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DESIGN WORKSHOPS IN THAILAND: DOCUMENTING PRACTICES AND RESEARCH ON THE PROMOTION OF "SOFT INTEGRATION" AMONG MULTI-ETHNIC COMMUNITIES

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Abstract: Research study is targeted towards design workshops in Thailand as a means for facilitating "soft integration" among multi-ethnic groups. Implementing a multi-method approach of participatory observation, in-depth interviews, and questionnaire surveys, this research study makes systematic investigations into design workshops in different parts of Thailand. The conclusions show that design workshops, as "soft" intervention, can promote intercultural communication, cultural identity, and social integration through three interrelated factors: cultural cohesion, collaborative design, and relational identity. This study not only enriches theoretical studies on multi-ethnic integration but also provides new conclusions and practical references to social governance innovation and cultural industry construction in areas inhabited by ethnical diversity. The "soft integration" model advocated in this research has important theoretical and practical value for explaining and fostering ethnic harmony in multicultural communities.
Keywords: Design workshops, Multi-ethnic communities, Soft integration, Thailand, Cultural identity, Co-creation

1 INTRODUCTION

1.1 Research Background and Problem Statement

With growing globalization, multi-ethnic countries are confronted with the challenge of preserving cultural diversity as well as ethnic integration and social harmony - a key theoretical and practical concern. Conventional approaches to ethnic integration have typically employed "top-down" policy instruments or economic incentives as "hard" policies. These have been moderately successful in some situations but also face difficulties in achieving real acceptance and long-term integration. In this regard, the "design workshops" (Design Workshop) organized in Thailand's multi-ethnic frontier regions represent a cultural "soft" approach towards increasing ethnic groups' cultural and psychological integration, which involves a new approach and methodology.
Thailand as a crossroads of Southeast Asia has complex ethnic composition and multilayered cultural richness. In recent years, the authority of Thailand started design workshop programs combining traditional handicraft with modern design, while, on the other hand, promoting traditional culture as well as allowing natural exchange and integration of ethnic groups. This new activity-based "soft integration" contrasts with traditional administrative mandating or economic incentives, and offers an alternative way for peaceful coexistence of multi-ethnic groups.

1.2 Research Importance

Theoretical importance of the research lies in the extension of the theoretical foundation of "multi-ethnic soft integration" by adding a model and feedback assessment system for "design-promoted soft integration" and both disclosing universal and specific aspects of design intervention for multi-ethnic communities. The research overcomes the absence of tangible research material on Thailand's "design workshop" activities through the provision of first-hand empirical data from participatory practice, observation, and interviews. Further, this research contributes to cross-disciplinary research methodology through the provision of a triangulation approach using narrative description and quantitative measurement to enhance the standardization and scientificity of "design-promoted soft integration" research.
In practice, the research provides a true database for ethnic art teaching design and policy comparison, realistic examples of art design implementation for "soft integration," and experiential references for ethnic work in our nation's new era.

1.3 Research Objectives and Content

This study aims to deeply investigate Thailand's design workshop project practice experience, elaborate on the role of participatory design in promoting grassroots governance innovation and multi-ethnic integration, and provide replicable experience and policy recommendations for the improvement of grassroots governance and cultural industry development in ethnic regions. Research content includes:
1.Systematic documentation of practices of Thailand's design workshop project to uncover their mechanisms and channels for enabling multi-ethnic "soft integration."

2.Formulation of a theoretical model of "design-fostered soft integration" and determination of its primary components and functioning processes.
3.Systematic evaluation of the role played by design workshops in multi-ethnic integration.
4.Examination of the feasibility of localizing the concept of the design workshop.

1.4 Research Methods and Innovations

The research applies diverse research methods, combining qualitative and quantitative models of analysis, including:
Participatory Observation Method: The research team actively engaged in the process of conducting Thailand's design workshop projects with intimate understanding of working procedures and real impacts by experiencing and observing firsthand.
Semi-standardized Interview Method: Interviewing multi-ethnic students who joined design workshops, project organizers, and local citizens in-depth to collect oral history materials.
Questionnaire Survey Approach: Designing questionnaire surveys to identify participants' sentiments and opinions on the projects, how the projects affect participants' cultural identity, social interaction, etc.
Case Analysis Approach: Selecting typical design workshop projects for close analysis to examine their unique practices and effectiveness in promoting multi-ethnic integration.
Analytic Hierarchy Process and Fuzzy Comprehensive Evaluation Method: Formulating a hierarchical model structure, acquiring effectiveness reviews and determining weights through questionnaires for analyzing the impacts of design workshop projects.
The research breakthroughs are best marked by: first conceptual proposal and rigorous definition of the term "soft integration"; development of a three-dimensional theoretical model for "design-promoted soft integration"; inter-disciplinary research approach creatively adapted; and offering firsthand empirical data on multi-ethnic integration through design workshops.

2 LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Definition and Theoretical Origins of "Soft Integration"

"Soft integration" as a new phenomenon implies a middle-of-the-road, gradual, and non-forced form of ethnic interaction, exchange, and integration with "hard" policy intervention of the past. Etymologically, "soft" means adjustability, flexility, and voluntary factors; "integration" addresses interaction, exchange, and interinfluence among plural ethnic groups towards ultimate harmonious coexistence.
The key meanings of "soft integration" might be deduced from the following factors:
Gentleness: Rather than coercive techniques such as administrative fiat or economic enticement, "soft integration" places greater reliance on the application of culture, art, education, and other soft tools in the establishment of natural integration milieus and spaces.
Bidirectionality: Far from one-way unidirectional assimilation or integration but cross-learning and cross-influence among ethnic groups with respect.
Subjectivity: Focus on autonomous involvement and proactive self-definition by ethnic groups as active actors and agents and not as passive recipients.
Processual Nature: Not a sudden result but a continuous, gradual dynamic process.
Multidimensionality: Integrating integration in economic, social, cultural, and psychological dimensions with particular emphasis on identification in cultural and psychological dimensions.
Design workshops, a new form of "soft integration," employ design exercises as a vehicle to create platforms for communication and exchange between different ethnic groups, enabling intersubjective understanding and identification between cultures, high typicality, and representativeness.

2.2 Theoretical Multi-ethnic Integration Research

Enabling research into multi-ethnic integration is of imperative significance in our contemporary globalized world, in which plural ethnic populations inhabit public places, social institutions, and administrative structures. Shaping such research not only adds to our theoretical understanding of the processes of integration but also provides critical evidence to enable more inclusive, effective policy.
Most importantly, from Canadian studies, integration models have been complemented by a double focus on multicultural policies and the reinforcement of national narratives embracing diversity and pluralism. Wu and So [1] argue that Canada's peculiar approach—high naturalization rates and a narrative of mutual respect—has been central in constructing ethnic as well as national belonging. Simultaneously, comparative Canadian citizenship and immigration studies recognize the need for policy to integrate multiculturalism into broader frameworks of civic engagement and thus shed light on the multi-dimensional worth of research in this field [2, 3].
Internationally, city case studies provide further traction to sound research on multi-ethnic integration. Liu and Mwanza [4] illustrate the differences in public attitudes and multicultural experiences across ethnic groups and suggest that the urban context itself is engaged in closing cultural gulfs or entrenching differences. Likewise, qualitative Hong Kong

data suggest regional multicultural practice variations need to be tackled through context-specific approaches that engage Chinese and non-Chinese communities [5]. These geographical and cultural analyses add further depth to our overall image of integration by allowing scholars to compare policy effect across national contexts and urban landscapes.

Multidisciplinary approaches are called for in a quest to harmonize at times competing goals for prejudice reduction and for activating active collective involvement. Urbiola et al.[6] provide a model that integrates prejudice reduction and collective action strategies through a multicultural commitment, which suggests that psychological factors are as vital as policy processes in facilitating effective integration. More so, Verkuyten [7] lays even more stress on the intragroup processes and cultural identity negotiation role in legitimating multicultural policies, thereby providing a critical counterpoint to those downplaying the importance of group processes.

Comparative European research offers further layers of sophistication by illustrating that the influence of multicultural policy on socio-administrative integration may be modest and conditional. Citrin et al. [8] and Bloemraad and Wright [9], for instance, illustrate that multicultural policies tend to foster modest levels of administrative inclusion and social cohesion but with variable success across countries. These findings provoke longitudinal and cross - national study designs to chart more precisely the interplay among dynamic state policy, civic participation, and cultural identity—a research agenda that might just as easily be pursued through mobilizing insight derived from scholarship that has critically examined multiculturalism's more diffuse impacts on society [10, 11].

In synthesis, evoking examination of multi - ethnic integration is not simply a matter of the experimentation of various policies but also one of forging a more refined relationship between theory and practice. These studies must draw on a variety of methodological approaches — from empirical quantitative information to qualitative research — to pose questions regarding the impact of integration policies on social inclusion, administrative engagement, and the daily lives of citizens in multiethnic society. The results that emerge from such efforts can ultimately guide policymakers towards the creation of interventions that are administratively viable and culturally attuned, thereby promoting unity in diversity across the globe.

2.3 Interdisciplinary Research of Design Studies and Ethnology

Interdisciplinary research spanning the domains of design studies and ethnological studies is emerging as a new frontier for theory building and applied innovation. The current research combines design studies' critical and creative approaches with the cultural, historical, and social understanding of the ethnological approach. With such a convergence, one can have a comprehensive approach that encompasses the diversity of human expression, social values, and material culture.

Among the most prominent of these traits of interdisciplinary research is knowledge sharing and design codification. Hamari et al.[12] demonstrate how systematic codification can be used to contribute towards enabling design research in interdisciplinary Design Science Research (DSR) projects. Their study points to the need for strong structures of knowledge management and communication to transform the artistic and functional design attributes into forms wherein ethnological measures of verification are possible. This points to the overall need for transdisciplinarity, as discussed in research appraisal studies that necessitated the implementation of interdisciplinarity standards for striking a balance between traditional barriers and preventing the disregard of disciplinary diversity [13].

Furthermore, methodological problems with study design are the most challenging at the integration of design studies and ethnology. Tobi and Kampen [14] suggest a general scheme of interdisciplinary studies considering both the design process and subsequent design outcomes. Their own model, design-oriented inquiry aside, can, however, be applied in the case of ethnological studies through a systematic study of cultural artifact, rituals, and customary practices. This app extends design practice by situating design methodologies within a broader context of social practice and cultural storying.

Furthermore, Chou and Wong [15] provide compelling proof for an integrative path which transforms design study from a discrete artefactual focus to an interdisciplinary collaboration one. They indicate that through bringing together design and cultural studies' methods, research can tackle sophisticated socio-cultural problems in a fresh way. The transformation enhances the depth of design research and enables ethnologists to apply design imagination in the re-interpretation of cultural reality.

Aside from these texts, Ciuccarelli [16] is writing about creating technological and conceptual tools—what he calls a "design macroscope"—intentionally made to advance interdisciplinary design research. The tools aim to make the conceptual foundations of design understandable in a common language where the design theories can dialogue with ethnographic perspectives. The tools are essential in ensuring that the design core is not truncated while operating with other disciplines, including ethnology.

Ethnology entails immense knowledge of human society's cultural phenomena. Gogora [17] considers digital curation of ethnology research reports, explaining how to create digital collections of studies documenting a wide variety of cultural practices and expressions. Methodologies introduced in his book offer significant directions for the syncretism of ethnology's analytical and archival paradigms with the newly emerging design studies approaches. Utilizing digital tools and platforms, researchers can produce multidisciplinary collections that are reservoirs of design innovation and ethnological knowledge, promoting a more inclusive set of research outputs.

Generally speaking, interdisciplinarity and the merging of design studies and ethnology bring forth a promising horizon for integrated knowledge about cultural innovation and human creativity. Through access to methodological innovation in codification and research design methods [12,14], fostering integrative methods that bridge disciplines [15], and adopting digital curation practices for the management of ethnological data [17], researchers can construct healthy models that not only go beyond traditional methodological limitations but also catalyze revolutionary change in both fields [13]. More research on such integrative processes is essential in addressing complicated social issues and establishing new patterns of cooperation among different research fields.

2.4 Theoretical Analysis Framework

Based on existing theories, the study formulates a three-dimensional model of "design-promoted soft integration" with reference to existing theories, investigating the process of design workshops to promote multi-ethnic integration from three dimensions: cultural bonding, cooperative design, and relational identity

Dimension of Cultural Cohesion: Focusing on the integration and innovation of cross-ethnic cultural resources, including traditional cultural resource collection and organization, cross-ethnic cultural element extraction and reconstruction, and cross-ethnic cultural symbol modern transformation and innovative expression.

Dimension of Collaborative Design: Focusing on the interactive innovation process of multiple subjects, including collaborative participation mechanism of multiple subjects, problem-oriented practical learning processes, and setting up knowledge-sharing and technological interaction platforms.

Relational Identity Dimension: Focusing on reconstruction and integration of multi-level identities, i.e., community cultural practices like multi-ethnic participation, establishing cross-cultural dialogue spaces, multiple identity reconstruction and integration.

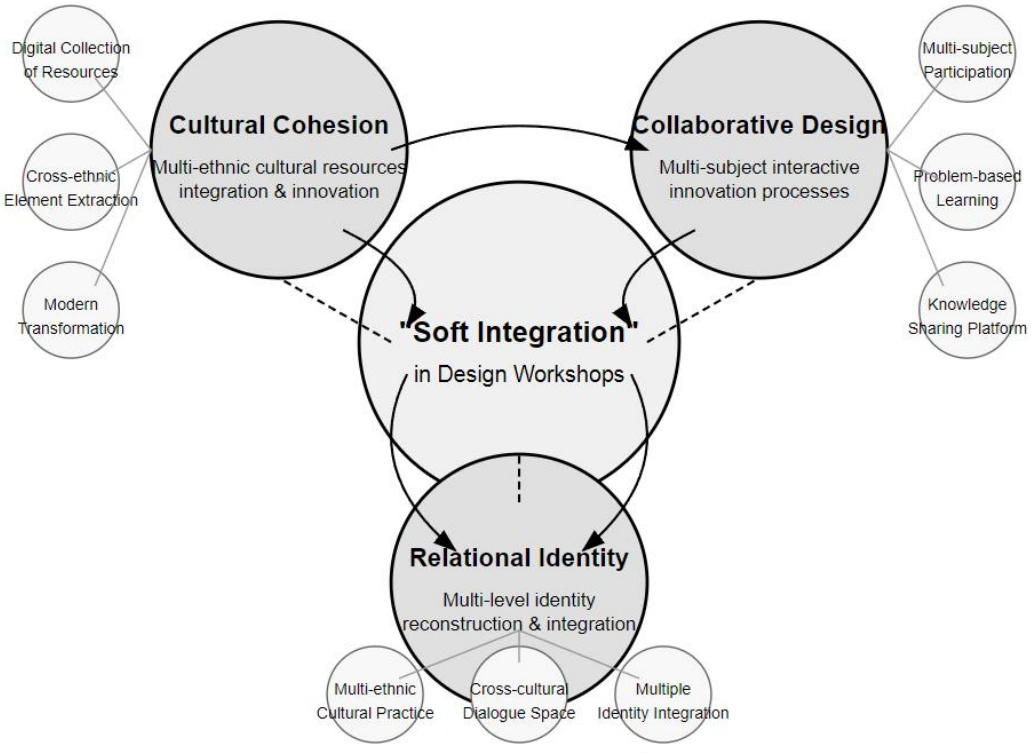

Figure 1 Three-Dimensional Model of "Soft Integration"

These three dimensions are mutually enabling and interdependent to each other, forming an interactive system, as shown in figure 1. Collaborative design provides content foundation for collaborative design, and cultural cohesion provides operative tools to collaborative design. They enable each other to form relational identity, thus strengthening collaborative design and cultural cohesion reciprocally to form a virtuous circle.

3 DOCUMENTATION OF THAILAND'S DESIGN WORKSHOP PROJECTS

3.1 Overview of Thailand's Multi-ethnic Background and Integration Policies

Thailand is multi-ethnic. Thai people make up about 75% of the population, but there are numerous minority ethnic groups distributed throughout the country, and thus a multi-ethnic mosaic is formed. Major minority ethnic groups include: northern Thai mountain tribes such as Hmong, Yao, Karen, Lisu, Lahu, Akha, etc. (collectively referred to as

"Hill Tribes"); Malay Muslims in southern Thailand; and Chinese, Laotian, and Khmer communities distributed all over the country.

The Thai ethnic policy has changed from "assimilation" to "unity in diversity." In the early to mid-20th century, the Thai authority enforced mainly assimilation policies, emphasizing the establishment of a single "Thai identity". In the 1960s and 1970s, with opium production and administrative security issues in mountain areas, the authority began to pay attention to the emergence of ethnic groups in mountains, but still continued to seek assimilation and domination.

Since the 1980s, Thailand's ethnic policy has developed step by step towards a more inclusive "unity in diversity" policy. The 1997 Thai Constitution first guaranteed the cultural rights of ethnic minorities for the first time, legally safeguarding multi-cultural development. Since the 2000s, the Thai authority has actively promoted the concept of "One Thailand, Diverse Cultures," emphasizing respect for cultural diversity as well as national unity.

Under such circumstances, design workshops are increasingly a new trend to enable "soft integration" between multi-ethnic communities. Design workshops conceptually aim at merging modern design concepts with folk craftsmanship by requiring designers to collaborate with artisans in an effort to design innovative traditional craftsmanship products, make them market-competitive, and inherit and conserve cultural legacy. Of greater importance, design workshops provide a platform for communication and collaboration between designers and craftsmen with different ethnic backgrounds and generate mutual recognition and understanding through the co-creative process to achieve "soft integration".

3.2 Case Analysis of Bamboo Weaving Craft Community in Yasothon Province

Yasothon Province in northeast Thailand's Isan region is a major production base for handicrafts of traditional bamboo weaving. It is made up of a multi-ethnic population with mainly Thai, Lao, and Khmer individuals, forming a unique type of multi-ethnic integration through the development of history over time.

