analysis of the Causes of the Outbreak of the Peloponnesian War. *Heihe Journal*, 2018(1): 109–111
- [17] Hammond NGL, 2017, *Greek History*. Commercial Press, Beijing.
- [18] Yu P, 2014, *History of Western Historical Thought*. Hunan Education Press, Hunan.
- [19] Hornblower S, 2014, *The Greek World*. Huaxia Publishing House, Beijing.
- [20] McNeil W, 2020, *Arnold Toynbee Biography*. Shanghai People's Publishing House, Shanghai.

Publisher's note

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

Exploration of the Digital Transformation Path for the Post-Award Management and Personalized Services of Scholarship or Grant Recipients

Zhuqing Chen*, Xiaolong Yang

School of Computing, Neusoft Institute Guangdong, Foshan 528225, Guangdong, China

**Author to whom correspondence should be addressed.*

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 post-management and service for scholarship or grant recipients have faced new challenges and opportunities due to the rapid progression of digital technologies. The traditional post-award management framework for scholarship recipients shows significant limitations, especially in dynamic monitoring and service standardization. To tackle these challenges, a restructured approach integrating three core digital components has been developed, including dynamic profiling models, intelligent alert systems, and personalized service matrices. This transformation shifts the management model from outcome-based tracking to comprehensive process optimization, ultimately establishing a data-driven support mechanism that enhances the educational effectiveness of financial assistance programs.

Keywords: Scholarship or grant recipients; Digital transformation; Post-dynamic management; Personalized service

Online publication: June 6, 2025

1. Introduction

Educational subsidies serve dual functions as financial support mechanisms and strategic instruments for advancing equitable educational access while cultivating comprehensive student development. However, accelerated digital transformation in education reveals structural limitations in conventional post-award support systems, particularly their diminishing capacity to capture students' multidimensional demands with requisite precision and responsiveness, thereby compromising the optimization of financial aid efficacy.

The introduction of digital intelligence technology in educational management provides an opportunity to solve this problem, because the realization of dynamic management and personalized services for students through digital intelligence technology is of great significance for improving the accuracy and effectiveness of financial aid work and promoting the all-around development of students.

2. Problems existing in the traditional post-award management and service of the scholarship or grant recipients

Current challenges in post-award management and personalized services include unscientific management, undifferentiated service delivery models, and poor information sharing.

2.1. Lack of scientific and systematic management methods

Conventional management practices predominantly dependent on manual documentation processes demonstrate systemic deficiencies in monitoring recipients' multidimensional development. The absence of automated tracking mechanisms frequently results in delayed updates of critical student indicators—including academic progression, extracurricular engagement, and psychological well-being—leading to the inability of managers to accurately grasp the current development situation of recipients. This operational gap consequently hinders administrators' capacity to deliver evidence-based interventions aligned with individual developmental trajectories.

2.2. Failure to tailor services to individual needs

Undifferentiated intervention strategies often emerge in current management and services, which fail to take into account the heterogeneous development trajectories and customized support needs of the recipients. Considerable heterogeneity exists among scholarship or grant recipients regarding academic objectives, career pathways, and extracurricular engagements, yet institutional mechanisms maintain a uniform assistance modality. This standardization of service delivery contradicts demonstrated beneficiary diversity, ultimately undermining both intervention efficacy and beneficiary satisfaction.

2.3. Insufficient information sharing leads to data silos

Systemic fragmentation persists across key administrative units—particularly between financial aid administration, academic affairs, and career services—manifesting insufficient information sharing including interdepartmental data silos within institutional architectures, asymmetric information distribution between administrative bodies and student beneficiaries, and inadequate feedback loop mechanisms. This dysfunction fundamentally undermines the development of the post-award management and personalized services of scholarship or grant recipients, as evidenced by longitudinal studies showing a 23.7% efficiency loss in cross-departmental collaboration. Consequently, the institution's capacity to deliver integrated student management and support services becomes operationally constrained, violating the core principles of holistic learner development frameworks.

3. Necessity of digital transformation for post-award dynamic management and personalized services of the scholarship or grant recipients

Digital transformation is crucial for the post-award dynamic management and personalized services of scholarship or grant recipients, as it helps to collect and analyze the information of the recipients throughout the entire cycle, adjust the intensity of assistance in real time and dynamically and precisely meet individualized needs, thereby enhancing the quality of assistance and educational effectiveness and promoting the all-round development of students.

3.1. Adapt to the development of educational informatization

The digital era has witnessed educational informatization emerge as an indispensable trajectory for pedagogical

restructuring, with digital transformation — operationalized through UNESCO's Education 2030 Framework — constituting its fundamental implementation mechanism ^[1].

It is possible to achieve the application of advanced technologies like big data analysis, cloud computing, and artificial intelligence facilitates dynamic management and personalized services for recipients, which is essential for meeting the demands of educational informatization development.