3.2.1 Background of Fa Huan Village design workshop project

Fa Huan Village, located in north Yasothon Province, is a multi-ethnic mixed village with Thai, Lao, and limited Khmer residents. The village has a historical tradition of bamboo weaving crafts but has more recently faced issues of market reduction, emigration of the youth population, and loss of skills. In 2019, with the support of the Yasothon Provincial Cultural Bureau, the village started the "Bamboo Weaving Innovation Design Workshop" project, which aims to revive traditional crafts via design innovation, develop multi-ethnic integration, and boost rural revitalization.

Particular project objectives were: (1) conservation and inheritance of ancient bamboo weaving arts; (2) enhancement of product added value by design innovation; (3) building of local design capabilities; (4) promotion of multi-ethnic cultural exchange and integration; and (5) establishment of a sustainable model of community development.

3.2.2 Organizational form and operational model

Fa Huan Village's design workshop was of the form of "1+3+N": 1 core staff, 3 professional teams, and N workshops.

The core group consisted of members of the village committee, local cultural leaders of the community, and external professional consultants, responsible for overall project planning and coordination. For maintaining equal representation of a number of ethnic groups, the structure of the core group carefully considered ethnic representation, which included representatives from Thai, Lao, and Khmer groups.

The three professional teams were design R&D team, skills inheritance team, and marketing team. The design R&D team consisted of external designers and local craftsmen, responsible for product innovation design; the skills inheritance team consisted of three-generation artisans (old, middle-aged, and young), responsible for passing on skills and nurturing talents; the marketing team was responsible for product exhibition, brand building, and sales channels.

The N workshops were the tangible working units of the project, and each workshop implemented activities on some themes or skills. For example, traditional pattern workshops, modern home product design workshops, bamboo dyeing workshops, etc. Workshops were operated in an open manner, and villagers were free to participate according to their interest and time.

The process of the design workshop was a "learning-creation-display-feedback" mode cycle: learning initially through inheritance of skills and workshops on design thinking; creating subsequently under the guidance of designers; then performing activities of work display; and finally receiving feedback from all directions in order to make adjustments to the content of the next round of learning and creation.

3.2.3 Participating subjects and interaction mechanisms

The objects of Fa Huan Village's design workshop were multi-level, mainly composed of: local artisans, professional designers, local residents, authority officials, and market operators. To enable smooth interaction among workshop subjects, the workshop established multi-level interaction mechanisms:

"Apprenticeship" interaction: Mature artisans with accompanying young apprentices, realizing skills inheritance through one-on-one guidance.

"Co-creation meeting" interaction: Periodic meetings for consultation where craftsmen and designers from different ethnic backgrounds jointly sought creative solutions.

"Cross-border combination" interaction: Building teams of members of different professional backgrounds and ethnic groups to fulfill certain projects cooperatively.

"Cultural salon" interaction: Intensifying cross-ethnic mutual understanding and friendship by sharing history, tradition, and eating foods, etc.

"Market docking" interaction: Inviting market players periodically for workshop participation and giving market demand information and feedback.

3.2.4 Design innovation achievements and ethnic integration effects

After three years of innovation, the design workshop of Fa Huan Village created abundant results: nearly 50 new products were made, 15 of which were bestsellers at the market; design innovation contributed 2-5 times product prices, significantly increasing artisan income; sales channels of products enlarged from local traditional markets to luxury malls and cross-border e-commerce platforms; products of the workshop won the "Best Cultural Innovation Award" during the 2021 Bangkok Design Week, enhancing brand popularity.

In terms of the promotion of ethnic integration, the design workshop also had deep impacts: workshop processes changed the interaction between participants from different ethnic groups from "frequent meetings" to "ongoing collaboration"; frequency of interaction was raised about three times a day; participants' perception of other ethnic groups as culture went from surface customs to values and aesthetic appreciation; other ethnic groups' traditional patterns, skills, and stories became accessible resources shared in the workshop; participants established emotional connections and trust relationships beyond ethnicities through co-design; participants maintained their original ethnic identities but, in parallel, an "artisan community" identity built on interests and common values.

3.3 Case of Design Workshops in Muslim Communities of Southern Thailand

Southern Thailand, especially the Pattani, Yala, Narathiwat, and Satun provinces, is controlled by Muslim Malay groups that have enormous disparities with the rest of Thailand in ethnicity, language, religion, and culture. The region has a long tradition of ethnic strife and separatism, which has posed enormous obstacles to local development and ethnic relations.

3.3.1 Project background and design

The research team conducted field research on the "Tradition and Modernity: Muslim Textile Design Workshop" project in Pattani Province, a collaborative ethnic integration project of the Thai Ministry of Culture and the Pattani Community Development Foundation. The project aimed to promote cultural exchange and economic relationships between Muslim Malays and other ethnic groups through design workshops to reduce ethnic tensions.

The design of the project integrated several essential features: Firstly, respect for cultural differences was infused, as respect for each ethnic group's religious beliefs and cultural characteristics was upheld as a basic principle by the project team; secondly, the project also emphasized balance of interest, such that each participant party could enjoy equitable returns in the cooperation process; thirdly, the project particularly emphasized emphasizing the distinctness and superiority of Muslim Malay culture as a differentiator in products; fourthly, the project emphasized the concept of co-creation, wherein all participants were objects of creation rather than passive recipients.

3.3.2 Innovative integration of religion and modern design

Another interesting feature of the Pattani design workshop was the innovative synthesis of Islamic cultural values and modern design. The synthesis honored religious rituals and integrated contemporary market demands to create unique cultural products.

The principal creative syntheses were realized in: integrating customary Islamic geometric motifs and calligraphy designs with contemporary graphic art; adding contemporary cutting and colors while upholding Muslim attire requirements; integrating customary handloom weaving, batik, and other artisanal crafts with contemporary materials; creating items complying with contemporary ways of life from customary crafts and cultural elements.

3.3.3 Successful experiences and challenges

The project had positive impacts in different aspects: Economically, the community products participating in the project increased by 80%, with 30-50% increase in income; socially, the rate of interaction between ethnic groups increased by more than three times, with significantly enhanced community cohesion; culturally, traditional craftsmanship was conserved and creatively cultivated, with more respect for traditional culture among the young generation.

However, the project wasn't without problem: Security concerns were the most important problem working in the area; due to geographical unaccessibility and ambient social considerations, products had heavy logistics costs and information asymmetry when marketing at home and foreign markets; some design innovations would unintentionally cross religious taboos or cultural sensitivities and become contentious; with the lapse of external sponsorship, the project's viability was compromised.

3.4 Design Workshop Practices in the OTOP (One Tambon One Product) Program

The "One Tambon One Product" (OTOP) program is a major local economic development policy launched by the Thai authority in 2001, aimed at encouraging each township community to develop products of local characteristics, enhance product quality and brand value through authority promotion and market operation, and stimulate local economic growth.

3.4.1 Positioning and functions of design workshops in OTOP

When the OTOP program evolved, classical product support frameworks gradually showed their limitations. In an effort to break such roadblocks, design workshops were incorporated into the OTOP program around 2010 as a novel type of assistance, acting as a strong nexus connecting traditional craftsmanship and modern-day markets.

Design workshops play multiple roles in the OTOP program: as a platform for innovation, injecting new ideas and dynamism into old handicrafts using modern design principles; as a center for capacity building in design, increasing the design awareness and technical skill of artisans through structured training and practice; as a cultural exchange center, uniting designers and artisans from different ethnic groups and regions to stimulate cross-cultural understanding; as a window to markets, involving designers, distributors, and consumers in product development; and as a vehicle for community organization, increasing community solidarity and self-governance ability.

3.4.2 "Young OTOP" One Village One Product Youth Force Workshop

With the progress of the OTOP program, the biggest problem was that the younger generation did not participate, and traditional crafts were about to be lost because of the problem of inheritance. In view of this problem, the Thai authority launched the Young OTOP "One Village One Product Youth Force Workshop" project in 2018 in the hope that young people would participate in the innovative development of traditional crafts.

Young OTOP workshop of Chiang Mai Province studied by the research team employed several new methods: in conforming to the "youth-led" principle with major participants between the ages of 18-35 years; applying a "master-apprentice combination" cultivation mode to promote a learning community with merits of three generations in a complement; giving top priority to "digital empowerment," which involved several digital technologies to act as assistants to design and marketing; providing whole-rounded "entrepreneurial support" to help young people realize their entrepreneurial dreams; and providing an active "social network" environment to meet the social demands and sense of belonging of young people.

3.4.3 Multi-ethnic participation features and effect evaluation

OTOP design workshops in multi-ethnic locations exhibited some unique participation characteristics: natural attainment of ethnic integration, with workshop participants usually from different ethnic groups but with common work targets and creativity enthusiasm across ethnic divisions; systematic practice of cultural respect, with traditional components and aesthetic preferences of each ethnic group valued and internalized; interactive exchange of skill acquisition, with skill techniques among different ethnic groups mutually learned, referenced, and incorporated in the workshop; successful establishment of benefit-sharing arrangements, with workshop returns often shared on a contribution basis regardless of ethnicity; and step-by-step integration of identity recognition, with participants increasingly bonding over common identity based on artisan status yet retaining their respective ethnic identities.

Effect evaluation proved that design workshops initiated successful impacts in the economic, social, and cultural fields: Economically, products of the involved communities are 2-3 times higher in average price, sales range expansion, and income of the participants is increased by 30-50%; socially, survey data indicated considerably enhanced social cohesion, where frequency of inter-ethnic relations increased more than three-fold, and considerably higher willingness to act as one in communal affairs; culturally, traditional craft was saved and innovatively enhanced, with further enhanced consciousness of traditional culture among the young generation, and innovative modes of new cultural expression initiated through new combination of diverse ethnic cultural factors.

4 ANALYSIS OF THE MECHANISMS OF DESIGN WORKSHOPS IN PROMOTING MULTI-ETHNIC "SOFT INTEGRATION"

4.1 Cultural Cohesion: Integration and Innovation of Multi-ethnic Cultural Resources

The primary dimension in which "design workshops" enable multi-ethnic integration is cultural cohesion. It builds inclusive cultural forms by excavating, integrating, and innovating multi-ethnic cultural resources and enables recognition and resonance at the cultural level among different ethnic groups.

4.1.1 Digital collection and organization of traditional cultural resources

The principal task of "design workshop" projects is the structured collection and sorting of conventional cultural material of various ethnic groups. It is not simply a collation of material but a structured sorting and preservation of conventional culture with the aid of advanced digital technology, serving as a foundation for subsequent design innovation.

Employees in northern Thailand worked in Chiang Mai Province to conduct a close-up study of mountain tribes' traditional textile arts in the area, collecting not only examples of traditional fabrics but also photographing traditional techniques, pattern characteristics, and color codes with high-definition cameras and 3D scanning. The digital content collected was indexed into a database of searchable terms by designers and artisans.

The greatest advantages of digital collection are: breaking geographical barriers, making it possible to organize and share dispersed cultural resources in different locations centrally; accurately documenting the information of traditional crafts, ensuring the proper transmission of craft techniques; and facilitating systematic analysis, helping to discover commonalities and interconnections between cultures of different ethnic groups.

4.1.2 Extraction and reconstruction of cross-ethnic cultural elements

As per the compiled cultural sources, "design workshops" disassemble and simplify the key constituents of various ethnic groups' cultures and reconstitute them creatively. It is not just a collage amalgam but rather an exploration for universals and points of connection on the grounds of an abysmal realization of the cultural undertones of every ethnic group and creating new expressions of culture that can appeal to multiple ethnic groups.

In Loei Province of northeastern Thailand, the project team observed and compared traditional patterns of the local Thai, Lao, and Khmer ethnic groups and found that all three ethnic groups employed diamond geometric patterns in

their design despite significant differences in language and lifestyles. Based on this discovery, designers extracted common elements of diamond patterns from the three ethnic groups and created a "Three-Tribe Diamond Pattern" that maintained the attributes of each ethnic group but could be commonly recognized by all three.

This extraction and reconstruction of cross-ethnic cultural elements honor the uniqueness of each ethnic group's culture while identifying the interconnections and commonalities among ethnic cultures.

4.1.3 Contemporary innovation and innovative expression of multi-ethnic cultural symbols

The third significant linkage in "design workshops" is to transform traditional cultural symbols into innovative expressions with contemporary aesthetics and uses. Such transformation is not such copying of traditions but enriching new contemporary meanings and forms of expression on the basis of understanding the spiritual essence of traditional culture.

In Phetchaburi Province in central Thailand, designers collaborated with local Chinese and Thai craftsmen to employ traditional woodcarving patterns in modern home product designs. Designers followed classic pattern structure and proportion but reduced intricate details for modern minimalist styles; while also altering product form to allow for classic patterns to be adapted for the needs of modern lifestyles. This innovation not only added value to products in the market but also allowed traditional cultural elements to blend with modern life and remain vibrant.

For instance, in a "design workshop" project in Chiang Mai, designers collaborated with Akha and Lahu tribe weavers to combine and contrast traditional textile crafts and modern fashion design. Those era designers honored earlier skills but paved new ways with color selection and style design, having their products retain ethnic qualities while fitting modern fashion sensibilities. Such a design was not only accepted at the national market but also gained entry into global fashion, which became an important aspect of Thai cultural "soft power."

The innovation and fresh representation of symbols of multi-ethnic culture lead traditional culture to enter the framework of modern society with an open mind and progressive mentality and have an impact upon a wider area. Innovation serves not only to protect cultural heritage but also gives a new driving force to culture and helps propagate and carry on culture in new places.

4.2 Interactive Innovation Process by Collaborative Design: Multi-subject Participation

The second most essential element of "design workshops" in promoting multi-ethnic integration is collaborative design, which can stimulate deep communication and collaboration among various ethnic groups and various groups through the generation of an interactive process of innovation with multi-subject participation and attaining complementation and integration of knowledge and skills.

4.2.1 Collaborative participation mechanism of multiple subjects

One of the key features of "design workshop" projects is establishing a system of participatory collaboration for different subjects, allowing people from different backgrounds, different professions, and different ethnic groups to collaborate with one another through equal conversation. This participatory collaboration is not merely a division of labor and cooperation but is centered on interactive synthesis of knowledge, skills, and perspectives.

For Thailand's "design workshop" programs, the subject involved typically consists of four groups: representatives of authority departments, primarily accountable for policy leading and coordinating funds; professional researchers and designers, providing design suggestions and technical advice; ethnic minority artisans and culture inheritors, possessing traditional crafts skills and knowledge of culture; and market and community members, providing information regarding consumer demand and community response.

These issues form a natural cooperation team in the "design workshop." Taking a project example in northern Thailand's Chiang Mai Province, the authority department of culture arranged venue and facility assistance and oversaw the involvement of different ethnic groups; Chiang Mai University gave design idea and approach guidance; Akha, Lahu, and Lahu tribe artisans provided inherited skill and ethnical knowledge; and local handicraft vendors and tourism association members provided market demand information. These subjects were not independent of one another but evolved close interactional associations.

The mutual co-participation mechanism of different subjects possesses several key merits: it demolishes the traditional knowledge authority mechanism, with different types of knowledge and capabilities discussing on a common platform; it promotes cross-professional and cross-cultural exchange and learning, widening the vision and capacity of both sides; and it provides a multiple voices' accommodatable negotiation mechanism, reinforcing the recognition sense and belonging feeling of all sides to the result.

4.2.2 Problem-based practical learning process

The second feature of "design workshops" is the application of practical learning processes on real problems to promote mutual learning and synthesis of knowledge and skills through the solution of specific design problems. It is not theoretical abstract instruction but learning through experience in solving practical problems.

At Songkhla Province in southern Thailand, a "design workshop" project gathered local Thai, Malay, and Chinese designers and artisans together to collaborate in solving the basic question of "how to make traditional handicrafts compatible with modern life." The workshop was divided into four stages: first, problem analysis, in which all concerned sat together and brainstormed the market problems facing traditional handicrafts; second, resource inventory, clarifying the traditional skills and material resources of each ethnic group; third, creative divergence, brainstorming and design games to generate various possible solutions; and finally, prototype making, developing the most promising ideas into actual product prototypes.

By this method, students learned specific design procedures and techniques but more importantly learned how to engage in cross-cultural, cross-professional collaborative problem-solving. Problem-based learning has various advantages: an emphasis on realistic problems, aligning learning to be goal-focused and directly translatable; prioritizing "learning by doing," promoting knowledge internalization and achievement of skills based on personal experience; and establishing a risk-free setting for exploration and experimentation, challenging participants to experiment and innovate boldly.

4.2.3 Establishing knowledge sharing and technical interaction platforms

"Design workshops" are not only sporadic innovation activities but also resolute to build long-term knowledge sharing and technical interaction platforms in order to achieve continuous exchange and cooperation between different ethnic groups and between different professions. These platforms both possess physical locations and digital networks, becoming multi-level channels of knowledge flow.

In Thailand's Nong Khai Province in the northeast, the "design workshop" activity left a "Creative Exchange Center" after the event ended. The center is both training and exhibition venue and exchange space. The center regularly holds craft exhibitions, technical training, and design sharing, attracting artisans and designers from ethnic groups. The center has also established material libraries and tool libraries, facilitating the ease of design experiments and technical exchanges among the participants.

Apart from physical locations, "design workshop" projects have also established digitalized knowledge exchange platforms. In Ayutthaya Province in central Thailand, the project team developed a mobile app with craft tutorials, design cases, and market information, enabling artisans and designers from all regions to learn and share information at any time.

These knowledge sharing and technical interaction spaces possess several core values: transcending time and space limitations, making knowledge and technology flow and diffuse more widely; promoting continuous learning and innovation, making the impact of "design workshops" longer than the project period; and creating cross-cultural and cross-professional innovation communities, establishing a basis for long-term multi-ethnic exchange and cooperation.

4.3 Relational Identity: Reconstruction and Integration of Multi-level Identities

The third most significant dimension of "design workshops" in enabling multi-ethnic integration is relational identity, which compels participants to redesign and reconsider relationships with other individuals on the basis of common creative practices to develop more inclusive recognition of identity.

4.3.1 Multi-ethnic participating community cultural practices

In "design workshops," local multi-ethnic cultural practices are a vital foundation for relational identity construction. They are not technical collaborations but also cultural co-productions, strengthening emotional bonds and recognition of identity through shared experience and product.

In northern Thailand's Nan Province, a "design workshop" program brought together local Tai, Yao, and Hmong communities to collaborate in collective innovative design of traditional clothing. The project adopted a "collective creation" approach, forming mixed crews of artists from the three ethnic groups, and each crew must consist of members from a minimum of three ethnic groups. The crew members needed to learn one another's traditional skills and jointly create costume designs that incorporated cultural elements from the three tribes. During the period of two-month production, artists from different ethnic groups not only exchanged techniques but also their narratives and life experiences.

After the completion of the project, members held a "Three-Tribe Costume Exhibition" showcasing the works they jointly created. The works retained both the traditional characteristics of each ethnic group and symbolized innovative integration elements, and therefore served as important roles as carriers of facilitating the three-tribe cultural exchange. More importantly, members established emotional connections and memories by going through this co-creation and exhibition process, beyond ethnic boundaries.

Such multi-ethnic community cultural practice has some outstanding characteristics: emphasizing the importance of "doing together," enabling mutual understanding and recognition through simultaneous practical actions; cultivating shared cultural symbols and memories as bearers of emotional connections between ethnic groups; and emphasizing the potential to construct a common culture but value cultural differences, providing a practical path for multi-ethnic integration.

4.3.2 Construction of cross-cultural dialogue spaces

"Design workshops" generate a setting for cross-cultural conversation through specific spatial arrangement and interactive configurations so that the participants from different ethnic groups can have rich dialogue in a fair, open environment. Such dialogue encompasses not just design and technology but also more general issues such as values, worldview, and recognition of identity.

In southern Thailand's Ranong Province, the "design workshop" project deliberately chose a market commonly utilized by multiple ethnic groups as the activity site. The location did not have any cultural affiliation to any ethnic group, and therefore it was a common ground for even discussion. The project team also created a dialogue environment by planning space and activity: work tables were set in a circular arrangement, disrupting the usual teaching configuration; material and tool spaces were made available to everyone without usage restriction; and various informal exchange periods were introduced in the activity process, offering chances for natural conversation.

The project also arranged a series of cross-cultural conversation activities. For example, "Cultural Story Sharing Sessions" invited various ethnic groups to visit and share their own experiences and cultural practices of handicrafts;

"Value Discussions" encouraged participants to exchange dialogue on such topics as "what is good design" and "what is valuable handicraft," in which values from various cultural backgrounds collided and merged with each other through discussion.

This intercultural conversation space has several significant characteristics: it is a "third space" neither completely owned by any one cultural heritage nor capable of containing multiple cultural expression; it values the equality and reciprocity of conversation, so everyone can get a turn to speak and be heard; and it can contain the co-presence of numerous voices, eschewing reduction to some monolithic consensus but promoting understanding and appreciation of diversity.

4.3.3 Integration and reconstruction of multiple identities

Through "design workshops," the participants experienced transformation and reconstruction in identity recognition, developing more complex and diversified identity recognition. This identity reconstruction is not discarding original identities but building more inclusive multiple identities with the preservation of ethnic cultural recognition.

In northeastern Thailand's Loei Province, the research team conducted in-depth interviews with those artisans who worked on the "design workshop" project for two years and found that their recognition of identity has evolved subtly but profoundly. One Lao artisan spoke about how, before she worked with the project, she only defined herself ethnically as Lao and kept a certain distance from Thai and Khmer individuals; but after extended cooperation with workers of other ethnic groups, she developed new compound identity acknowledgment—she is not only an inheritor of old Lao traditional skills but also a representation of "Northeastern Thailand Handicrafts" regional culture, and an "innovative designer" connecting tradition and modernity.

The project also facilitated the expansion of participants' "we" concept. Based on questionnaire surveys, before the project participants would only quote their respective ethnic groups when they spoke of "we," but after the project, the "we" target expanded to multi-ethnic groups who worked on the project together, and even to the entire regional community. Such expansion of collective identity implies that collaborative creative processes can foster the formation of recognition of identity across ethnic boundaries.

Most striking is that this coming together of several identities is not a negation of the original ethnic identity but an extension and enrichment of identity meanings. Participants tended to maintain consciousness and pride of their own ethnic cultures and evolved multicultural identities that could communicate and understand with one another across cultural boundaries.

4.4 Innovative Mechanism of "Design Workshops" Facilitating Multi-ethnic "Soft Integration"

The three major dimensions of "design workshops" that cause multi-ethnic "soft integration" - cultural cohesion, cooperative design, and relational identity - are not separate but integrated as a system of inter-relationship and support, as shown in figure 2.

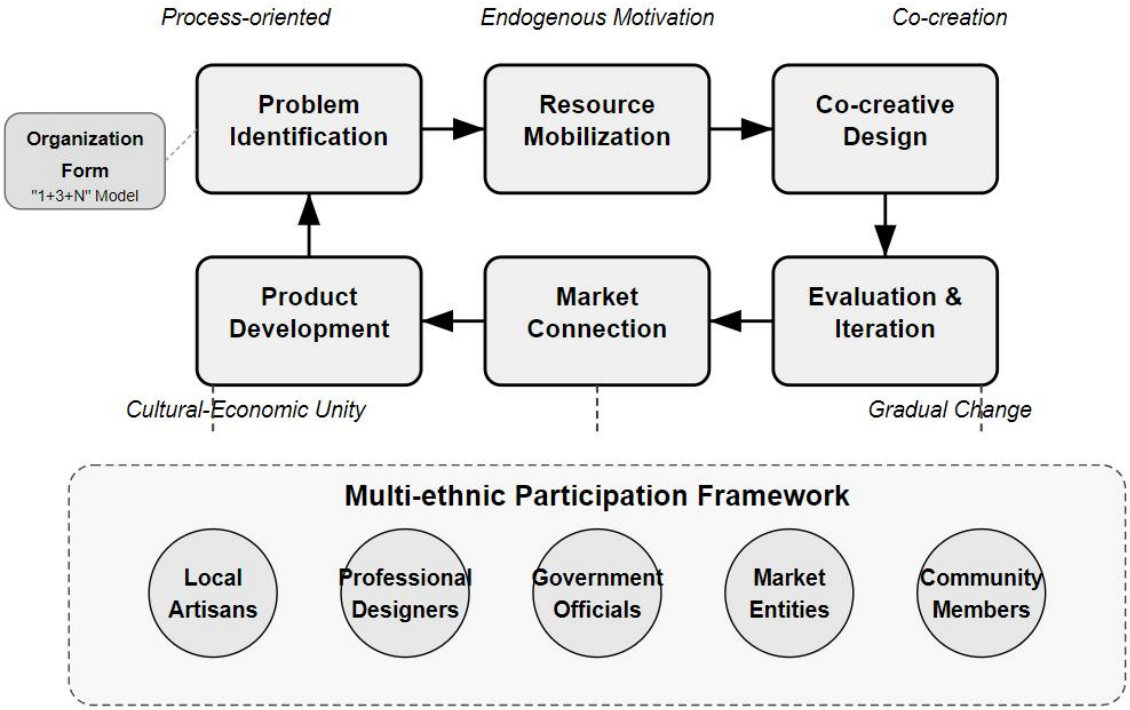

Figure 2 Three-Dimensional Model of "Soft Integration"

4.4.1 Three-dimensional interactive relationship analysis

There are close interactive relationships among the three dimensions of cultural cohesion, cooperative design, and relational identity to constitute an interactive dynamic system.

First of all, cultural integration provides the content foundation for cooperative design. The integration and creation of multi-ethnic cultural resources provide rich cultural elements and creative sources for cooperative design. Without being provided by this integration and creation of cultural resources, cooperative design would lack cultural depth and ethnic characteristics.

Second, collaborative design provides efficient solutions to cultural cohesion. The multi-subject innovation process of interactivity provides certain efficient ways for integrating and innovating cultural resources. Such methodological support makes cultural cohesion not only a theoretical idea but an applied practical procedure.

Thirdly, cultural coherence and collaborative design mutually reinforce the building of relational identity. The integration of multi-ethnic cultural resources emphasizes points of connection and commonalities between different ethnic cultures, grounding a cultural foundation for relational identity; while the interactive innovation process with multi-subject involvement builds social conditions and practical spaces for relationship formation.

Finally, the building of relational identity in return reinforces the fortification of cultural coherence and collaborative design. When the participants develop relational identity transcending ethnic borders, they become more willing to pass on their cultural knowledge and skills and open to accepting influence from other cultures, hence cultural cohesion develops towards higher levels; at the same time, cooperation willingness and trust are enhanced with relational identity, so the cooperative design process runs more smoothly and efficiently.

This three-way interaction generates a virtuous circle: cultural cohesion provides content roots, collaborative design provides working practices, and they both generate relational identity, which in turn reinforces increasing cultural cohesion and collaborative design. This is not a linear process but a spiraling process of development, with each of the three dimensions mutually reinforced and enriched as interaction deepens.

4.4.2 Features and values of the "Soft Integration" mechanism

As a vehicle of multi-ethnic "soft integration," "design workshops" exhibit a certain shared set of characteristic features and virtues that make it a viable avenue for ethnic integration.

First of all, "design workshops" are more process than outcome focused. As opposed to typical policy measures, "design workshops" do not emphasize the achievement of ethnic integration as such but focus on creating conditions under which integration occurs naturally. Being more process-focused thus circumvents administrative opposition, and participants may create relations in a relatively relaxed setting.

Second, "design workshops" promote endogenous rather than external motivation. "Design workshops" promote ethnic exchange and integration by stimulating participants' intrinsic drives such as the desire to create, to learn, and to cooperate. This endogenous motivation guarantees a more natural and enduring integration process.

Third, "design workshops" are more co-creative than instillation. "Design workshops" demolish the age-old one-way knowledge-transmission paradigm, bringing into prominence co-creation and shared participation across multiple subjects. This framework of co-creation is dignifying of the value and subjectivity of all, intensifying feelings of belongingness and participation.

Fourth, "design workshops" emphasize the combination of cultural value and economic value. "Design workshops" organically combine cultural protection and economic development. Traditional cultural resources are transformed into marketable goods through design innovation, achieving a win-win result of cultural inheritance and economic development.

Finally, "design workshops" emphasize gradual change rather than sudden change. "Design workshops" recognize that ethnic integration is a long-term complex process and adopt a gradual, continuous approach. This gradual approach respects the natural laws of cultural change, avoiding the rebound and resistance that radical changes can cause.

5 IMPACT ASSESSMENT OF "DESIGN WORKSHOPS" FACILITATING MULTI-ETHNIC "SOFT INTEGRATION"

5.1 Research Design of Assessment Framework

Objectively assessing the impact of "design workshops" on facilitating multi-ethnic "soft integration," this study constructed a multi-dimensional and multi-level assessment framework grounded in quantitative indicators and qualitative changes to comprehensively grasp the intricate impacts of "design workshop" programs.

5.1.1 Evaluation dimensions and indicator system

On the basis of economic, social, and cultural factors, this study built an assessment indicator system, and every dimension includes hard indicators (indicators that were possible to measure directly), soft indicators (indicators that needed to measure indirectly), and composite indicators that could represent the entire status of the dimension.

Its measurement indicators are: rate of growth in products' sales, rate of growth in participants' income, quantity of products innovated, quantity of cross-ethnic firms, and other hard indicators; product premium rate, rate of sharing the factors of production, stability in cooperation projects, and other soft indicators; and economic interdependence coefficient as a general indicator.

The indicators to be employed in social dimension measurement are: frequency of cross-ethnic contact, rate of mixed community formation, rate of shared participation in public affairs, and other hard indicators; level of social trust, satisfaction in conflict resolution, social cohesion, and other soft indicators; social integration index as a general indicator.

Indicators to measure cultural dimension are: proportion of cross-ethnic cultural participation, number of intangible cultural heritage projects launched, proportion of cross-ethnic collaborative design projects, and other hard indicators; frequency of borrowing cultural symbols, degree of identity extension, degree of cross-cultural understanding, and other soft indicators; and cultural proximity index as composite indicator.

5.1.2 Appraisal methods and data sources

The study employed a multi-method, quantitative analysis and qualitative study, and collected evaluation data from multiple sources:

Quantitative methods are mostly: conducting questionnaire surveys of the members of different ethnic groups taking part in "design workshop" projects; collecting product sales rates, income change rates, and other economic factors before and after the project for comparative purposes; and examining interaction relationship changes between different ethnic groups with social network analysis software.

Qualitative methods largely include: deep interviewing of participants in the project, organizers, and local leaders; direct participation of the research team in "design workshop" activities for participatory observation; and case selection for full-process tracing studies in order to observe concrete impact and experience.

Sources of data are: first-hand data collected by the research team themselves, e.g., questionnaire surveys, interview records, observation records; second-hand data, e.g., project reports, authority statistics, literature of related studies; and material evidence, e.g., design work output by projects, product sales data, and news reports.

5.2 Economic Benefit Assessment

One of the main goals of "design workshop" projects is to bring economic value to conventional handicrafts by design innovation and achieve economic development in multi-ethnic regions. The assessment concluded that the projects achieved high-level outcomes at the economic level.

5.2.1 Direct economic benefit analysis

Direct economic effects merely report the immediate increase in sales and income produced by the project. Research showed that "design workshop" projects performed exceptionally well in this regard:

Sales growth in products: The artisans and individuals in the project recorded an average 127% sales growth. For Tai, Yao, and Hmong artisans in Nan Province, northern Thailand, their sales for products grew between 135% to 215% within a year following the project. Their percentage rate of improvement was even greater than that of a control group of people that was not subjected to the project (32% improvement rate).

Income level upgrading: The project promoted participants' incomes directly. Through questionnaire surveys, artisans who received "design workshop" projects elevated their average monthly income from 5,800 baht before the project to 13,200 baht after the project, and it increased by 127.6%.

Product premium rate improvement: By design innovation, premium rate of genuine handicraft products in the marketplace was improved by a wide margin. In the Songkhla Province project in south Thailand, genuine rattan products, by design innovation, had their price in the marketplace improved from 350 baht per unit average to 780 baht with an increased premium rate of 122.9%.

Innovative product innovation: The 12 villages with "design workshops" produced 328 new products, 78% of which entered commercial production and sale, as indicated by statistics. Not only were new products characterized by traditional craftsmanship elements but also changed according to market demand under the current circumstances, thus remaining competitive in the market.

5.2.2 Analysis of indirect economic benefits

In addition to direct economic impacts, "design workshop" programs also initiated a sequence of indirect economic benefits, such as:

Industry chain extension: The projects encouraged the growth of related industry chains. For instance, hi-tech development of traditional clothing generated the boom in northern Thailand's Chiang Rai Province of tourism, catering, and educational training industries. Statistics indicate that each "design workshop" project could support 3-5 related industries at a medium scale and 15-25 indirect job opportunities.

Brand value creation: The projects promoted the creation of regional brands with local cultural characteristics. In northeast Thailand's Loei Province, the project helped to establish the "Three-Tribe Brocade" brand, which enjoyed a good reputation both at home and abroad, and advocated the development of the handicraft industry in the entire region.

Spillover of knowledge and skill: Technical know-how and design acquired through the project provided spillover effects within communities. Surveys indicated that each artisan engaged directly in training had been able to transfer the acquired skills and knowledge to 3.8 average community members, with a knowledge and skill multiplier effect.

Sharing of factors of production: The project encouraged sharing of factors of production among different ethnic groups. In southern Thailand's Yala Province, three previously dispersed ethnic groups began to share channels of raw material procurement, processing factories, and markets, hence reducing the cost of production and increasing efficiency in the use of resources.

5.2.3 Transformation of economic interdependence relations

"Design workshop" activities generated not just economic development but, more importantly, changed the economic interdependence relations among ethnic groups to promote greater economic integration.

Cross-ethnic business firms arise: The project stimulated the formation of joint business firms among ethnic groups. In northern Thailand's Chiang Mai Province, 78% of 32 new handicraft firms that were newly created after the project were jointly owned and established by members of ethnic groups.
Development of the economic interdependence coefficient: According to economic cooperation and exchange among ethnic groups, the economic interdependence coefficient was calculated. Research identified that in participating communities of "design workshop" projects, the economic interdependence coefficient between various ethnic groups rose from 0.32 pre-project to 0.67 post-project, up by 109.4%.
Improved sustainability of cooperation projects: In addition, the sustainability of cross-ethnic economic cooperation was improved. One-year follow-up questionnaires after the project completion indicated that 82% of the cross-ethnic cooperation projects initiated by "design workshops" were still in operation in continuous development, and 68% of them had succeeded in scale expansion.

5.3 Social Benefit Assessment

Social impact of "design workshop" projects is realized to a greater extent in the encouragement of social communication, development of inter-group solidity, and construction of inter-ethnic relationships. The analysis proceeded to the conclusion that the projects achieved the targeted impact within society.

5.3.1 Change of social interaction network

The foundation for ethnic integration consists of social communication. The investigation proceeded to the conclusion that "design workshop" projects initiated social communication between ethnics effectively:
Increased interaction: With the help of the diary method to monitor the participants' daily interaction, it was found that the frequency of interaction among members of different ethnic groups working on the project grew exponentially. The average number of interactions per week among members of different ethnic groups was 1.2 times before the project and increased to 5.7 times after the project, a growth rate of 375%.
Improved quality of contact: Frequency of contact was not only improved, but the quality of contact was also more enriching. Through in-depth interviews, it was found that the project encouraged more enriching contact, more enriching than commodity contact to technical contact, emotional support, and cultural contact.
Expanded. Interaction range: Social network analysis revealed. that the project improved social network integration among. various ethnic groups. Social networks between various. ethnic groups. were quite. segregated. before the. project; the. degree of network integration. improved after. the project, indicating. that social. circles between. various ethnic. groups overlapped. and were interconnected.

5.3.2 Improved community governance and ethnic relations

Enabled "design workshop" projects launched the following positive impacts on community governance and ethnic relations:
More collective participation: The project enabled collective participation of different ethnic groups in public affairs of communities. Statistics show that through the project, public affairs participation rate in multi-ethnic communities rose from 55% to 78%, and ethnic group participation gap declined from 25 percentage points to 8 percentage points.
Enhanced conflict resolution mechanisms: The project encouraged the establishment of more participatory mechanisms for conflict resolution. Reports indicate that 80% of the participating communities established conflict resolution mechanisms founded on dialogue and negotiations, up from a previous 33% prior to the project.