3.2. Improve the management efficiency and accuracy

In the post-award management of scholarship or grant recipients, digital management platforms can be employed to facilitate real-time data collection, organization, and analysis, which approach enhances the efficiency and accuracy of information processing.

Furthermore, school counselors and student affairs managers can utilize such platforms to promptly access recipients' academic, living, and psychological status, which enables more precise management and service provision, thereby optimizing information processing efficiency and accuracy while reducing management costs.

3.3. Meet the needs of recipients' individualized development

Scholarship and grant recipients exhibit distinct developmental needs and potentials that necessitate tailored support systems. Implementing digital transformation in post-award management enables institutions to deliver personalized academic mentoring, career development strategies, and psychological support services through multidimensional tracking systems and data-driven assessment tools.

This approach empowers awardees to optimize their individual capabilities while fostering holistic growth aligned with their unique trajectories.

4. Digital transformation path for the post-award management and personalized services of scholarship or grant recipients

A dynamic tracking and managing mechanism for scholarship or grant recipients has been established, and precise personalized service delivery through data analysis and intelligent platforms has been enabled by leveraging digital technology.

4.1. Build an integrated digital management platform

To realize the interconnection and interoperability of school information, the authors propose developing a unified post-award management platform for scholarship or grant recipients that integrate systems such as students' record management, educational administration, and financial aid, thereby establishing functional modules for data collection, storage, analysis, display, and interaction for these students. The data is analyzed to generate reports that help make strategic decisions regarding students, courses, programs, departments, and staff by management information systems ^[2].

During operation, this platform will connect with various business systems to automatically collect students' personal information, grades, family economic conditions, awards and assistance records, and other relevant data. Upon completion of data cleaning and standardization, a comprehensive database for scholarship or grant recipients will be established.

Additionally, the school will encourage the scholarship or grant recipients to utilize mobile applications to independently update information regarding part-time job experiences and social practice activities, thereby

enriching the data dimensions.

4.2. Achieve precise profiling and dynamic monitoring through big data analysis

The dynamic student data management using resource optimization technology in the higher education platform proposed in this study can effectively improve the efficiency of college student data management ^[3]. During the post-award management of scholarship or grant recipients, the school's student financial aid management department can utilize big data analysis technology, which can mine and analyze multidimensional data such as students' academic performance, consumption behavior, and social activities. Subsequently, accurate student profiles can be constructed to understand students' learning abilities and directions of interest. Then, a dynamic monitoring model can be established to track students' status changes in real time.

When recipients face academic decline, worsening family financial circumstances, or irregular spending patterns, the dynamic monitoring system automatically activates an early warning mechanism that promptly alerts counselors to implement appropriate support measures, including academic guidance, psychological support, and emergency financial aid.

4.3. Introduce artificial intelligence services to enhance the level of personalized services

Artificial intelligence technology has been extensively applied, significantly enhancing the personalization of services during digital transformation. Artificial Intelligence for Assessment and Feedback shows that artificial intelligence can effectively enhance students' learning outcomes and meet their individualized needs ^[4]. Intelligent recommendation systems, utilizing collaborative filtering and deep learning algorithms, can accurately offer students learning resources, information on scholarships and financial aid, career planning, and internship and employment opportunities based on their profiles, which help students plan their personal development.

Virtual intelligent assistants can provide round-the-clock online consultation via voice or text, which services cover financial aid policy interpretation, life service consultation, and mental health counseling. They automatically answer common questions and can manually transfer complex ones, thus improving service efficiency.

4.4. Establish a collaborative and co-governed mechanism for the post-award dynamic management and personalized services

Large sums of time, money, and energy from various educational departments are invested in educational research each year in the hope of yielding productive outcomes for educational practice, which produce the bulk of the curricula, assessments, and professional development opportunities that directly affect great numbers of teachers and learners ^[5].

Against the backdrop of digitalization, schools face new challenges in the post-award management of scholarship or grant recipients. To address these challenges, schools should strengthen interdepartmental collaboration and establish a multi-departmental coordination mechanism that includes the student financial aid management department, the teaching department, the employment guidance department, and the mental health education department.

By building a digital management platform to facilitate information sharing and collaborative work among these departments, schools could create an all-encompassing, end-to-end recipient management and service system, which will provide students with higher-quality services to meet the challenges of the new era.

5. Retrospect and prospect

Digital transformation presents new opportunities for the post-award management and personalized services of scholarship or grant recipients. Through building digital management platforms, applying big data analysis, introducing AI services, and establishing collaborative governance mechanisms, schools can achieve precise management, dynamic monitoring, and personalized services for recipients, thus improving the quality and efficiency of educational assistance work and promoting the overall development of the scholarship or grant recipients.

However, during the digital transformation process, data security and privacy protection must be prioritized to safeguard the rights of scholarship recipients. Robust encryption methods and data access controls should be implemented to prevent the leakage of students' sensitive information, which clarifies the boundaries of information collection, use, and storage, ensuring students' personal privacy is respected and protected.