5.3.3 Overall social integration index assessment

In order to best measure the contribution of "design workshop" projects to social integration, the research team constructed a "social integration index" that completely considered a variety of dimensions such as social interaction, public participation, and relation of trust:
Total assessment: According to the assessment of 12 project locations, after "design workshop" projects the social integration index was found to have risen by an average of 62%, proving the success of the projects in promoting social integration. Among them, the communities where the project duration was longer and the participation scale was larger showed improved social integration index more.
Regional difference: There were differences in regional effects of the projects. In the Thai north mountains, where ethnic relations were more harmonious in the past, the social integration effect of the project was more powerful, and the social integration index was improved by 75%; while in the Malay Muslim south of Thailand, due to the history of conflict and religious divisions, the social integration effect of the project was comparatively weak, and the social integration index was improved by 38%.
Analysis of sustainability: By follow-up questionnaires of projects completed 2-3 years prior, they found that there was sufficient social integration sustainability of impact. The scale of social integration didn't decrease significantly after the project closed down, and there were even some communities that went on to further develop, indicating the fact that social interaction mechanisms and trust relations built up by the project contained some self-reinforcing power.
Comparison with control groups: Compared to control group societies where "design workshop" projects had not been implemented, project societies were socially integrated by 45% more, which implied that the project's effect in facilitating social integration was not a result of natural increase but was the result of direct project intervention.

5.4 Cultural Benefit Assessment

Cultural values are also among the most basic values of "design workshop" projects, and the major expression is to facilitate cultural inheritance and innovation, cross-cultural cognition and recognition, and create a common multicultural identity.

5.4.1 Effectiveness of cultural inheritance and innovation

"Design workshop" projects were very effective in facilitating traditional cultural inheritance and innovation:

Spurring intangible cultural heritage projects: Surveys also indicated that among the communities, the extent of endangered traditional crafts restored significantly. In northern Thailand's Nan Province, by the "design workshop" project, seven endangered traditional crafts (e.g., Yao embroidery, Hmong batik, etc.) were restored, and the number of practitioners rose by 126%, and the percentage of young practitioners (those aged less than 35 years old) rose from 15% to 34%.

Intergenerational transfer of traditional skills: The project promoted intergenerational transfer of traditional skills. Statistics show that in the participating villages, the number of apprentices for traditional crafts on average increased by 86% and 70% were youth from the same ethnic village. In northeast Thailand's Loei Province, the number of inheritors of a traditional brocade skill increased from 3 before the project to 15 after the project, and the age structure was significantly younger.

Innovative design output: The project produced a massive quantity of innovative designs that integrated tradition and modernity. According to the statistics, the 12 project sites produced 482 innovative design works, and 63% of them were realized in commercial production. The works not only preserved traditional cultural elements intact but also adjusted to conform to modern aesthetics and usage needs, realizing modern transformation of traditional culture.

Cross-ethnic cultural fusion innovation: Significantly, cross-ethnic cultural fusion innovation was enabled in the project. In Songkhla Province in southern Thailand, joint production fusion design products occupied 33% of overall design output. The products encompassed both groups' cultural features and embodied innovative aspects of cultural fusion.

5.4.2 Enabling cross-cultural understanding and respect

"Design workshop" activities effectively promoted cross-cultural respect and understanding by promoting the cultural exchange between different ethnic groups:

Increased engagement in cultural activity: Research indicates that after taking part in a project, members of a certain ethnic group were significantly more engaged in other ethnic groups' cultural activities. In northeast Thailand's Udon Thani Province, the rate of engagement in other ethnic groups' cultural activities by the members of a given ethnic group rose from 18% before the project to 57% after the project, or 217% higher.

More borrowing of cultural symbols: Surveys showed that borrowing of cultural symbols between different ethnic groups accelerated by a broad margin. In artisan production related to the project, the degree of borrowing cultural symbols from other ethnic groups increased from 12% to 35%. This was not imitation but creative adaptation due to respect and comprehension.

Reduced bias towards culture: Through a standardized measure of bias towards culture, it was determined that the bias between members from different ethnic groups came down significantly after joining the project. The average score of bias came down from 4.3 (5-point scale with higher the score, higher the bias) to 2.3, which is a reduction of 45%. Through extensive interviews, it was also confirmed that through personal contact and cooperation in the project, participants' stereotypes and prejudices towards other ethnic groups considerably reduced.

Enhanced cross-cultural communication ability: Participants' cross-cultural communication ability was also enhanced as a result of the project. Cross-cultural competency testing showed that participants' ability in language communication ability, cultural awareness ability, conflict coping ability, and other abilities increased as the average ability score increased from 2.8 (on a 5-point scale, with higher numbers indicating higher capacity) to 4.2, a 50% increase.

5.4.3 Change in cultural identity and identity construction

"Design workshop" activity had a long-term impact on the cultural identity and construction of identity of the participants:

Growing ethnic cultural confidence: Surveys showed that due to the project, representatives of all ethnic groups became significantly more confident and proud of their own ethnic culture. Cultural confidence ratings grew from 3.5 to 4.4 points on a 5-point scale, i.e., by 26%. In Chiang Rai Province in northern Thailand, one of the participants an Akha craftsman participated: "Thanks to the project, I understood that other people like our traditional patterns and ways so much, and I also feel more proud of my culture."

Range of identity recognition broadened: Most importantly, the project gave the participants a broadened range of identity recognition. Through the study of identity stories, it was found that participants began building more complex identity recognition but did not shed ethnic identity. Although 93% of participants had one ethnic identity before the project, 67% of participants built multi-level identity recognition after the project, e.g., "both Tai and Northern Thai," or "both Malay artisan and Thai contemporary designer."

Augmented cultural proximity index: On the basis of overall analysis of ethnic groups' frequency of cultural exchange, quality of interaction, and level of recognition, an augmented cultural proximity index was calculated. Findings show that pilot villages' cultural proximity index increased from 0.41 to 0.78 (top 1), an increase of 90%, indicating that gap between ethnic groups decreased substantially and cultural recognition increased.

Formation of collective memory: Cross-ethnic collective memory formation was also made possible by the project. Collective experience and memory among members of various ethnic groups were formed through collaboration in creating something, and the experience acted as affective glue that kept ethnic groups together. An independent "Design Workshop Commemoration Exhibition" was staged by participants in northeast Thailand's Nong Khai Province

centered on the project process and outcome and emerged as a shared cultural marker and collective memory binding heterogeneous ethnic groups.

6 CONCLUSION AND DISCUSSION

6.1 Main Research Findings

Grounded upon systematic study and multi-dimensional analysis of Thailand's design workshop projects, this research has reached the following key conclusions:

Firstly, "design workshops" as a "soft integration" policy effectively promote multi-ethnic integration and interaction in the interface among three dimensions of cultural cohesion, collaborative design, and relational identity. These three dimensions are interconnected and mutually reinforcing, and they form a system of virtuous cycles: cultural cohesion provides content foundation to collaborative design, collaborative design provides workable solutions to cultural cohesion, they both contribute to the construction of relational identity, while relational identity further supports the processes of cultural cohesion and collaborative design.

Second, "design workshop" projects create positive impacts in economic, social, and cultural domains. In the economic dimension, the projects promote innovative production of traditional handicrafts, raise product value and participant income, and change economic interdependence relations between different ethnic groups; in the social dimension, the projects enhance the intensity and frequency of interaction between different ethnic groups, enhance community governance and ethnic relations, and enhance the level of social integration; in the cultural dimension, the projects promote inheritance and innovation of traditional culture, enhance cross-cultural understanding and respect, and promote the construction of multi-level identity recognition.

Third, the "design workshop" model demonstrates a set of distinct mechanism features that render it a successful trajectory for ethnic integration. These features are: being process-oriented and not result-oriented; endogenous motivation and not external coercion; co-creation instead of one-way instillation; unity of cultural value and economic value; and gradual change instead of rapid transformation. These characteristics enable "design workshops" to ensure exchange, understanding, and cooperation between different ethnic groups on the basis of appreciating cultural diversity.

Fourthly, although the "design workshop" model has achieved excellent results, it still has some certain constraints and difficulties. The biggest constraints are: limited coverage, slow large-scale promotion; after-project sustainability problem; elite-centered participation bias, comparatively low marginal group participation rate; poor efficiency in deep-set conflicts involving religious beliefs, claims of land etc.; and over-commercialization risk of culture. These limitations will need to be improved and solved in future practice.

6.2 Theoretical and Practical Significance

The theoretical significance of the present study is primarily evident in the following respects:

First, it presents and elaborates the theory of "soft integration," expanding the theoretical horizon of multi-ethnic integration research. Traditional ethnic integration research focuses on "hard" variables in the realms of politics, economy, and institutions. This book emphasizes the function of "soft" variables such as cultural interaction, creative practice, and identity recognition, and provides a new theoretical framework for understanding peaceful coexistence in multi-ethnic societies.

Secondly, it constructs a three-dimensional theoretical framework of "design-promoted soft integration," and reveals the mechanisms and channels of design intervention in multi-ethnic integration. Not only can this framework be applied to analyze design workshop projects, but also to other creative cultural activities, providing an operational analytical framework for research on multi-ethnic integration.

Third, it enriches cross-disciplinary studies between design studies and ethnology in terms of methodology and content. The study introduces design thinking method into multi-ethnic integration studies and brings ethnological thinking into design studies, extending the research fields of both subjects and enabling cross-disciplinary integration and exchange.

In practical application, the study is helpful as a reference for cultural industry development and social governance innovation in multi-ethnic regions:

First, the "design workshop" model puts forward a practical solution to protecting and innovatively developing traditional handicrafts. Through design intervention, traditional crafts can both inherit cultural characteristics and meet existing market demands, achieving a win-win situation of industrial development and cultural inheritance.

Second, the idea of "soft integration" introduces innovative theories for innovation in ethnic work methods. Compared to traditional administrative approaches or economic incentives, ethnic work methods based on "soft" weapons such as design, art, and education are better able to stimulate the initiative and creativity of ethnic groups and produce natural and long-lasting integration effects.

Finally, the evaluation framework and procedures of this research provide standards for effectiveness measurement of similar projects. The multi-dimensional, multi-method evaluation system prioritizes economic impacts in the short run as well as cultural impacts in the long run in order to comprehensively grasp the complex effects of such projects.

6.3 Limitations of Research

Although this research has achieved some things, it also has some limitations:
Second, most of the research cases are drawn from Thailand. Though there is cross-regional comparison, cultural and institutional specificities as well as universality of research findings need further verification. In particular, differences in administrative systems, social organization, and cultural patterns among nations may shape the effectiveness in implementing the "design workshop" model.
Second, the study duration is brief, and the long-term project influence evaluation has not yet been finished. Multi-ethnic integration is a long-term process, and this observation duration of the study (up to maximum 3 years) might be not long enough to encompass its long-term development patterns.
Third, the research objects are mainly artisans and local inhabitants who participate in the project, with relatively insufficient research on the impact of non-participants. The radiation effect and indirect impact of the project need to be verified by broader social surveys.
Finally, being a "soft" intervention approach, the effectiveness of the "design workshop" model in solving deep-rooted ethnic contradictions and conflicts should also be studied further. In some areas with protracted conflicts and high religious differences, it might be difficult to solve deep-seated problems with mere "soft" approaches.

6.4 Future Research Directions

Based on the results and setbacks of this study, future research can go deeper from the following:
Second, expand the scope of investigation to conduct comparative studies in other countries and regions, to validate the cross-cultural applicability of the "design workshop" mode, and to compare the variations of implementation strategies and impacts under varying cultural and institutional contexts.
Second, extend the research cycle to implement long-term tracking studies, systematically examine the long-term impact and development tendency of "design workshop" projects, emphasizing long-term impacts and self-sustaining mechanisms after the project close.
Third, extend research objects to explore the impact of projects on indirect participants, study the social radiation effects and diffusion mechanisms of the "design workshop" model, and explore how to expand project coverage and impact.
Fourth, deepen theoretical construction into dialogue and integrate the theory of "soft integration" with other ethnic integration theories to construct a more systematic and fine theoretical system of multi-ethnic integration.
Fifth, study the effective interaction between "soft" and "hard" measures, exploring how to organically combine "soft" intervention measures such as "design workshops" with "hard" measures such as administrative, economic, and legal means to form a multi-level comprehensive ethnic integration strategy system.
Finally, explore the new evolution of the "design workshop" model in the information age, researching how information technology, social networks, virtual worlds, and other emerging technology resources are utilized to expand the substance and structure of "design workshops" so their influence and viability can be intensified.
In short, research on "design workshops" for multi-ethnic "soft integration" not only has great academic value but also wide practical value. Future studies should continue to deepen theoretical studies, expand practical applications, and provide more wisdom and solutions for constructing a harmoniously diversified multi-ethnic society.

COMPETING INTERESTS

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INTERACTIVE RESEARCH ON THE DIGITAL DIVIDE AND SOCIAL ALIENATION OF THE ELDERLY IN ZHEJIANG PROVINCE

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Abstract: This study focuses on the digital integration problems of the elderly in Zhejiang Province, aiming to analyze the intrinsic connection between the digital divide and the sense of social alienation, and to explore the effective path to alleviate the sense of social alienation of the elderly. Through a questionnaire survey (270 older adults) and in-depth interviews, we analyzed the digital divide from the dimensions of personal cognition, social support, external environment, and operation and use, and analyzed older adults' difficulties in the use of electronic products, aging needs, and sense of social alienation using principal component analysis and linear regression. The results show that the digital divide is closely related to older people's sense of social alienation, and its influence mainly stems from older people's own factors, technological environment and social support. Accordingly, the study suggests that the keys for older people to cross the digital divide and alleviate their sense of social alienation are technological inclusion, group guidance and active acceptance. This will help older people to better integrate into the digital society and enjoy a happy old age.
Keywords: Digital divide; The elderly in Zhejiang province; Social alienation; Interactive research

1 INTRODUCTION

At present, population ageing in China is accelerating at an unprecedented pace and scale. Zhejiang Province, as a representative region of deep aging, the proportion of elderly people aged 65 and above in the household register continues to rise. At the same time, the rapid development of digital technology, the digital divide problem in the elderly group is more and more prominent: a large number of older people are at a loss for technological leaps, difficult to keep pace with the times, and there is a significant gap between their digital knowledge, access and use and that of young people [1]. This not only hinders the enjoyment of technological convenience by older persons, but also affects their social integration and quality of life, and requires urgent attention and solutions.

To date, there has been some academic research on the digital divide and social alienation in old age:

(1) There are different understandings in the conceptual definition [2,3], such as the digital divide in the elderly refers to the gap between the elderly and young people in the possession and access to information and the use of digital resources [4]. And social alienation refers to the negative emotions such as loneliness and helplessness felt by individuals in the process of integrating into the society due to various reasons, which is outwardly manifested as a change in objective behavior when interacting with the environment [5].

(2) There are also various perspectives on the causes of alienation, for example, empty nesters in cities tend to develop more social alienation [6]; and migrant elders often have difficulty in resolving their negative emotions, so that they are alienated and disconnected from society [7].

(3) Most scholars are positive about the Internet's contribution to positive aging, for example, they believe that older people's connectivity facilitates the maintenance of physical and mental health and promotes positive emotional experiences [8].

In summary, the limitations of existing research include: there is currently an abundance of research on the relationship between negative emotions and the generation of social alienation in the elderly in China, but there is little research on the interaction mechanism between alienation and the digital divide; and there is a lack of specific knowledge among academics about the content and frequency of networking among the elderly in a particular region, which has a greater impact on subsequent research.

Therefore, this paper analyzes the plight of digital access for the elderly in Zhejiang based on a survey on the network participation of the elderly in Zhejiang, and explores the factors influencing the formation and development of the sense of alienation; digs deeper into the mechanism of the digital divide's effect on the sense of alienation of the elderly in Zhejiang, explores the positive and negative relationships, and puts forward countermeasure proposals to promote the network participation of the elderly and alleviate their sense of alienation from the perspective of the micro-geographical region, so as to help build a more inclusive and integrated digital society, to This will help build a more inclusive and integrated digital society and promote the sharing of people's well-being and the common prosperity of spiritual life.

2 STUDY DESIGN

2.1 Main Research Methods

This study mainly adopts the questionnaire survey and in-depth interview method to gain an interpretive understanding of the behavior and meaning construction of the interviewees, and to reduce the self-defense psychology of the interviewees, so as to gain a deeper understanding of the difficulties in the use of electronic products by the elderly and their aging needs, and then put forward countermeasures to reduce the digital divide and alleviate the sense of social alienation.

2.2 Basic Information on the Survey

According to the Statistical Bulletin on the Elderly Population and Aging in Zhejiang Province in 2023 issued by Zhejiang Provincial Office for the Aged, the top 3 cities in the province in terms of the degree of aging are Zhoushan, Shaoxing and Huzhou City, and the city with the lowest degree of aging is Wenzhou City. The questionnaire issued basically covered the above mentioned areas with prominent or lighter aging (city administrative district as the basic unit), including urban and rural zones, and a total of 270 questionnaires were recovered. Interviews were conducted with 30 elderly people, and the interview questions focused on the difficulties in the use of electronic products by the elderly, the scope of application, the needs of aging and the degree of social alienation caused by the digital divide.
The respondents included 131 men (59 to 90 years old) and 139 women (55 to 94 years old). Literacy (highest level of education) was distinguished as follows: 5 illiterates, 91 elementary school students, 47 junior high school students, 40 secondary school students, 28 college students, 22 university students, 3 master's degree holders, and 1 doctoral degree holder.
The textual data from the questionnaire is converted numerically below in Table 1.

Table 1 Variable Definition and Symbol Description

Controls	Nnotation	Clarification
Social alienation of older persons	Isolation	5 = "Much more detached", 4 = "More detached", 3 = "Fairly detached", 2 = "Not too detached", 1 = "Not at all"
distinguishing between the sexes	Gender	1=Male, 0=Female
(a person's) age	Age	\
educational level	Education	1 = illiterate; 2 = elementary school; 3 = middle school; 4 = high school; 5 = vocational high school; 6 = Associate Degree; 7 = Bachelor's Degree; 8 = master's degree; 9 = Doctoral Degree
income level	Income	1=None, 2=less than or equal to 2000, 3=2000-5000, 4=5000-8000, 5=more than 8000

2.3 Description of Research Variables

2.3.1 Explained variable: social alienation of the elderly (Isolation)

Questionnaire item "Do you feel socially disconnected in your life now?" was used to measure the degree of social detachment felt by older people. There are five options, namely, "much more detached", "more detached", "fairly detached", "not too detached", and "not at all". The options were assigned a value of 5 to 1 in that order, with larger values indicating a greater sense of detachment.

2.3.2 Core explanatory variable: digital divide (Divide)

This research explains the variable of digital divide in four dimensions:
(1) Personal cognition dimension: The three data items in the questionnaire, "Do you feel overwhelmed when using digital products," "Do you want to ask for help when you encounter difficulties when using digital products," and "Can you alleviate the difficulty in time if it arises? "The three data items explain the personal perception.
(2) Social support dimension: The two data items in the questionnaire, "availability of digital devices" and "availability of network coverage at the place of residence", explain social support.
(3) External environment dimension: the questionnaire's three data items, "Whether children teach the elderly to use digital tools," "Whether there is relevant digital skills training in the community," and "How to ask for help when encountering difficulties when using digital products," explain the external environment dimension. "The three data items explain the external environment.
(4) Operational Usage Dimension: the questionnaire explains the operational usage of five data items: "one-week social network usage", "one-week video software usage", "one-week electronic payment usage", "one-week online shopping frequency", "one-week online registration and medication frequency", and "one-week online registration and medication frequency". "one week of online shopping frequency" "one week of online registration and medication frequency" in the questionnaire, these five data explain the operation usage.
These 4 dimensions are rationalized below:
The survey data were subjected to principal component analysis dimensionality reduction. Obtaining the following Table 2.

Table 2 Reasonableness Test of Principal Component Analysis

Reasonableness Test	Value
KMO sampling applicability	0.778
Bartlett spherical test significance	0.000

As can be seen from Table 2, the applicability of KMO sampling is 0.778, indicating that the data is very suitable for principal component analysis; the significance of Bartlett spherical test is much less than 0.05, indicating that there is correlation between the variables, which makes it suitable for principal component analysis; meanwhile, the principal component analysis shows that it is more appropriate to retain four principal components, which also confirms the previous analysis of the four dimensions of the digital divide.

Subsequently, the four principal components were calculated to obtain the quantitative results of the digital divide. Since the geographical environment and socio-economic characteristics of different regions are very different, and their digitalization levels are very different, the above results were reprocessed to obtain a standardized digital divide index at the individual level, with a larger value indicating a smaller digital divide at the individual level.

2.4 Analysis of survey data

In order to study in detail the mechanism of related indicators on digital divide and social isolation, the linear regression modeling was carried out according to the relationship between digital divide and indicators by adopting the stepwise regression step method, and the results show that with the continuous addition of independent variables, the R2 of the model is increasing, the standard deviation is decreasing, and the model's explanatory ability is increasing. The linear regression model between the digital divide and the indicators was finally obtained as:

$$Divide = \beta_0 + BX + \varepsilon \tag{1}$$

where the constant terms $\beta_0 = -2.287$, ε represents the error and the meaning of X with its coefficients are shown in Table 3:

Table 3 Independent Variables and Their Coefficients

X	hidden meaning	Unstandardized coefficient B	Standardized coefficient β
x_1	Whether the child would teach the elder to use digital tools	0.407	0.203
x_2	How to get help when you have trouble using digital products	0.485	0.243
x_3	Weekly social network usage	0.183	0.259
x_4	Weekly video software usage rate	0.378	0.189
x_5	Weekly frequency of electronic payments	0.175	0.249
x_6	Weekly frequency of online shopping	0.106	0.140
x_7	Weekly frequency of online medication pickup	0.355	0.175
x_8	Can the bad mood be relieved in time if it arises	0.164	0.132
x_9	Whether you feel overwhelmed when using digital products	0.282	0.141
x_{10}	Whether you want to ask for help when having trouble using digital products	0.229	0.115
x_{11}	Availability of digital equipment	0.066	0.092
x_{12}	Availability of network coverage where you live	0.056	0.085
x_{13}	Availability of relevant digital skills training in your community	0.015	0.008

In order to study the mechanism and causes of social alienation, we choose five independent variables, including "digital divide", "gender", "age", "education level", "income level", etc. to analyze the mechanism, and use Python to draw Spearman correlation coefficients as shown in Figure 1 below. ", "income level" and other five independent variables to analyze the mechanism, using Python to draw Spearman correlation coefficients, as shown in Figure 1 below:

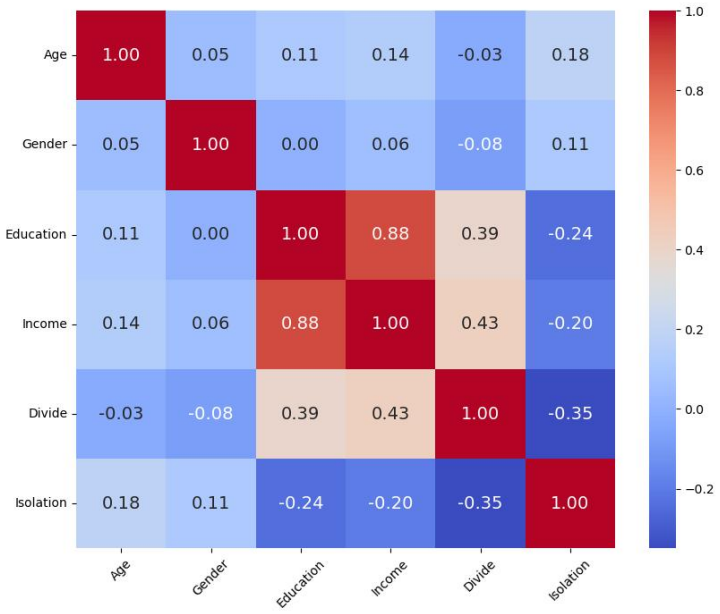

Figure 1 Heat Map of Spearman Correlation Analysis

The above figure illustrates that the negative correlation between the sense of social alienation and the digital divide index is large, while the correlation with other variables is weak. Thus, the least squares method is used to establish a one-way linear regression model between the sense of social alienation and the digital divide:

$$Isolation = \beta_0 + \beta_1 Divide_i + \varepsilon \tag{2}$$

The solution is $\beta_0 = 1.173 \times 10^{-16}$, $\beta_1 = -0.381$, and the goodness of fit of the model $R^2 = 0.449$, indicating that the model is able to explain the variables.

3 DISCUSSION

3.1 Analysis of Factors Contributing to the Sense of Alienation

Combining the data and interview information, the analysis concludes that the problem of the digital divide among the elderly can be divided into: (1) Technology access barriers: many elderly people do not have cell phones or are unable to access the Internet, limiting their digital access. (2) Lack of operating skills: There is a lack of systematic learning and training of digital skills for the elderly, especially in rural areas. (3) Inadequate design of smart devices: many product interfaces give less consideration to the special needs of the elderly, such as declining audiovisual ability, leading to difficulties in their use. (4) Psychological barriers: the unfamiliarity with technology and privacy and security issues have caused fear and rejection among the elderly, resulting in a decrease in their willingness and initiative to learn and accept new technologies, and difficulties in digital access.

The four core factors of the digital divide that influence the formation and development of alienation in older adults include:

(1) Older people's own factors: self-perceived limitations and psychological resistance

The decline of physiological functions of the elderly, such as the weakening of perceptions, the decline of memory and comprehension, and the gradual deterioration of the mental level, leads to the cognitive limitations of digital products, generates the fear and rejection of new technologies, and is prone to self-suspicion when operating, which triggers a sense of social alienation.

(2) External factors of the technological environment: technology adaptation and regional development differences

Inadequate design of age-friendly interfaces, such as small fonts, many advertisements and unclear functions of icons, hinders the use experience and digital literacy of older persons. Differences in regional development have led to uneven digital infrastructure, with developed regions having more digital opportunities for the elderly, while lagging regions face difficulties in accessing the Internet, exacerbating the digital divide and sense of alienation.

(3) Social support system: community care and family support

Community technology hotlines and digital-themed activities are insufficient, and there is a lack of "one-to-one" assistance and "digital buddy" mechanisms; family support mechanisms are immature, and the elderly lack emotional support and need more patient accompaniment from their families in order to help them cross the digital divide and improve their well-being. A sound social support system is the key to promoting digital access for the elderly and reducing the sense of social alienation.

3.2 Recommendations for countermeasures

3.2.1 Technological inclusion: a foundational force in bridging the digital divide

Technological inclusion is the willingness and ability of digitally disadvantaged groups to actively participate in digital application scenarios and achieve better digital inclusion [9].

To this end, software and apps should develop age-friendly interfaces with large fonts, high contrast, simple layouts and clear icons, reduce complex steps and multi-layered menus to simplify the operation process, provide voice interaction functions to reduce the obstacles and discomfort of older persons, and alleviate their sense of alienation in the digital society. Enhance the ease of use of devices, for example, by designing cell phones and computers with larger buttons and better grip.

Network coverage and stability should be strengthened to ensure the smooth use of digital services by older persons. Great importance should be attached to data security, and technical protection should be strengthened to safeguard the personal information and property of older persons when they use digital technology.

3.2.2 Group guidance: effective strategies for crossing the digital divide

Community-led digital learning groups for the elderly are formed to encourage the exchange of experience among the elderly. Invite young volunteers to conduct regular lectures and training on popularization of digital technology, teaching in an easy-to-understand manner. Organize competitions on the application of digital technology for the elderly, setting up simple and interesting tasks such as the production of electronic photo albums and giving them rewards, so as to stimulate the elderly's sense of competition, sense of achievement and participation in the digital society. Online, setting up technical assistance hotlines and specialized digital learning platforms for the elderly, providing a wealth of teaching videos and graphic tutorials. An online question-and-answer area has been set up to help older persons solve technical problems in a timely manner, utilizing remote assistance technology.

Encourage children to patiently teach their elders digital technology at home, and schools have launched the "Little Hands Holding Big Hands" campaign, which allows students to teach their elders about digital knowledge, enhancing intergenerational interaction and emotional exchange. Cases of older persons successfully crossing the digital divide have been publicized through the media to set an example and inspire older persons to learn digital technology.

3.2.3 Active acceptance: a necessary condition for crossing the digital divide

Older persons themselves should enhance their sense of acceptance of fresh technology. They should bravely take the first step to learn new concepts and master new technologies, and overcome their fear and rejection of new technologies. They should actively seek advice from their friends and seniors, and gradually familiarize themselves with the operation procedures of new technologies, so as to reduce the sense of social alienation brought about by unfamiliarity with the technologies.

Only when the elderly proactively embrace new technologies can they truly integrate into this fast-changing era and lead a more colorful, convenient and comfortable life in their twilight years.

4 CONCLUSION

Through questionnaire survey (270 older adults) and in-depth interviews (30 older adults), combined with principal component analysis and linear regression, this study explored the intrinsic links between the digital divide and social alienation among older adults in Zhejiang Province, as well as its influencing factors. The results show that older adults' self-perceived limitations, unfriendly external environment and insufficient social support are the core factors of the digital divide affecting the sense of social alienation.

The main research work includes: 1) conducting questionnaire surveys and in-depth interviews with older adults in different aging areas of Zhejiang Province; 2) analyzing the digital divide in four dimensions, namely, personal cognition, social support, external environment, and operational use; 3) applying statistical methods to reveal the relationship between the digital divide and the sense of social alienation and the mechanism of the digital divide; and 4) proposing targeted countermeasure suggestions, which will provide theoretical and practical guidance for solving the problem of the digital divide in older adults.

The feasibility and application value of the countermeasure suggestions proposed in this study are outstanding, and they are expected to create an age-friendly digital environment, reduce the sense of social alienation, and promote active aging. The threshold of digital access for the elderly is lowered through technological inclusion; the group guidance strategy enhances the motivation and confidence of the elderly to learn with the help of community and family support; and the concept of active acceptance guides the elderly to actively learn new technologies and improve their digital literacy.

Future research can expand the following directions: 1) expand the scope of the study to include older adults from more regions and explore regional and cultural differences; 2) combine the development of emerging technologies (e.g., AI, IoT) and explore their potential application in digital inclusion of older adults; 3) strengthen interdisciplinary research (psychology, sociology, information science, etc.) to analyze the complex interaction mechanism between the digital divide and the sense of social alienation, and to facilitate the construction of a more inclusive digital society.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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DECISION OPTIMIZATION IN THE PRODUCTION PROCESS BASED ON DYNAMIC PROGRAMMING

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Abstract: This study proposes an optimization method for production decisions in the manufacturing process of popular electronic products, focusing on issues such as component procurement, product assembly, and quality inspection. In the production process, companies need to purchase key components, and any defective part may lead to a substandard final product. For defective products, the company may choose to either scrap or disassemble them for recycling. This paper employs a binomial distribution model to design a sampling inspection scheme, establishes a mathematical model, and determines the sample size at different confidence levels to accurately assess whether the defect rate exceeds the threshold. Additionally, this paper integrates various factors to construct a production cost minimization model, identifying the optimal production strategy in most scenarios. This strategy includes comprehensive inspections of both components and finished products, as well as disassembly and recycling plans for defective products. The results show that optimizing production decisions can significantly improve production efficiency, reduce costs, and enhance the company's market competitiveness.
Keywords: Binomial distribution model; Production cost minimization; Multi-stage decision optimization; Production process efficiency

1 INTRODUCTION

With the increasing popularity of electronic products and the growing market demand, efficiently and economically producing high-quality products has become a major challenge for companies. In recent years, many scholars have conducted relevant research in this field, proposing various optimization methods and models. ShaoBo studied a product sampling model based on cost and quality control, proposing a strategy to reduce product quality inspection costs through controlled sampling inspection [1]; ZhangBianya calculated the average number of products in a queue and the average waiting time, analyzed the key factors influencing production efficiency, and proposed an optimization scheme to shorten processing time by adjusting the number of workshop processors [2]; ZhangMengyan proposed a fuzzy multi-objective nonlinear optimization algorithm based on opportunity constraints, using membership functions and Taylor expansion methods for optimization [3] .

Although the aforementioned studies have made significant progress in optimizing the product production process, most of the research focuses on optimizing single production stages and rarely addresses the systemic and dynamic nature of the entire production process. Moreover, existing studies often fail to adequately consider the impact of market changes and personalized demands on production decisions, factors that play a critical role in actual production.

To address the gaps in current research, this paper proposes a more comprehensive and dynamic production process optimization method based on existing studies. This method not only covers all production stages from raw material procurement to finished product assembly, but also introduces a dynamic programming model, allowing production decisions to be adjusted in real time according to market demand and production conditions. Furthermore, by incorporating big data analysis technology, this paper proposes a decision support system to enhance the scientific accuracy of production decisions, thereby enabling enterprises to formulate more rational production strategies, reduce production costs, improve production efficiency, and enhance market competitiveness.

2 MODEL ESTABLISHMENT AND SOLUTION OF THE SAMPLING INSPECTION SCHEME

2.1 Establishment of the Binomial Distribution Model

In this study, we aim to determine whether a batch of components should be accepted or rejected based on a small number of inspections. Among several models, including the Poisson distribution model, Bayesian probability model, conditional probability model, and binomial distribution model [4], the binomial distribution model is chosen for analysis. Its advantage lies in its ability to accurately describe the probability distribution of the number of successes in a fixed number of independent Bernoulli trials [5].

2.1.1 Hypothesis verification

Using the binomial distribution for modeling, the status of each component in the sample inspection can be seen as a result of a binomial distribution. Let the probability of rejection be denoted as p_0 , then p_0 >10% for rejection, and p_0 <10% for acceptance. The probability mass function for a binomial distribution is given by:

$$p(x=k)=\binom{n}{k}p^k(1-p)^{n-k} \tag{1}$$

Where X is the number of defective products in the sample,n is the sample size,p is the defect rate, and k is the number of defective products observed.

2.1.2 Approximation of the binomial distribution to the normal distribution

The normal distribution model is considered an advanced conceptual model that clearly and intuitively displays dynamic changes in data [6]. Due to the complexity of the binomial distribution, when the sample size is large, it can be approximated by the normal distribution:

$$x \sim n(np, np(1-np)) \tag{2}$$

Based on statistical tests, the test statistic for the binomial distribution can be simplified as [7]:

$$z=\frac{p_0-p}{\sqrt{\frac{p_0(1-p_0)}{n}}} \tag{3}$$

2.2 Solution of the Model

At a 95% confidence level, the rejection region corresponds to a Z value of 1.645. Therefore, the condition for rejecting the batch of components is Z>1.645. At a 90% confidence level, the acceptance region corresponds to a Z value of 1.282. Thus, the condition for accepting the batch is Z<1.282. The sample size can be determined by:

$$n=\frac{(p_0-p)^2}{z^2 p(1-p_0)} \tag{4}$$

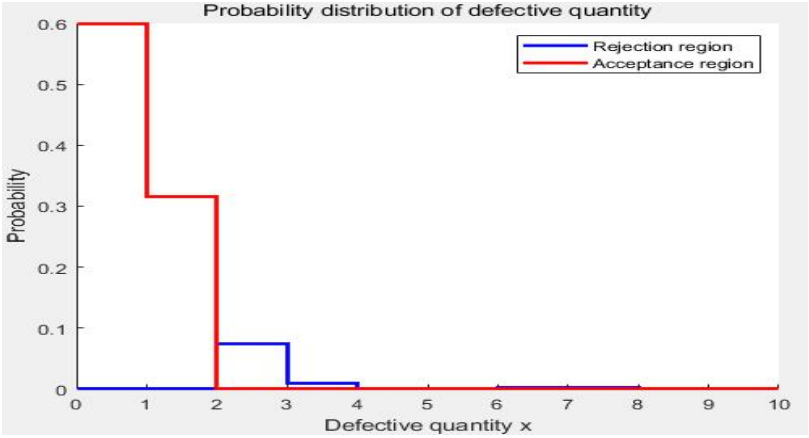

Figure 1 Probability Distribution of the Number of Defective Products

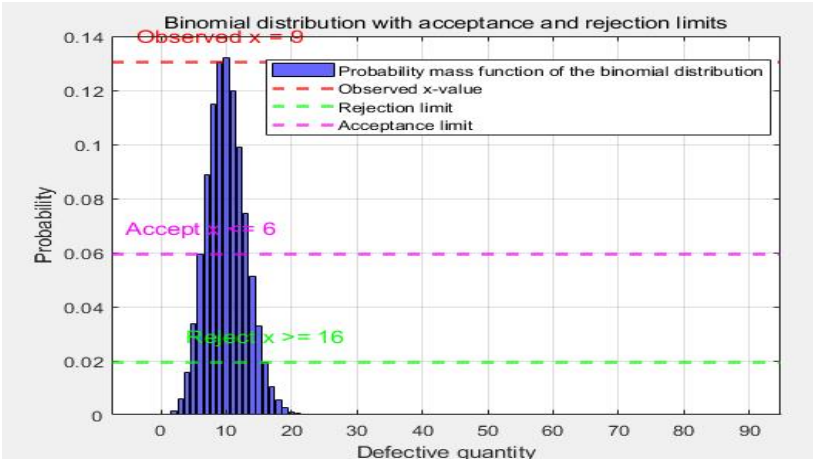

Figure 2 Binomial Distribution with Acceptance and Rejection Limits

From Figures 1 and 2, it can be observed that at a 95% confidence level, in order to protect product quality and the company's reputation from the potential damage of a high defect rate, the sample size is set to 98. In this case, if the number of defective items exceeds the preset critical value, the batch of components will be rejected. This decision standard aims to effectively prevent potential quality risks.