As technological innovations continue to emerge and advance, the application of digitalization in post-award management and personalized services is bound to become more profound and extensive. It is set to play an increasingly significant role in achieving the goals of educational equity and talent development, opening up new avenues for optimizing resource allocation and enhancing service precision in the education sector.

Funding

The 2024 Guangdong Province University student financial aid special research project "Exploration of Innovative Models for the Post-award Management and Services of Scholarship or Grant Recipients Empowered by New Quality Productivity" (2024DRXJ-XG01)

Disclosure statement

The authors declare no conflict of interest.

Author contributions

Zhuqing Chen: Built the thesis framework and developed its core ideas, controlling academic standards and leading the topic selection, and was also responsible for writing and refining the majority of the content.

Xiaolong Yang: Assisted in gathering materials and organizing data, contributed to drafting and polishing some sections, and offered suggestions for improving the manuscript's details.

References

- [1] UNESCO, UNICEF, World Bank, UNFPA, UNDP, UN Women, UNHCR, 2015, Education 2030: Incheon Declaration and Framework for Action for the Implementation of Sustainable Development Goal 4: Ensure Inclusive and Equitable Quality Education and Promote Lifelong Learning Opportunities for all. UNESCO, Incheon.
- [2] Kuadey NA, Ankora C, Adjei L, et al., 2024, Evaluating Students' User Experience on Student Management Information Systems. *Advances in Human-Computer Interaction*, 2024(8450204): 1–11.
- [3] Lu CH, Saeed O, 2023, Dynamic Student Data Management Using Resource Optimization Technology in Higher Education Platforms. *Mobile Information Systems*, 2023(9686763): 1–10.

- [4] Hooda M, Ran C, Dahiya O, et al., 2022, Artificial Intelligence for Assessment and Feedback to Enhance Student Success in Higher Education. *Mathematical Problems in Engineering*, 2022(5215722): 1–19.
- [5] McKenney S, Schunn CD, 2018, How can Educational Research Support Practice at Scale? Attending to Educational Designer Needs. *British Educational Research Journal*, 44(6): 1084–1100.
- [6] Guo CJ, 2019, Post-award Management and Services for Funded University Students. *Western Quality Education*, 5(14): 160–161.
- [7] Wang JB, 2025, Research on the Current Status, Existing Problems, and Countermeasures of Student Financial Aid in Guangxi Universities under Digitalization. *Educational Observation*, 14(1): 16–19 + 23.
- [8] Han X, Han XY, Yang MY, 2025, How Student Financial Aid Policies Achieve Educational Effectiveness: An Empirical Study Based on Universities in Beijing, Shanghai, and Zhejiang. *China Higher Education Research*, 2025(2): 36–43.
- [9] Jiang QH, Yuan XY, 2024, Driving Forces and Prospects of Digital Transformation in University Funding Education Models. *Jiangsu Higher Education*, 2024(7): 88–95.

Publisher's note

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

Revisiting the Cinematic Value of Bruce Lee's Martial Arts Films through the Lens of Physical Artistry

Xiaohan Zhang¹, Boyu Wang^{2*}

¹School of Literature and Communication, Quanzhou Normal University, Quanzhou 362000, Fujian, China

²School of Physical Education, Quanzhou Normal University, Quanzhou 362000, Fujian, China

**Author to whom correspondence should be addressed.*

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 employs body aesthetics and semiotic theories to analyze Bruce Lee's martial arts films, revealing how the cinematic body transforms from traditional ethical symbols to vehicles of national identity. Through multidimensional encoding of corporeal forms, kinetic grammar, and audiovisual rhetoric, Lee's muscular physique evolves into a "poetic symbol" of anti-colonial resistance. The iconic scene of shattering the "Sick Man of East Asia" plaque functions as a performative act of symbolic healing for national trauma while establishing new paradigms for global action cinema. The generational shift from "externalized power" to "internalized cultivation" in martial arts narratives demonstrates how body imagery facilitates cross-media dissemination of physical aesthetics, providing innovative frameworks for traditional martial arts revitalization and digital-era cultural soft power construction.

Keywords: Bruce Lee; Martial arts films; Chinese cinema

Online publication: June 6, 2025

1. Introduction

When Bruce Lee's foot shattered the "Sick Man of East Asia" plaque, the onscreen violence transcended cinematic boundaries to become a spiritual totem for Third World anti-colonial struggles. As a 1970s cultural phenomenon, Lee reconstructed global action cinema through four-and-a-half martial arts films, transforming the martial artist's body from an ethical appendage in traditional wuxia films into a concrete symbol of national awakening. This corporeal-mediated cultural breakthrough subverted Western Orientalist fantasies epitomized by the "Fu Manchu" stereotype, leaving an indelible imprint on global film and cultural history.

This transformation reflects historical inevitability. Modern Chinese history constitutes both a chronicle of national survival and a process of corporeal consciousness awakening. Early 20th-century Chinese cinema, constrained between traditional cultural norms and Orientalist gazes, manifested collective bodily anxiety

through fantastical wire-fu spectacles that evaded physical reality. By the 1970s, Lee and contemporaries confronted the body directly, transforming fleshly violence into discursive weapons against Orientalism while reconstructing the political subjectivity of national bodies.