At a 90% confidence level, in order to balance quality control with cost control, the sample size is set to 60. Under this

standard, if the number of defective items does not exceed (i.e., is less than or equal to) the critical value, the batch of components will be accepted as meeting the quality standard.

3 MODEL ESTABLISHMENT AND SOLUTION OF PRODUCTION PROCESS DECISIONS

This study focuses on the following four decision areas that the company needs to make in the production process:
Component Inspection Decision: Whether to inspect the components to prevent defective parts from entering the assembly stage.
Finished Product Inspection Decision: Whether to inspect the assembled finished products to ensure their quality before they enter the market.
Disassembly of Defective Products: Whether to disassemble defective products for recycling or to scrap them.
Customer Exchange Decision: Whether to provide unconditional exchanges for defective products purchased by customers and bear the associated costs.

3.1 Establishment of the Decision Model

3.1.1 Decision variables

d_1、d_2：: Binary decision variables indicating whether to inspect component 1 and component 2 respectively (d_i=1 indicates inspection, d_i=0 indicates no inspection).
d_f: Binary decision variable indicating whether to inspect the assembled finished product d_f=1 indicates inspection, d_f=0 indicates no inspection).
d_r: Binary decision variable indicating whether to disassemble a defective finished product (d_r=1 indicates disassembly, d_r=0 indicates no disassembly).

3.1.2 Decision logic and cost calculation

(1) Component Inspection Decision

In manufacturing, the decision to inspect components before assembly is crucial. If the components are inspected, although some inspection costs are incurred, the risk of defective components leading to scrapped final products is effectively avoided. On the other hand, if the inspection is skipped, the risk of having quality issues in the assembled product remains. Furthermore, the decision of whether to inspect the assembled finished products before they are released to the market is equally important. If finished products are not inspected, defective products entering the market can result in compensation costs far exceeding the inspection cost. By conducting a final product inspection, the quality of products entering the market can be assured.
For defective products identified during inspections, a further decision must be made regarding whether to disassemble them. If disassembly is chosen, additional disassembly costs are incurred, but it helps in resource recovery and reuse. If disassembly is not chosen, the products will be scrapped, resulting in resource waste [8].

(2) Cost Calculation

The procurement quantity for Component 1 is calculated as:

$$\frac{n}{(1-r_1(1-d_1))} \tag{5}$$

The procurement cost for Component 1 is:

$$\frac{n}{(1-r_1(1-d_1))}c_{p1} \tag{6}$$

The inspection cost for Component 1 is:

$$d_1\frac{n}{(1-r_1)}c_{t1} \tag{7}$$

Similarly, the procurement and inspection costs for Component 2 are calculated as:

$$\frac{n}{(1-r_2(1-d_2))} \tag{8}$$

$$\frac{n}{(1-r_2(1-d_2))}c_{p2} \tag{9}$$

$$d_2\frac{n}{(1-r_2)}c_{t2} \tag{10}$$

The assembly cost for the finished product is:

$$nc_a \tag{11}$$

The inspection cost for the finished product is:

$$d_f nc_{tf} \tag{12}$$

If no inspection is performed, defective products enter the market, causing replacement losses:

$$(1-d_f)nr_f c_e \tag{13}$$

The disassembly cost for defective products is:

$$d_r n(1-p_{\text{Qualified}})c_r \tag{14}$$

$$p_{\text{Qualified}} = (1-r_1(1-d_1))(1-r_2(1-d_2))(1-r_f(1-d_f)) \tag{15}$$

Where n is the total sample size, is the defect rate of component 1, is the defect rate of component 2, is the purchase unit price of component 1, and is the purchase unit price of component 2.

3.2 Solution of the Model

Through the developed model, we can solve for the optimal production process decision by evaluating different decision combinations and their associated costs, as shown in Figure 3. These combinations cover a variety of possible strategies for inspecting and disassembling products. The cost analysis provides a deeper understanding of which strategies are most effective in reducing total costs while ensuring product quality [9].

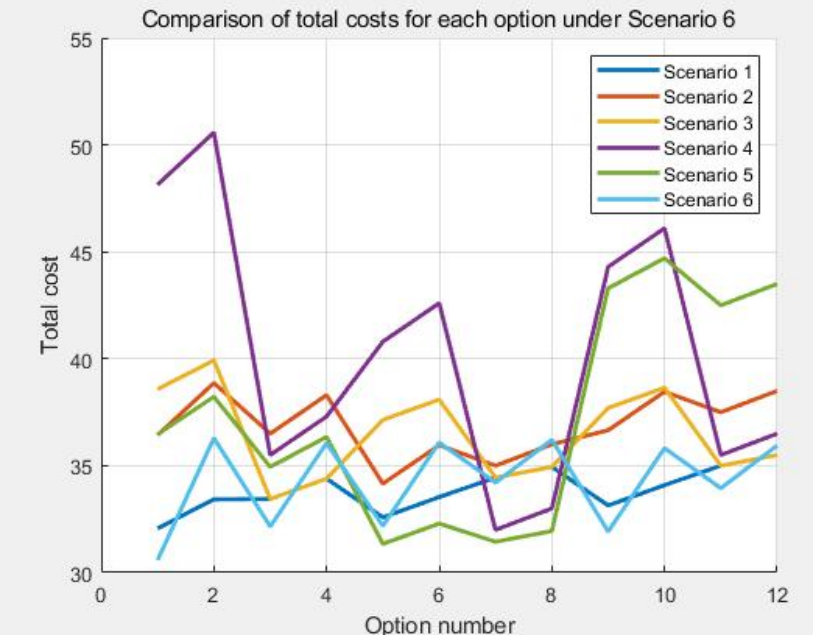

Figure 3 Comparison of Total Costs for Each Scenario under 6 Situations

3.3 Analysis of Production Process Decision Results

Through the above scenario cost charts, six situations can be obtained as shown in Table 1, and the optimal total cost is shown in Figure 4. (Use 1 to indicate detection, and 0 to indicate no detection).The comparison of the decision alternatives under different scenarios helps the company make informed decisions regarding cost optimization and resource allocation.

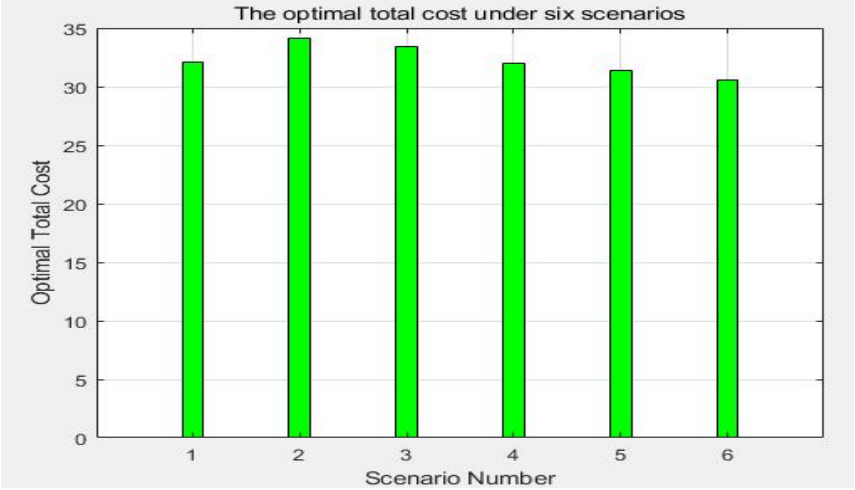

Figure 4 Optimal Total Cost under Six Scenarios

Table 1 Inspection Table for Each Scenario

Scenario	Optimal solution	Component 1	Component 2	Finished product	Disassembly of non-conforming finished products
1	1	0	0	0	0
2	5	0	1	0	0
3	3	0	0	1	0
4	7	0	1	1	0
5	5	0	1	0	0
6	1	0	0	0	0

4 MODEL ESTABLISHMENT AND SOLUTION FOR MULTI-STAGE DECISION OPTIMIZATION

This section investigates multi-stage decision optimization problems, involving the inspection and processing decisions for each process step. The ultimate goal is to find an optimal set of strategies that minimize the overall cost throughout the production process. The costs to be optimized include: deciding whether to inspect components; deciding whether to inspect the finished products; whether to dismantle or scrap non-conforming products, or conduct replacements after they have entered the market; the potential impact of defective products during assembly on the final product quality; and the additional replacement costs incurred by the company if defective products reach the market. In such problems, we typically aim to reduce the overall production costs by controlling the frequency of inspections and processing strategies, while ensuring quality [10].

4.1 Model Establishment

4.1.1 Cost of component inspection

In this paper, it is assumed that there are n types of components, and in m processes, whether to inspect the components in each process can be chosen. The procurement quantity of parts:

$$m_{\text{Quantity of Part N}} = \frac{y}{(1-r_x(1-d_x))} \tag{16}$$

Procurement cost and inspection cost for (n) types of parts:

$$m_{\text{Procurement Cost of Part N}} = \sum_{x=1} \frac{y}{(1-r_x(1-d_x))} c_{px} \tag{17}$$

$$m_{\text{Inspection Cost of Part N}} = \sum_{x=1} d_x \frac{y}{(1-r_x)} c_{tx} \tag{18}$$

d_x is the inspection decision for component n, r_x is the defect rate of component n , c_{px} is the purchase price per unit of component n, and c_{tx} is the inspection price per unit of component n.

4.1.2 Semi-finished product inspection cost

In this paper, it is assumed that there are y types of semi-finished products, and whether to inspect the y types of semi-finished products. The assembly cost and inspection cost for semi-finished product y composed of n types of parts:

$$m_{\text{Assembly Cost of Semi-finished Products}} = \sum_{y=1} y c_{ay} \tag{19}$$

$$m_{\text{Inspection Cost of Semi-finished Products}} = \sum_{y=1} d_{fy} y c_{ty} \tag{20}$$

c_{ay} is the assembly price per unit of the semi-finished product, c_{ty} is the inspection price per unit of the semi-finished product, and d_{fy} is the inspection decision for semi-finished product (y).

4.1.3 Finished product inspection cost

The finished product inspection determines whether the finished product enters the market. If inspected, it can prevent defective products from entering the market. The assembly cost and inspection cost of the finished product:

$$m_{\text{Assembly Cost of Finished Products}} = \sum_{y=1} y(1-r_{fy}) r_f c_a \tag{21}$$

$$m_{\text{Inspection Cost of Finished Products}} = \sum_{y=1} y(1-r_{fy}) r_f c_{tf} \tag{22}$$

r_{fy} is the defect rate of the semi-finished product, r_f is the defect rate of the finished product, c_a is the assembly price per unit of the finished product, and c_{tf} is the inspection price per unit of the finished product.

4.1.4 Handling of non-conforming products

In the production process, non-conforming products can be detected through inspection and handled, with two handling options: disassembly and recycling, or direct scrapping. Semi-finished product disassembly cost:

$$m_{\text{Disassembly Cost}} = \sum_{y=1} d_{ry} y(1-p_{\text{Qualified}})c_{ry} \tag{23}$$

$$p_{\text{Qualified}} = \prod_{x=1}\prod_{y=1}((1-r_x(1-d_x))(1-r_{fy}(1-d_{fy})) \tag{24}$$

Cost of finished product disassembly:

$$m_{\text{Disassembly Cost}} = \sum_{y=1} d_r y(1-r_{fy})r_f(1-p_{\text{Qualified}})c_r \tag{25}$$

$$p_{\text{Qualified}} = (\prod_{x=1}\prod_{y=1}(1-r_x(1-d_x))(1-r_{fy}(1-d_{fy})))(1-r_f(1-d_f)) \tag{26}$$

Total cost of disassembly:

$$m_{\text{Total Cost}} = \sum_{y=1} d_{ry} y(1-p_{\text{Qualified}})c_{ry} + \sum_{y=1} d_r y(1-r_{fy})r_f(1-p_{\text{Qualified}})c_r \tag{27}$$

4.1.5 Assembly and replacement loss

When certain components are not inspected or defective finished products enter the market, the company may incur market replacement losses. The cost of replacement due to non-inspection entering the market:

$$m_{\text{Finished Product Replacement Cost}} = \sum_{x=1}\sum_{y=1} y(1-r_{fy})r_f c_e \tag{28}$$

c_e is the unit price of replacement loss.

4.1.6 Total cost of assembling into finished products

$$\begin{aligned} m_{\text{Total Cost}} &= \sum_{x=1}\frac{y}{(1-r_x(1-d_x))}c_{px} + \sum_{x=1} d_x\frac{y}{(1-r_x)}c_{tx} + \sum_{y=1} d_{fy} y c_{ty} + \sum_{y=1} y(1-r_{fy})\, r_f\, c_a \\ &+ \sum_{y=1} d_{ry} y(1-p_{\text{Qualified}})c_{ry} + \sum_{y=1} d_r y(1-r_{fy})r_f(1-p_{\text{Qualified}})c_r + \sum_{x=1}\sum_{y=1} y(1-r_{fy})r_f c_e \end{aligned} \tag{29}$$

4.2 Model Solution

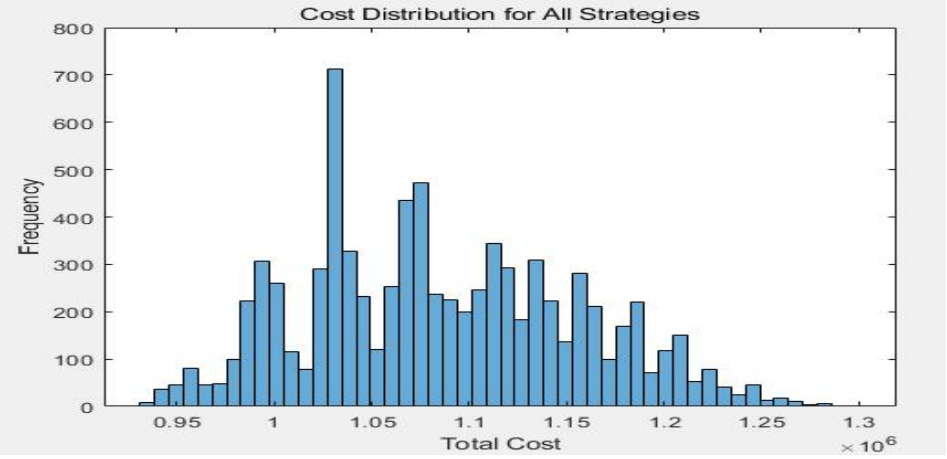

Figure 5 Partial Cost Breakdown Chart

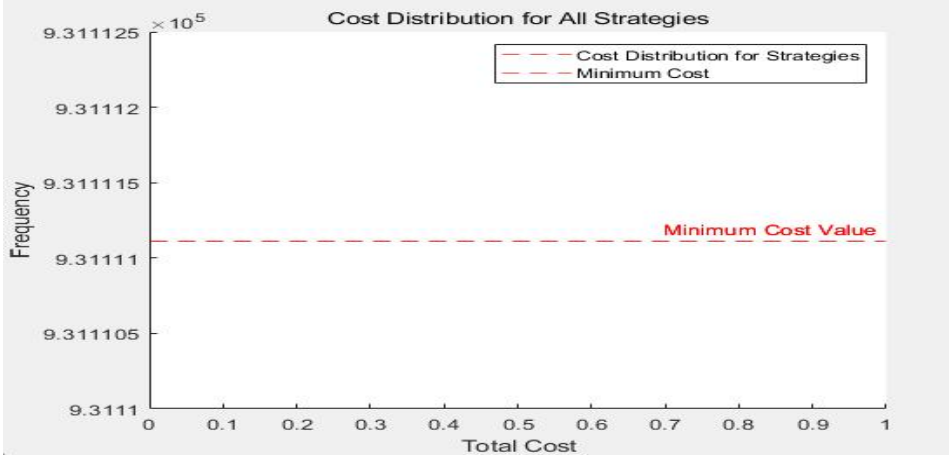

Figure 6 Minimum Cost Value

As can be seen from Figures 5 and 6: By analyzing the costs of different decision combinations, the company can choose a strategy of comprehensive non-inspection and disassembly of non-conforming finished products to effectively control the defect rate and reduce losses. Although this decision incurs inspection costs and disassembly fees, it can minimize the total cost in the long-term production.