2. Constructing body imagery: The historical context of Bruce Lee's martial arts cinema

2.1. Technological revolution and the awakening of modern body consciousness

The technological innovations in photographic processes since 1839 have enabled the precise replication of bodily imagery through physical and chemical reactions. Represented by advancements in photosensitive materials, optical lens design, and camera manufacturing, these technical iterations not only enhanced the efficiency of photographic reproduction while reducing costs but also transformed bodily imagery from static portraits into dynamic narrative vehicles. Such technological progress compelled creators to explore new artistic techniques for expressing their visions. Pioneers across generations expanded the boundaries of photography, culminating in the Lumière brothers' public film screening in 1895—an event that mechanized visual perception, astonished global audiences, and inspired waves of filmmakers. Walter Benjamin affirmed cinema's universal value as mechanically reproduced art, emphasizing its capacity for leisurely reception, collective catharsis, and resistance to modern alienation ^[1].

Filmmakers reconstructed diverse creative motifs through cinema's audiovisual medium, forming distinct genre branches. In the context of Chinese cinematic practice, the integration of martial chivalry (wuxia) culture and martial arts birthed wuxia cinema—a quintessentially Chinese film genre. Wang Xiaohua posits: “The body is simultaneously the author, protagonist, and spectator of cinema. As a reinterpretation of reality, film embodies a complete corporeal schema: performed by bodies for bodily observation. The cinematic body perpetually constructs its own world, which constitutes the very enterprise of subjectivity” ^[2]. By equating cinema with dance as embodiments of physical artistry, he affirms the body's central agency in artistic creation.

This study proposes an extended perspective: the martial arts depicted on screen—performative rather than authentic, aestheticized rather than combative—should be recognized as a form of physical artistry parallel to dance and cinema. It manifests as an intercorporeal technique where the subjective body, simultaneously serving as medium and object, engages in adversarial performance—an art form preserved through technological mediation.

2.2. From wuxia to kung fu: Origins, constraints, and divergence

It is imperative to first clarify that wuxia (martial chivalry) cinema and kung fu (martial arts) cinema represent distinct film genres, though the latter is often regarded as an extension of the former in Chinese cinematic practice. During the formative era, directors adapted chivalric legends and Jianghu (martial underworld) narratives into visual spectacles rooted in traditional culture, thereby establishing wuxia cinema. Scholar Jia Leilei identifies *The Car Thief* (1919), directed by Ren Pengnian, as the earliest prototype of Chinese wuxia cinema. Though adapted from an American detective film, it pioneered action elements such as chases and combat while incorporating quintessential wuxia motifs—chivalric codes, martial ethics, and martial arts duels ^[3]. Subsequent works like *Burning of the Red Lotus Monastery* (China, 1928) and *The Hero of the East* (China, 1933) achieved widespread popularity, with specialized martial artists and stunt performers rising to prominence alongside the genre's maturation.

By the mid-20th century, wuxia cinema entered a formulaic phase. Narratives prioritized historical figures and chivalric archetypes, emphasizing traditional ethics and moral edification while remaining detached from contemporary realities. Action choreography adhered to classical martial techniques and bladed combat, with actors clad in flowing robes concealing both their physiques and wirework rigging to achieve superhuman feats like “scaling walls and leaping rooftops.” The wuxia world thus persisted as a heterotopia—a fantastical escape from mundane struggles.

As creative practices deepened, filmmakers grew dissatisfied with the genre’s stagnant conventions. Departing from established traditions, they began foregrounding corporeal realism and kinetic syntax, shifting narratives from mytho-historical realms to contemporary settings while reimagining Chinese martial heroism. This divergence birthed kung fu cinema—a new genre distinct from wuxia in both aesthetics and execution. Early works like Wang Yu’s *The Chinese Boxer* (1970) and Chang Cheh’s *Vengeance* (1970) exemplified this emergent form, showcasing novel characteristics absent in classical wuxia ^[4].

3. Corporeal-centric narratives and innovative paradigms in Bruce Lee’s films

Films like *The Chinese Boxer* (龙虎斗) and *Vengeance* (报仇), while signaling the embryonic stage of kung fu cinema as a new genre, remained limited in influence. They failed to fully liberate martial arts cinema from formulaic conventions or achieve profound semiotic transformation in character representation, particularly in advancing from signifier (surface iconography) to signifier (ideological depth). The paradigm shift arrived with Bruce Lee’s return to Hong Kong and his debut lead role in *The Big Boss* (唐山大兄 , Hong Kong, 1971), which catalyzed the genre’s metamorphosis. During this era, Lee’s groundbreaking physicality—muscular definition, scarred flesh, and visceral violence—transformed the martial arts body from a fantastical appendage of wuxia mythos into a corporeal subject of the material world, cementing his status as a global kung fu icon.