5 CONCLUSION

This model has significant application value in manufacturing quality control and cost optimization. Through calculation and graphical analysis, this paper concludes that at a 95% confidence level, to protect product quality, the sample size is set to 98, and strict rejection criteria are established; at a 90% confidence level, to control costs, the sample size is adjusted to 60, achieving a balance between quality and cost. Comprehensive inspection of components and finished products, especially when the defect rate is high or the inspection cost is low, can reduce economic losses. For non-conforming finished products, appropriate measures are taken according to the disassembly cost to promote resource reuse. These strategies reflect the flexibility and specificity of the model, supporting enterprises to improve product quality, effectively manage costs, and enhance competitiveness. The advantage of the model lies in simplifying the production process, quality control, and cost assessment, making it widely applicable.

In the future, this research can be expanded in multiple ways. Firstly, artificial intelligence technologies can be introduced to mine production data through machine learning algorithms, thus accurately predicting the defective rate. For instance, deep - learning models can be used to analyze data such as equipment parameters and raw material characteristics, detect quality risks in advance, optimize the inspection strategy, and achieve intelligent quality control. Secondly, in combination with supply chain management, factors such as supplier stability, delivery time, and fluctuations in raw material prices can be incorporated into the model to construct a more complete production decision - making system, enhancing enterprises' ability to respond to supply - chain risks. Thirdly, explore the differences in the application of the model in different sub - fields of the manufacturing industry. For industries with extremely high requirements for quality and cost control, such as automotive and electronic chip manufacturing, refine the model parameters, improve adaptability and accuracy, provide customized decision - making optimization solutions for enterprises, and promote the high - quality and high - efficiency development of the manufacturing industry.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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THEORETICAL REFLECTION ON THE PRACTICE OF URBAN COMMUNITY CONSTRUCTION

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Abstract: China's rapid urbanization since the 1990s has fundamentally reshaped grassroots social structures, prompting state-led community construction initiatives. Unlike Western concepts of organic social cohesion,Chinese urban communities are externally shaped entities, particularly following the policy reforms post-2000. This paper examines how these forces have redefined community roles amid social integration challenges following the decline of the danwei (work-unit) system. By analyzing conceptual shifts, it provides theoretical insights into governance practices and proposes a balance between state guidance and social autonomy. The study highlights the tension between administrative efficiency and grassroots vitality, offering pathways for sustainable community development in China's urban landscape.
Keywords: Community concept; Urban governance; Social transformation; Post-danwei society; Grassroots democracy

1 INTRODUTION

China's urbanization since the 1990s has been one of the most rapid and transformative processes in modern history, fundamentally reshaping the country's social, economic, and political landscapes. This unprecedented urban expansion has not only altered the physical environment but has also profoundly impacted grassroots social structures, particularly the traditional community systems that once defined Chinese urban life[1]. The decline of the danwei (work-unit) system, which served as the cornerstone of urban social organization for decades, has left a void in social integration and governance, prompting the Chinese state to initiate a series of community construction policies aimed at redefining urban communities[2]. Unlike Western notions of organic social cohesion, Chinese urban communities have emerged as externally shaped entities, heavily influenced by state-led interventions and policy reforms, especially in the post-2000 era[3]. This paper seeks to explore how these forces have redefined the roles of urban communities in China, addressing the challenges of social integration and governance in the context of a post-danwei society. By analyzing the conceptual shifts in community construction, this study provides theoretical insights into governance practices and proposes a framework for balancing state guidance with social autonomy, ultimately offering pathways for sustainable community development in China's urban landscape.

The danwei system, which dominated urban China from the 1950s to the 1990s, was more than just an economic unit; it was a comprehensive social institution that provided housing, healthcare, education, and social welfare to its members[1]. It functioned as a microcosm of the socialist state, ensuring social stability and political control through its tightly knit organizational structure. However, with the economic reforms of the late 20th century, the danwei system began to erode, giving way to market-oriented practices and a more mobile labor force[2]. This shift led to the fragmentation of traditional social networks, creating new challenges for social integration and governance in urban areas[4]. As the danwei system declined, the state recognized the need to rebuild urban communities from the ground up, not only to maintain social order but also to foster a sense of belonging and collective identity among urban residents.

In response to these challenges, the Chinese government launched a series of community construction initiatives aimed at redefining the role of urban communities in the post-danwei era[5]. These initiatives were characterized by a top-down approach, with the state playing a central role in shaping the structure and function of urban communities. Unlike Western concepts of community, which often emphasize organic social cohesion and grassroots participation, Chinese urban communities have been largely constructed as administrative entities, designed to serve as intermediaries between the state and individual citizens[6]. This state-led approach has been particularly evident in the policy reforms introduced after 2000, which sought to strengthen community governance by establishing neighborhood committees, promoting community services, and encouraging citizen participation in local affairs.

However, the state-led construction of urban communities has not been without its challenges. One of the key tensions in this process has been the balance between administrative efficiency and grassroots vitality. On the one hand, the state has sought to maintain tight control over urban communities, ensuring that they function as effective tools for social management and political stability. On the other hand, there is a growing recognition of the need to foster grassroots democracy and social autonomy, allowing communities to develop organically and respond to the diverse needs of their residents. This tension has been a central theme in the evolution of urban community governance in China, reflecting broader debates about the role of the state in shaping social structures and the potential for bottom-up participation in a highly centralized political system.

This paper examines these dynamics by analyzing the conceptual shifts in community construction and governance practices in urban China. It begins by exploring the historical context of the danwei system and its decline, highlighting

the challenges that emerged in the post-danwei era. It then examines the state-led initiatives that have sought to redefine urban communities, focusing on the policy reforms introduced after 2000 and their impact on community governance. Drawing on theoretical insights from urban studies and political science, the paper provides a critical analysis of the tensions between state guidance and social autonomy, offering a framework for understanding the evolving role of urban communities in China. Finally, it proposes pathways for sustainable community development, emphasizing the need to balance administrative efficiency with grassroots vitality and to foster a more participatory approach to urban governance.

The study contributes to the growing body of literature on urban governance and social transformation in China, offering new insights into the challenges and opportunities of community construction in a rapidly urbanizing society. By highlighting the tension between state-led interventions and grassroots participation, it provides a nuanced understanding of the complexities of urban governance in China and offers practical recommendations for policymakers and practitioners. Ultimately, this paper seeks to advance the discourse on sustainable community development, not only in China but also in other contexts where rapid urbanization and social transformation pose similar challenges. Through its analysis of conceptual shifts and governance practices, it aims to provide a theoretical foundation for rethinking the role of communities in urban landscapes, offering a vision of urban governance that is both efficient and inclusive.

2 COMMUNITY CONNOTATIONS IN WESTERN SCHOLARSHIP

2.1 Tönnies' Dichotomy and Early Developments

The study of communities has its roots in the seminal work of Ferdinand Tönnies, whose 1887 distinction between Gemeinschaft (community) and Gesellschaft (society) laid the foundation for modern community studies[7]. Tönnies defined Gemeinschaft as a traditional, emotionally bonded society rooted in kinship, shared values, and mutual obligations, contrasting it with Gesellschaft, which is characterized by rational, contractual relationships typical of modern industrial societies. This framework profoundly influenced early sociological thought, including the work of Chinese scholars such as Fei Xiaotong[8], who adapted Tönnies' ideas to characterize Chinese society as a "ritual society" (li shehui), emphasizing moral obligations over legal contracts.

The Chicago School of Sociology further expanded Tönnies' work by operationalizing the concept of community as a spatial unit. Robert Park, a leading figure in the Chicago School, emphasized the importance of geographical boundaries and social interaction in defining communities[9]. His 1915 work, The City: Suggestions for the Investigation of Human Behavior in the Urban Environment, shifted the focus of community studies from abstract theorizing to empirical analysis of urban dynamics. This approach was exemplified in the Lynds' Middletown, a holistic study of a small American town that documented the impact of industrialization on social norms, power structures, and community life.

2.2 Evolution of Community Definitions

By the mid-20th century, the concept of community had become increasingly complex, with scholars offering diverse definitions[10]. Hillery's review identified over 90 distinct definitions of community, noting that most shared three core elements: social interaction, geography, and shared identity[10]. This tripartite framework provided a useful starting point for understanding communities, but it also highlighted the challenges of defining a concept that is both spatially and socially contingent.

Anthony Giddens' work bridged structural and cultural perspectives, framing community as both a spatial unit and a mechanism for social empowerment. His "third way" theory advocated for active citizenship and hybrid governance models, emphasizing the role of communities in fostering social cohesion and democratic participation. Giddens' ideas have been particularly influential in the context of urbanization, where the fragmentation of traditional social structures has created new challenges for community building.

3 LOCALIZATION OF COMMUNITY IN CHINA

3.1 Early Adaptations and Academic Contributions

The introduction of Western sociological theories to China in the early 20th century led to the localization of the community concept. Early Chinese sociologists such as Wu Wenzao and Fei Xiaotong integrated Western theories with functionalist anthropology, creating a uniquely Chinese approach to community studies. Wu emphasized the importance of spatial boundaries in defining communities, while Fei focused on rural villages as microcosms of broader societal structures. Their work formed the basis of the "Modern Chinese Sociological School," which blended Tönnies' typology with Malinowski's functionalism.

Fei Xiaotong's seminal work[5], From the Soil: The Foundations of Chinese Society, remains a cornerstone of Chinese sociology. Fei argued that Chinese society is fundamentally different from Western societies, emphasizing the importance of moral obligations and interpersonal relationships (guanxi) over legal contracts. This perspective has profoundly influenced Chinese approaches to community building, particularly in the context of urbanization.

3.2 Policy-Driven Transformation

The post-1980s market reforms in China dismantled the danwei system, which had served as the primary mechanism for social integration and welfare provision[2]. This created a vacuum in social governance, necessitating new mechanisms for community building. The 1987 Ministry of Civil Affairs initiative introduced community services to address welfare gaps, marking the beginning of state-led community construction in urban areas.

By 2000, the Opinions on Promoting Community Construction redefined urban communities as administrative units, conflating geography with governance. This policy shift created "governance communities" that prioritized social control over organic cohesion[11]. While this approach addressed immediate challenges, it also led to the institutionalization of communities as extensions of the state apparatus, rather than organic social entities.

3.3 Institutionalization and State Dominance

State policies since 2000 have increasingly tied community development to political objectives, such as building a "harmonious society" (hexie shehui). This has resulted in a top-down approach to community governance, with neighborhood committees serving as the primary mechanism for implementing state policies. However, empirical studies reveal significant challenges, including low resident participation and administrative overload. Chen and Tang found that neighborhood committees often struggle to balance their administrative responsibilities with the need to foster grassroots engagement, leading to a disconnect between state objectives and community needs[5].

4 POST-DANWEI SOCIETY AND COMMUNITY GOVERNANCE

4.1 Challenges of Social Integration

The collapse of the danwei system left significant gaps in social welfare and governance, creating new challenges for social integration. Lin Shangli argues that urban communities have become strategic spaces for addressing these challenges, including migration, inequality, and social fragmentation[1]. However, the over-reliance on administrative models risks replicating the rigidities of the danwei era, stifling grassroots innovation and social vitality.

4.2 Hybrid Governance Models

Scholars have advocated for hybrid governance models that combine state guidance with civil society participation. Tian and Lü propose "post-danwei governance" as a framework for balancing top-down coordination with grassroots autonomy[2]. This approach emphasizes the importance of decentralized decision-making and resource allocation in fostering social capital and community resilience.

Zhao and Lei highlight the role of resource allocation as a critical function of community governance, arguing that decentralized decision-making can enhance the efficiency and responsiveness of community services[3]. Their research underscores the importance of fostering social capital through participatory governance and community-led initiatives.

4.3 Grassroots Innovations

Case studies from cities such as Guangzhou and Shanghai demonstrate the potential for grassroots innovations to enhance community governance. Chen and Tang document successful initiatives in Guangzhou that balance state policies with community-led projects, such as participatory budgeting and social enterprise partnerships. Similarly, Yu and Zhao (2020) highlight the role of social enterprises in fostering resident engagement and service efficiency in Shanghai[3].

5 TRANSCENDING ADMINISTRATIVE MODELS

5.1 Rethinking Governance Structures

Scholarly discourse has highlighted the need to balance administrative frameworks with community dynamics. Leading sociologists emphasize that sustainable community development requires fostering local capacities while maintaining regulatory oversight. Empirical research indicates that overly centralized approaches may inadvertently limit participatory mechanisms. Comparative studies suggest that governance models incorporating bottom-up elements often demonstrate higher levels of civic engagement, though contextual adaptations are critical for applicability in diverse urban settings.

5.2 Pathways for Social Empowerment

International comparisons highlight the importance of trust and civic engagement in fostering sustainable communities. Rothstein argues that the quality of government institutions is a key determinant of social trust and community resilience[12]. In China, adaptive strategies are needed to reconcile administrative efficiency with social vitality. These include:

• Participatory Governance: Expanding platforms for resident decision-making, such as participatory budgeting and community forums.
• Social Capital Development: Fostering voluntary associations and mutual aid networks to enhance community resilience.
• Regulatory Flexibility: Allowing bottom-up initiatives within legal frameworks to encourage grassroots innovation.

5.3 Theoretical Reconstruction

A reconstructed theory of community should integrate Tönnies' Gemeinschaft ideals with China's social context. This requires recognizing the community as both a governance unit and a social entity, where state guidance coexists with civil society autonomy. Such a framework would provide a more nuanced understanding of community dynamics in China's urban landscape.

6 CONCLUSION AND DISSCUSSION

China's urban community construction has emerged as a critical arena for addressing the social and governance challenges brought about by rapid urbanization and the decline of the danwei system. Over the past two decades, state-led initiatives have played a pivotal role in reshaping urban communities, transforming them into administrative entities designed to ensure social stability and political control. While these efforts have successfully addressed immediate challenges related to social integration and governance, they have also revealed inherent tensions between top-down administrative models and the organic development of grassroots social dynamics. This tension underscores the need for a more nuanced approach to urban community construction—one that balances state guidance with the cultivation of resident autonomy and social capital.

The state-led model of community construction has undeniably achieved significant successes[13], particularly in terms of administrative efficiency and the provision of public services. By establishing neighborhood committees, promoting community services, and encouraging citizen participation, the state has created a framework for urban governance that ensures social order and addresses the practical needs of residents. However, this model has also been criticized for its overreliance on top-down control, which risks stifling the organic growth of communities and limiting the potential for grassroots innovation. The emphasis on administrative efficiency often comes at the expense of social vitality[3], as residents are treated more as passive recipients of services rather than active participants in community life. This approach not only undermines the development of social capital but also limits the potential for democratic participation and civic engagement.

To transcend these limitations, policymakers must prioritize strategies that foster resident autonomy and social capital accumulation. This requires a shift away from purely administrative models of governance toward more inclusive and participatory approaches. Empowering residents to take an active role in community decision-making can help build a sense of ownership and belonging, which are essential for the long-term sustainability of urban communities. By creating spaces for dialogue and collaboration, policymakers can encourage the development of social networks and trust, which are the foundations of social capital. These efforts should be complemented by policies that support grassroots organizations and civil society initiatives, providing them with the resources and autonomy they need to thrive.

Moreover, future research should explore hybrid governance models that integrate the strengths of state-led initiatives with the dynamism of grassroots social dynamics. Such models could involve the co-production of public services, where the state and residents work together to design and implement community programs. They could also include mechanisms for participatory budgeting, where residents have a direct say in how resources are allocated within their communities. By fostering collaboration between the state and civil society, these models have the potential to enhance both administrative efficiency and social vitality, creating a more balanced and sustainable approach to urban governance.

The implications of these hybrid models extend beyond the immediate challenges of community construction. They offer a pathway for addressing broader issues related to social stability and democratic participation in China's urban landscape. By fostering a more inclusive and participatory approach to governance, these models can help build a sense of shared responsibility and collective identity among urban residents. This, in turn, can contribute to greater social cohesion and resilience, reducing the risk of social fragmentation and conflict. At the same time, by creating opportunities for civic engagement and democratic participation, these models can help lay the groundwork for a more vibrant and dynamic civil society.

In conclusion, the future of China's urban community construction lies in finding a balance between state guidance and grassroots vitality. While state-led initiatives have played a crucial role in addressing the challenges of rapid urbanization, they must be complemented by efforts to empower residents and foster social capital. By prioritizing resident autonomy and exploring hybrid governance models, policymakers can create urban communities that are not only efficient and stable but also inclusive and dynamic. This approach offers a promising pathway for sustainable community development, one that can serve as a model for other rapidly urbanizing societies facing similar challenges. Ultimately, the success of China's urban community construction will depend on its ability to adapt to the evolving needs of its residents, fostering a sense of belonging and shared purpose in an increasingly complex and diverse urban landscape.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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THE IMPROVEMENT OF GANSU PROVINCE'S BASIC PUBLIC SPORTS SERVICE SYSTEM

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Abstract: With the promotion of the national fitness strategy, the construction of the public sports service system in Gansu Province has made certain progress, but it still faces many challenges. Based on new public management theory and new public service theory, this study conducts an in-depth examination of the current situation of Gansu's public sports service system using methods such as literature review and surveys. The study finds that Gansu Province has made preliminary achievements in policy and regulations, sports organization construction, and physical fitness monitoring, but there are still issues such as insufficient financial investment, uneven resource allocation, lagging development of community sports instructors, and inadequate sports facilities. To address these problems, the following recommendations are made: accelerate the reform of sports organizations, improve sports information service levels, strengthen financial support and legal guarantees, increase financial support for underdeveloped areas, reasonably plan sports facility construction, promote the balanced development of the sports service system, and ensure that all residents of the province enjoy a higher level of public sports services.
Keywords: Gansu province; National fitness; Public sports services; Sports facilities

1 INTRODUCTION

With the rapid development of the global and national economy and the increasing awareness of public health, sports have become an important means of improving national health levels, promoting social harmony, and achieving regional sustainable development. International research indicates that organized sports activities not only significantly improve physical health but also enhance psychological and social health, having a profound impact on the overall well-being of individuals and communities[1]. Misener and Doherty point out that community sports clubs must enhance their organizational capacity in areas such as human resources, finance, infrastructure, planning, and external relations in order to effectively fulfill their public service functions[2]. Furthermore, Doherty, Misener, and Cuskelly propose a multidimensional framework of capacity for community sports clubs, emphasizing how targeted investments can improve service quality and sustainability under limited financial and human resources[3]. Green criticizes the traditional "pyramid" sports development model, arguing that an integrated strategy should be adopted to optimize the recruitment, retention, and transition of athletes and participants, which is of great significance for the construction of grassroots sports service systems[4]. At the same time, the SPLISS framework proposed by De Bosscher et al. divides the policy factors influencing national sports success into nine pillars, highlighting the importance of strategic coordination and resource allocation in public sports services[5].