3.1. The body’s dominance: A case study of Bruce Lee

The formation of kung fu cinema resulted from multiple synergistic factors. While its predecessor, wuxia cinema, faced stagnation through formulaic conventions, decades of creative practice had objectively cultivated professional expertise, established creative paradigms, and generated momentum for innovative reform.

Distinct from wuxia’s mythic escapism, kung fu cinema concentrated its narrative space within the material world, privileging the agentive body and martial technique as dominant forces. *The Big Boss* (Hong Kong, 1971) exemplified this through its Hong Kong-style corporeal documentation—muscular physiques, bruised flesh, bloodstains, and primal vocalizations collided with modern cinematic technologies. Cinematographic techniques and post-production sound design collaborated to engineer visceral body-to-body confrontations, excavating and cathartically channeling audiences’ subconscious desires and collective anxieties, thereby achieving profound socio-cultural resonance.

3.1.1. “Martial artist first” philosophy

Bruce Lee revolutionized cinematic combat choreography with his distinct personal style that diverged fundamentally from traditional wuxia conventions. Prioritizing his identity as a martial artist over that of a performer, Lee’s approach to screen combat, as analyzed by Dai Guobin, manifested as “authentic fighting” that

constructed the image of “kung fu chivalry”^[5-6]. Drawing from extensive combat experience, Lee emphasized martial arts’ practical efficacy, systematically developing Jeet Kune Do—a combat philosophy prioritizing swift neutralization of opponents. This philosophy directly shaped the signature characteristics of Lee’s on-screen combat: speed, precision, and lethal efficiency.

In contrast to the deliberately mythologized and obscured corporeality in conventional wuxia cinema, Lee’s martial arts films pursued liberation of the physical form from subjective and objective constraints, showcasing progressively enhanced physical prowess through cinematic representation. His lifelong martial arts training and practical combat experience informed a unique combat philosophy grounded in biomechanical efficiency and physiological optimization.

Lee’s dual background as a child star and U.S.-educated filmmaker endowed him with a sophisticated understanding of Western cinematic mechanisms. This enabled innovative synthesis of traditional Chinese martial arts and chivalric ethos with modern filmmaking techniques. Through this intercultural cinematic praxis, Lee subverted Orientalist stereotypes of Chinese masculinity while facilitating global dissemination of Chinese cultural values.

Wang Xiaohua’s theory of somaesthetics posits the body as a unified entity of materiality and consciousness. Drawing parallels to dance, where the body functions simultaneously as creative subject, expressive medium, and symbolic communicator through movement and gesture, martial arts in cinema similarly transform physical combat into symbolic body art. The cinematic body becomes both a performative agent and a semiotic medium, transmuting combative actions into aesthetic signs that ritualize violence, akin to dance or ceremonial reenactments, while transcending practical functions of offense and defense.

3.1.2. Multilayered corporeal semiotics

Bruce Lee’s martial choreography in his cinematic oeuvre delivered visceral audiovisual impact while constructing multi-layered corporeal narratives through three-dimensional somatosemiotics.

Under his “martial artist first, filmmaker second” philosophy, Lee foregrounded the authentic physical body’s cinematic materiality. Contrasting with wuxia’s metaphysical paradigm, where bodies serve as vessels for invisible gongfu cultivation, Lee’s physiological paradigm rooted combat efficacy in tangible muscular power and mental fortitude. This re-semiotized the martial body from transcendental poetic symbolism to concrete visual semiosis grounded in biomechanical reality.

In *The Big Boss* (Hong Kong, 1971), Lee’s character Cheng Chao-an demonstrates this paradigm through ice factory combat sequences. Confronted with multiple attackers, Cheng employs environmental improvisation—hurling flashlights, scattering dust, and utilizing spatial obstacles—while executing reactive grappling and counterstrikes. This dynamic combat methodology, emphasizing situational adaptability over preset routines, established enduring action cinema principles still prevalent across genres.

Technologically, Lee leveraged emerging cinematographic capabilities to enhance kinetic realism. Through close-range multi-camera setups, alternating between tight close-ups and subjective camera angles, he intensified combat sequences’ spatial immediacy and psychological tension. The technical apparatus became co-constitutive in crafting what Deleuze might term “affection-images” of corporeal struggle.

Symbolically, Lee’s martial archetype descended from wuxia’s heterotopic fantasy to urban reality. While preserving chivalric ethos, he dispensed with jianghu code formalism, instead pioneering complex combat geometries mirroring street brawl dynamics. By replacing conventional one-on-one duels with asymmetrical

one-against-many and multi-directional engagements, Lee's choreography demanded: Spatial cognition of opponent positioning; Fluid mobility across combat zones; Tactical modulation between offensive; defensive modes.

This paradigm shift amplified both technical complexity and spectatorial immersion. The chaotic multi-vector combat necessitated precise inter-performer coordination while heightening narrative stakes through realistic tactical progression ^[7-12]. Cinematically, this transformed martial sequences into hyper-kinetic spatial puzzles where bodies became tactical signifiers negotiating three-dimensional battlegrounds.

3.1.3. The spatial transformation of the modern martial world and the rise of the commoner hero

In traditional martial arts films, the "jianghu" (martial world) is often depicted as a closed, self-contained heterotopia, where major sects exist as isolated powers engaged in perpetual rivalry, detached from the constraints of time, space, and the mundane world. This portrayal reflects a deliberate evasion of real-life societal issues. In contrast, Bruce Lee's martial arts films recenter the narrative within the modern world, reimagining the streets as the new "jianghu." By focusing on the realities of everyday life and the struggles of "living people", Lee employs the language of spatial politics to critique issues of race, class, and colonialism.

In his films, Lee often portrays protagonists from the working class—ordinary individuals who labor physically to survive. These characters are neither saints nor invincible warriors; they grapple with basic needs, desires, and moral dilemmas, yet retain the simplicity and integrity idealized in traditional martial culture. Through personal trials and conflicts, they undergo transformative arcs, awakening to confront oppression and injustice. These "tragic heroes" or "commoner heroes", flawed yet fiercely righteous, resonate more deeply with audiences than idealized paragons. Their imperfections and grounded humanity invite viewers to project their own struggles onto the characters, fostering emotional connection. This theme of righteous violence, rooted in traditional chivalric values, taps into the audience's yearning for fairness and catharsis, allowing them to vicariously experience triumph through the hero's journey.

In *The Big Boss* (Hong Kong, 1971), the protagonist Cheng Chao-an is a Chinese immigrant laborer forced into grueling work under a criminal syndicate. After enduring personal loss and inner turmoil, he ultimately rises to challenge and defeat the gang's leader, avenging his friends and reclaiming justice.

Fist of Fury (Hong Kong, 1972) serves as Lee's bold declaration against colonialism and a rallying cry for national dignity. The film's hero, Chen Zhen, seeks vengeance for his mentor Huo Yuanjia's murder, storming a Japanese martial arts dojo to smash the infamous plaque labeling Chinese as the "Sick Men of East Asia." His iconic roar—"We Chinese are not the 'Sick Men of East Asia'!"—resonates as both a personal and collective defiance. Lee's choreography often culminates in visceral moments where he strips to the waist, revealing a body glistening with sweat, muscle, and scars. This deliberate exposure contrasts his lean, clothed silhouette, transforming his physique into a visual metaphor for resilience.

Here, the body transcends its physicality to become a political symbol. On one level, it resists external forces that seek to dominate individual autonomy; on another, it embodies a nation's struggle against colonial subjugation. Lee's glorification of the martial body—unified in spirit and flesh—elevates it into a symbolic totem of national identity. His films thus visually dismantle the Orientalist myth of the "Sick Man," replacing it with an unapologetic celebration of strength and resistance.

Amid the 1970s backdrop of Third World national liberation movements and countercultural upheavals like the hippie movement, Lee's cinematic ethos mirrored China's own quest for rejuvenation and independence.

His characters' defiance and triumph offered hope to global audiences fighting oppression, democratizing the appeal of martial arts cinema, and cementing Lee's legacy as a transnational icon of liberation.

3.2. The evolution and global integration of martial arts cinema aesthetics

Bruce Lee and his martial arts films marked the definitive birth of the martial arts genre as a new cinematic category through their distinctive narrative structures, choreography, and technical innovations. These works not only established a blueprint for action cinema worldwide but also reinvigorated traditional wuxia (martial chivalry) narratives by breaking creative stagnation and fostering cross-genre integration. The genre's techniques—such as dynamic fight sequences and environmental storytelling—have been widely adopted by other film genres to enhance visual impact and narrative depth.

In Hong Kong cinema, successors like Jackie Chan and Stephen Chow further expanded the genre's boundaries. Chan's films emphasize environmental interactivity, incorporating acrobatic stunts, improvised weaponry, and comedic timing in chaotic settings (e.g., *Drunken Master*), while Chow's *Kung Fu Hustle* (2004) blended slapstick humor with stylized action, redefining martial arts comedy. Meanwhile, Donnie Yen's *Ip Man* series (2008–2019) elevated the genre by focusing on biographical depth and technical precision. The films' minimalist yet powerful Wing Chun choreography, combined with immersive sound design and CGI, showcased both the artistry and practicality of traditional Chinese martial arts.

Globally, Bruce Lee's influence permeates diverse cinematic traditions. Quentin Tarantino's *Kill Bill* series (2003–2004) paid direct homage to Lee's iconic yellow jumpsuit and nunchaku, while amplifying “aestheticized violence” and dark humor through hyper-stylized, one-against-many combat sequences. In the U.S., the *John Wick* series (2013–2023) reimagined martial arts as “gun-fu”, merging close-quarters combat with tactical firearm use—a reflection of America's gun culture and action cinema's adaptability. Even Uganda's burgeoning “Wakaliwood” film movement draws inspiration from Lee's ethos, blending low-budget ingenuity with grassroots martial arts storytelling.

4. The influence and inspiration of Bruce Lee's “body consciousness” in martial arts cinema on contemporary film

As creative practices deepen, the economic, political, cultural, and social value of martial arts cinema as a genre continues to be explored. Operating within modern commercial film industries, creators innovate in themes and techniques to meet market demands, developing diverse styles to cater to audience preferences, thereby generating economic value and driving cultural consumption. Beyond commerce, martial arts cinema also holds enduring significance in shaping political and cultural narratives.

4.1. Horizontal exchange: Reconstructing global cultural landscapes through bodily narratives

Historically, Western-centric discourse dominated global narratives, marginalizing and distorting representations of Asian, African, and Latin American cultures. Stereotypes like the “Yellow Peril” and Orientalist caricatures such as “Fu Manchu” framed Western perceptions of Asians. The rise of 1970s Hong Kong martial arts cinema, led by Bruce Lee, challenged this hegemony. Films like *Fist of Fury* (1972) depicted oppressed Chinese characters using martial arts—a bodily art—to reclaim agency, crafting powerful, righteous Chinese heroes who resisted colonial narratives.

Cinema, as a reproducible audiovisual medium, became a potent tool for disseminating counter-narratives. Martial arts' visceral combat scenes tapped into primal instincts of survival and resistance, enabling the genre to transcend cultural and temporal barriers. These bodily confrontations were encoded as symbols of social and ethnic struggles, aligning with postcolonial "writing back" theories. For example, *Ip Man* (2008–2019) redefined Chinese identity through the titular master's unyielding dignity. By portraying resilient Asian heroes, these films disrupted Western monopolies on bodily representation, reclaiming narrative control and sparking global "kung fu fever." This shift not only reshaped Western action cinema but also repositioned Asia within global cultural hierarchies, fostering cross-civilizational dialogue.

4.2. Vertical integration: Film technology and the modern preservation of intangible heritage

Traditional martial arts, born from historical practice, now face existential threats as intangible cultural heritage. Their transmission—fragile, apprenticeship-dependent, and non-standardized—has struggled amid declining practical needs and external cultural influences. Modern preservation emphasizes cultivating martial virtue (*wude*) and physical discipline over combat utility.

Contemporary film technology offers innovative solutions. High-definition imaging and high-speed cinematography capture intricate techniques, aiding research and education. Digital archives and online platforms provide accessible preservation channels. Motion-capture data can animate martial arts in virtual reality games, inspire dance, or fuel cross-disciplinary creativity. Collaborations between filmmakers and martial artists, through roles as actors, choreographers, or consultants, create symbiotic opportunities. By digitizing and diversifying martial arts' expression, cinema helps secure its survival, fostering modernization and integration with modern sports.

In summary, martial arts cinema bridges horizontal cultural exchange and vertical heritage preservation. Through bodily narratives and technological innovation, it challenges hegemonies, safeguards tradition, and redefines global cultural dynamics.

5. Conclusion

The awakening of bodily consciousness marked the beginning of the Chinese people's struggle for sovereignty and national independence, gradually reclaiming their place at the center of the global stage and regaining the right to narrate their own bodily experiences. Martial arts cinema, as an art form that synthesizes martial arts and film, embodies this return of the body to artistic prominence. Cinema, as a composite medium of bodily narratives, has become a powerful tool for the self-representation and expression of the body.

Bruce Lee's cinematic portrayal of the physical body elevated it to a position of profound significance. His films transformed the body from a mere individual entity into a symbol of the Chinese nation, breaking free from the allure of fantastical heterotopias and grounding itself in the real world. Through his imagery, Lee reshaped the global cultural positioning of Chinese people, giving voice to their stories. The "commoner hero" archetype in his films stirred audiences' emotions, encouraging self-reflection and affirming the centrality of the body and its agency.

Building on the legacy of *wuxia* (martial chivalry) cinema, Chinese filmmakers innovated within global cultural currents, advancing the international dissemination of Chinese culture. Re-examining this history

through the lens of bodily artistry reveals new dimensions of martial arts cinema's value. It reminds people to prioritize the body's subjective role in contemporary creative practices, leveraging advancements in both martial arts and filmmaking, through new technologies, ideas, and methodologies, to drive the inheritance and global communication of traditional Chinese culture. By fostering cultural confidence and consciousness, people can craft compelling Chinese narratives, showcase the richness of Chinese heritage, and strengthen cinema's role as a bridge for cross-cultural exchange and mutual understanding.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Benjamin W, 2003, *The Work of Art in the Age of Mechanical Reproduction*. China City Press, Beijing.
- [2] Wang XH, 2021, *The Paradox of the Body: Western Art Studies Through the Lens of Subjective Aesthetics*, 1st ed. People's Publishing House, Beijing, 207.
- [3] Jia LL, 2007, *Martial Dance Mythology: Chinese Wuxia Cinema and Its Cultural Spirit*, thesis, Nanjing Normal University.
- [4] Chen JL, 1999, Mythic Heroes: A Study of Bruce Lee's Films. *Journal of Beijing Film Academy*, 1999(3): 82–90.
- [5] Linda L, 2014, *Bruce Lee: The Tao of Jeet Kune Do*. Beijing United Publishing Co., Beijing.
- [6] Dai GB, 2011, A Study on the Developmental Characteristics of Martial Arts Film Stars Across Historical Periods: Bruce Lee, Jackie Chan, and Jet Li as Case Studies. *Journal of Beijing Sport University*, 34(6): 37
- [7] Dai GB, 2011, A Study on the Developmental Characteristics of Martial Arts Film Stars Across Historical Periods: Bruce Lee, Jackie Chan, and Jet Li as Case Studies. *Journal of Beijing Sport University*, 34(6): 37.
- [8] Wang DZ, 2024, Technological Subversion and Image Reinvention: A Brief Analysis of the “Deconstruction” and “Reconstruction” in Bruce Lee's Kung Fu Films. *Beauty & Times (Part 2)*, 2024(1): 151.
- [9] Guo YC, 2008, The Inheritance and Development of Traditional Martial Arts in Contemporary Society. *Journal of Shanghai Sport University*, 2008(2): 51–57.
- [10] Jiang X, 2022, *Earthly Salvation: Jiang Xun on Eastern and Western Body Cultures*, 1st ed. People's Literature Publishing House, Beijing, 188.
- [11] Yang YJ, Wang DB, 2019, Regulation of Civilian Weapons in the Tang Dynasty and Its Implications. *Journal of Hengshui University*, 21(5): 123–128.
- [12] Wang BY, 2011, A Brief Analysis of Sun Yat-sen's Martial Arts Values: Reading Preface to *Jingwu Chronicle*. *Journal of Quanzhou Normal University*, 29(2): 110–112.

Publisher's note

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



Integrated Services Platform of International Scientific Cooperation

Innoscience Research (Malaysia), which is global market oriented, was founded in 2016. Innoscience Research focuses on services based on scientific research. By cooperating with universities and scientific institutes all over the world, it performs medical researches to benefit human beings and promotes the interdisciplinary and international exchanges among researchers.

Innoscience Research covers biology, chemistry, physics and many other disciplines. It mainly focuses on the improvement of human health. It aims to promote the cooperation, exploration and exchange among researchers from different countries. By establishing platforms, Innoscience integrates the demands from different fields to realize the combination of clinical research and basic research and to accelerate and deepen the international scientific cooperation.

Cooperation Mode



Clinical Workers



In-service Doctors



Foreign Researchers



Hospital



University



Scientific institutions

OUR JOURNALS



The *Journal of Architectural Research and Development* is an international peer-reviewed and open access journal which is devoted to establish a bridge between theory and practice in the fields of architectural and design research, urban planning and built environment research.

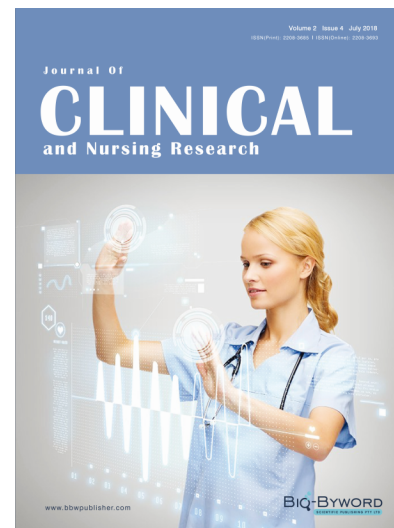
Topics covered but not limited to:

- Architectural design
- Architectural technology, including new technologies and energy saving technologies
- Architectural practice
- Urban planning
- Impacts of architecture on environment

Journal of Clinical and Nursing Research (JCNR) is an international, peer reviewed and open access journal that seeks to promote the development and exchange of knowledge which is directly relevant to all clinical and nursing research and practice. Articles which explore the meaning, prevention, treatment, outcome and impact of a high standard clinical and nursing practice and discipline are encouraged to be submitted as original article, review, case report, short communication and letters.

Topics covered by not limited to:

- Development of clinical and nursing research, evaluation, evidence-based practice and scientific enquiry
- Patients and family experiences of health care
- Clinical and nursing research to enhance patient safety and reduce harm to patients
- Ethics
- Clinical and Nursing history
- Medicine



Journal of Electronic Research and Application is an international, peer-reviewed and open access journal which publishes original articles, reviews, short communications, case studies and letters in the field of electronic research and application.

Topics covered but not limited to:

- Automation
- Circuit Analysis and Application
- Electric and Electronic Measurement Systems
- Electrical Engineering
- Electronic Materials
- Electronics and Communications Engineering
- Power Systems and Power Electronics
- Signal Processing
- Telecommunications Engineering
- Wireless and Mobile Communication