At the national level, the "14th Five-Year Plan for Sports Development" clearly proposes the construction of a higher-level public fitness service system and the promotion of the equalization of sports resource allocation[6]. The "National Fitness Plan (2021-2025)" issued by the State Council in 2021 further emphasizes the need to "fill the gaps in public fitness services, with a focus on supporting the construction of sports facilities in the central and western regions, ethnic areas, and rural areas"[7]. As people's living standards continue to improve, the role of sports in promoting health, enhancing social cohesion, and cultural inheritance has become increasingly prominent[8,9]. In this context, China is in a period of unprecedented policy support, strong endogenous momentum, and increasing technological support, creating an important strategic opportunity[10].

As a less-developed western province and an area with a large ethnic minority population, Gansu Province faces many challenges in promoting national fitness and implementing the "Healthy China" strategy. According to data from the Gansu Provincial Bureau of Statistics (2025), the per capita sports facility area in Gansu Province was 2.44 square meters in 2024[11], lower than the national average (3 square meters), with significant urban-rural disparities. Although Gansu Province has rich natural resources and cultural advantages, it still faces considerable difficulties in improving the public sports service system.

Based on this, this study will conduct an in-depth analysis of the current state of public sports services in Gansu Province, explore the main problems and development trends, and propose feasible improvement paths. The research will focus on key areas such as sports infrastructure construction, talent development, and event organization, aiming to provide theoretical support and practical guidance for the sustainable and healthy development of sports in Gansu Province.

2 ANALYSIS OF THE GUARANTEE SYSTEM FOR THE CONSTRUCTION OF THE SPORTS PUBLIC SERVICE SYSTEM IN GANSU PROVINCE

2.1 Institutional Guarantee

Gansu Province, in line with the actual economic and social development of the region, has formulated a series of laws and regulations in response to national policies and laws. These include the "Gansu Province Implementation of the Sports Law of the People's Republic of China Measures," "Gansu Province National Fitness Regulations," and the "Gansu Province National Fitness Implementation Plan (2021-2025)," among others. The "14th Five-Year Plan for Public Services in Gansu Province" mentions the need to further improve the sports public service system and vigorously develop mass sports. The "Gansu Province Mass Sports Event Service Guidance and Implementation Measures" provides service guidance for mass sports events, promoting the widespread development of mass sports activities.

The issuance of these sports policies and regulations indicates that multiple policies and regulations are now in place to ensure and promote the construction of the sports public service system in Gansu Province. The formulation of these policies has broken the previous pattern where sports departments made decisions unilaterally, and a new pattern of joint cooperation and participation in the construction of the sports public service system has begun to take shape. These policies and regulations provide strong guarantees for the construction of the sports public service system in Gansu Province.

2.2 Guarantee of Financial Investment

2.2.1 Lottery revenue and public welfare fund collection

The sales of lottery tickets in Gansu Province have been rising year by year, but the province's ranking has consistently remained in the lower part of the national rankings, in line with the province's economic development level.

In 2020, due to the impact of the COVID-19 pandemic, Gansu Province's total lottery sales amounted to 3.159 billion yuan, slightly decreasing compared to the previous year. In 2021, the total sales reached 3.678 billion yuan, setting a record for the highest sales in the history of Gansu's lottery industry. In 2022, the sales reached a historic milestone, reaching 4.051 billion yuan, with steady growth in sales. In 2023, sales reached 4.68 billion yuan, setting a new historical high, indicating that the Gansu Province lottery market is developing well.

Although the sales of lottery tickets in Gansu Province continue to grow, the public welfare fund collected has also increased, but the proportion allocated for the public welfare fund has gradually decreased. It is recommended to appropriately increase the proportion of the lottery public welfare fund allocation. (Table 1).

Table 1 Fundraising Situation of Gansu Province Sports Lottery Public Welfare Fund (Billion Yuan)

Year	Total Sales	Total Public Welfare Fund	Extraction Ratio (%)
2020	31.59	8.64	27.35
2021	36.78	9.45	25.69
2022	40.51	10.21	25.20
2023	46.80	11.55	24.68
2024	45.17	11.24	24.88

Data Source: Gansu Provincial Sports Bureau

2.2.2 Expenditure of lottery public welfare fund

The expenditure of the provincial-level lottery public welfare fund in Gansu Province is mainly focused on two areas: competitive sports and mass sports. Statistical data shows that in recent years, the expenditure of the provincial-level lottery public welfare fund in Gansu has consistently reached 60% of the lottery public welfare fund revenue, in accordance with the regulations for the national fitness plan. The annual expenditure has been above 70%, with the expenditure exceeding 80% in 2021. Therefore, it is necessary to strengthen the scientific allocation of the Gansu lottery public welfare fund, implement corresponding measures, and enhance the management and supervision of the lottery public welfare fund. (Table 2).

Table 2 Expenditure of Provincial-level Sports Lottery Public Welfare Fund on Sports in Gansu Province (Ten Thousand Yuan)

Year	Total Public Welfare Fund Expenditure	Total Expenditure on Competitive Sports	Percentage %	Total Expenditure on Mass Sports	Percentage (%)
2021	18199	3,121	17.15	15,078	82.85
2022	33900	9664	28.51	24236	71.49

2023	27285	5572	20.42	21713	79.58

Data Source: Gansu Provincial Sports Bureau

3 ANALYSIS OF THE PUBLIC SPORTS SERVICE SYSTEM IN GANSU PROVINCE

3.1 Current Status of the Sports Facility Service System

As of the end of 2024, Gansu Province has a total of 100,175 sports venues, covering an area of 59.987 million square meters, with an average of 2.44 square meters of sports venue area per capita. According to Table 3, there are significant differences in the distribution of sports venues across different types of sports. There are 3,719 athletics venues in the province, of which 611 have a 400-meter running track, accounting for 16.43%, while the other types of athletics venues total 3,108, accounting for 83.57%. In terms of swimming venues, the province has 151 in total, with 13 outdoor swimming pools (8.61%) and 138 indoor swimming pools (91.39%). For ball sports venues, the province has 75,904 venues in total, with 37,672 dedicated to the "three major ball games" (soccer, basketball, volleyball), accounting for 49.63% of the total; 37,174 venues for table tennis and badminton, accounting for 48.98%; and 1,058 other types of ball sports venues, accounting for 1.39%. Specifically, there are 2,531 football fields, with futsal courts dominating, accounting for 52.59%; 32,292 basketball courts, of which 95.75% are standard basketball courts, while 3x3 basketball courts and basketball halls account for 2.77% and 1.48%, respectively; 2,849 volleyball courts, the vast majority of which are standard volleyball courts, accounting for 97.79%; 31,907 table tennis venues, with 96.51% being standard table tennis courts; and 5,267 badminton courts, with 92.20% being standard badminton courts.
In addition, winter sports venues are relatively scarce in the province, with a total of 46 venues: 25 ice skating rinks, accounting for 54.35%, and 21 ski resorts, accounting for 45.65%. In terms of public fitness facilities, the province has 17,069 fitness paths, 1,276 gyms, and 1,061 fitness walking trails, totaling 2,959.13 kilometers. From the above data, it can be concluded that the number and distribution of venues for different sports vary. Although certain sports, such as basketball and table tennis, have a relatively abundant supply of venues, there is still significant room for improvement in winter sports and certain fitness facilities.

Table 3 Sports Facility Statistics of Gansu Province

Site type	Total number	Main categories (percentage)
Athletics Track	3719	400-meter track (16.43%); Others (83.57%)
Swimming Pool	151	Outdoor swimming pool (8.61%); indoor swimming pool (91.39%)
Soccer Field	2531	11-a-side (23.75%); 7-a-side (23.66%); 5-a-side (52.59%); beach soccer (0.04 %)
Basketball Court	32292	Conventional basketball court (95.75%); three-person basketball court (2.77%); basketball hall (1.48%)
Volleyball Court	2849	Volleyball court(97.79 %);Volleyball hall(1.90%); Beach volleyball (0.31%)
Table Tennis Court	31907	Table tennis court (96.51%); Table tennis hall (3.49%)
Badminton Court	5267	Badminton court (92.20%); Badminton hall (7.80%)
Ice and Snow Sports Venue	46	Ice skating rink (54.35%); Skiing area (45.65%)
Sports and Fitness Venue	19406	Fitness path (87.96%); gym (6.58%); fitness trail (5.46%)

Data Source: Gansu Provincial Sports Bureau

3.2 Current Situation of the Sports Activity Service System

With the in-depth development of the national fitness campaign, Gansu Province has also established its own sports activity service system, which mainly includes two aspects. One is the ordinary and regular national sports meeting system, such as sports meetings for various groups of people and the provincial national fitness sports meeting. The other is various sports activities organized by sports associations at the county level and below. Currently, the widely carried out mass fitness series activities such as the "National Fitness Day", the New Year's Mountain Climbing Fitness Conference, the Chongyang Mountain Climbing Fitness Conference, and the "National Fitness in Longyuan" are having an increasingly greater influence. The construction level and recognition degree of the "Gansu Silk Road Sports and Fitness Corridor" have been further improved. The sports events with Gansu characteristics, such as outdoor sports, ice and snow sports, aviation sports, and science and technology sports, have become highlights. National fitness activities are developing towards normalization, a lifestyle orientation, and mass participation. At present, the "big mass sports" work pattern of joint management by the government as the leading force, other relevant departments collaborating, and the whole society participating has been initially formed in our province.

3.3 Current Situation of the Sports Guidance Service System

Through interviews with relevant experts from the sports authorities in Gansu Province, it is known that the social sports management work in urban areas of Gansu Province is generally the responsibility of community neighborhood

committees and sub-district offices, while in rural communities, it is the responsibility of township cultural stations. The staffing standard for social sports management workers is 1-2 people. However, there are only 0.08 sports workers on average in each rural community, while there are 1.14 sports workers on average in each urban community, showing a very obvious gap between urban and rural areas. The data in Table 4 shows that by the end of 2023, Gansu Province had cumulatively trained 76,000 public welfare social sports instructors at all levels. Among them, there were 1,250 national-level instructors, 7,855 first-level social sports instructors, 23,156 second-level social sports instructors, and 43,246 third-level social sports instructors. The task of training 70,000 social sports instructors in the province during the "14th Five-Year Plan" period was completed ahead of schedule, and there are 3.28 social sports instructors per thousand people. This has laid a certain human resource foundation for rural sports guidance work. In terms of the cultivation of female social sports instructors in rural areas, Gansu Province actively responds to relevant national plans. In 2023, the General Administration of Sport of China, the Ministry of Agriculture and Rural Affairs, and the All-China Women's Federation jointly launched the "Training Plan for Female Social Sports Instructors in Ten Thousand Villages". Gansu Province plans to carry out special training for female social sports instructors in rural areas from 2023 to 2025 in 15,925 administrative villages in the province, at a provincial training ratio of 0.6% per year. As of April 2024, 8 training courses for female social sports instructors in ten thousand villages have been held, training more than 750 female social sports instructors in rural areas. With the continuous advancement of such training, the number of social sports instructors in rural areas is expected to gradually increase, and the structure will also be continuously optimized.

Table 4 Statistics of Social Sports Instructors in Gansu Province for 2023

	National Level	Level 1	Level 2	Level 3	Total
Number of People	1250	7855	23156	43246	75507
Percentage	1.65%	10.40%	30.67%	57.28%	100%

Data Source: Gansu Provincial Sports Bureau

3.4 Current Status of the Sports Organization Service System

Reconstructing the "roots" of the national fitness organization by focusing on grassroots sports organizations is of great significance for building a higher-level public service system for national fitness and for the in-depth implementation of the national fitness strategy[12]. Surveys show that Gansu Province has increased efforts to build the public sports service system for nationwide fitness, continuously improving the "large group" work structure, gradually addressing the shortcomings in the development of national fitness, and continuously expanding the supply of public sports services, leading to new achievements in the national fitness work. To further improve the nationwide fitness work mechanism, the Gansu Provincial Committee for National Fitness has been actively coordinating and collaborating closely among its member units. The number of member units has increased from 37 to 41, strengthening the organization and coordination of national fitness efforts. At the same time, various sports associations have been actively developed. By the end of 2023, the number of provincial-level sports social organizations had grown to 70, and sports federations had been established in all 14 cities and prefectures. National physical fitness monitoring stations have been fully established, and 10 demonstration sites integrating national fitness and public health have been set up.

3.5 Current Status of National Physical Fitness Monitoring Services

The national physical fitness monitoring in Gansu Province is conducted every five years. According to the statistics from the fourth national physical fitness monitoring, the physical fitness pass rate for children in Gansu is 95.6%, with 9.3% reaching the excellent level, 29.7% at the good level, and 56.6% at the pass level. The percentage of boys reaching the pass level or above is higher than that of girls ($P < 0.05$). Among them, girls have higher rates of excellence and good fitness than boys during the same period. The physical fitness pass rate for adults in Gansu is 93.7%, with 13.6% reaching the excellent level, 30.2% at the good level, and 49.9% at the pass level. The percentage of men reaching the pass level or above is lower than that of women ($P < 0.05$), with women having higher rates of excellence and good fitness compared to men during the same period. The physical fitness pass rate for the elderly is 87.7%.

3.6 Current Status of Public Sports Information Services

Public sports information services refer to the process by which the government, sports organizations, sports social organizations, and relevant enterprises provide sports public service information to the public. These services utilize modern communication and computer technologies to facilitate the rapid dissemination of sports public information to the general public. Gansu Province will continue to improve its sports information platforms, including the official website of the Gansu Provincial Sports Bureau, the Gansu Sports Vision publication, and the WeChat public account of the Gansu Provincial Sports Bureau. The province will also continue its collaboration with Gansu Television Station for the National New Sports program and partner with Lanzhou Morning Post and mobile apps to establish a multimedia platform. Additionally, the provincial government will work with Daily Gansu Net to co-create the Gansu Sports Headlines online media platform, expanding its reach through multiple new media channels and ensuring full coverage

for sports promotion.

In 2024, the Provincial Sports Bureau, leveraging various channels such as the official website, WeChat account, press conferences, newspapers, magazines, TV broadcasts, bulletin boards, and promotional materials, disclosed over 19,520 pieces of news information. Of these, 2,436 articles were published on the official website, totaling more than 3.52 million words and 11,089 images, with a total click count of 343,327. The WeChat public account pushed 285 issues, containing 1,412 news articles. The Gansu Sports Vision publication issued 6 editions, with 9,000 copies, about 710,000 words, and nearly 1,600 images.

Not only has the Bureau actively promoted and explained policies such as the Gansu Provincial Sports Event Management Implementation Measures, but it has also significantly publicized event information to enhance the publicity and quality of event reporting. The Bureau has organized large-scale events such as the Lanzhou Marathon, Gannan Tibetan Legend, and various projects related to the first National Nationwide Fitness Competition's Northwest Regional. The satisfaction level for service quality has been outstanding, with the National Public Service Quality Monitoring on May 21, 2024, showing that the public sports service quality satisfaction score in Gansu reached 81.19 points, placing it in the "satisfied" range and ranking third among all public service fields in the province, surpassing the national average satisfaction score by 0.42 points.

4 MEASURES TO IMPROVE THE CONSTRUCTION OF GANSU PROVINCE'S SPORTS PUBLIC SERVICE SYSTEM

To build a more comprehensive public service system for national fitness and achieve a leap from "having" to "improving," it is necessary to improve the legal and regulatory system, strengthen financial support, promote the balance of resource allocation, enhance the convenience of fitness facilities, diversify sports events, improve the structure of sports organizations, ensure the scientific nature of fitness guidance, and expand public participation[13].

4.1 Improve the Legal and Regulatory System for Sports Public Service Construction

The scientific and sustainable construction of the sports public service system in Gansu Province relies on the development of relevant laws and regulations. These laws and regulations can oversee government actions, monitor the operation and management of sports organizations at all levels, and ensure that the behavior of these organizations aligns with legal norms. When constructing laws and regulations related to sports public services, it is essential to guarantee the basic sports rights of the public, address existing issues, and ensure these laws are practical, operable, and targeted. When the government purchases sports public services, it should improve relevant legal frameworks to avoid rent-seeking behaviors, establish a comprehensive and multi-layered legal system, and support policies that increase law enforcement to ensure the rule of law in sports.

4.2 Improve the Relevant Financial System to Ensure Investment in Sports Public Services

Economically developed regions have ample financial resources to solve funding issues, while economically underdeveloped regions may rely on higher-level government financial support. Therefore, based on the actual situation of our province, the fiscal transfer system should be strengthened, with economically developed regions providing appropriate assistance to underdeveloped areas. A scientifically regulated intergovernmental fiscal transfer system can help maintain equitable investment in sports public services across regions.

4.3 Coordinate the Construction of Sports Venues and Facilities

We should continuously increase investment in sports public facilities in urban and rural areas, building more accessible sports venues for the public. This includes expanding outdoor fitness equipment and adding devices suitable for people of all ages. Further efforts should be made to open school sports facilities to the public, and large-scale sports venues should strive to offer free or low-cost access. The layout of sports venues should be rationalized, with enhanced maintenance and operational management levels. Additionally, the construction of the "10-15 Minute Fitness Circle" in local areas should be strengthened, aiming to improve the overall fitness infrastructure.

4.4 Strengthen the Construction of the Social Sports Instructor Team

The common situation in the western regions is that there are serious issues such as loose internal management of social sports instructors, low enthusiasm for social sports services, and a low level of professionalism, as well as a shortage of professional sports instructors with both medical and sports backgrounds[14]. The orderly development of nationwide fitness activities depends on the efforts of professional talents. Therefore, it is necessary to focus on the cultivation of social sports instructors. First, suitable candidates should be identified, the number of instructors should be increased, and targeted training for key personnel should be provided. Practical skill training and regular re-training are essential to stimulate their enthusiasm. Secondly, scientific methods should be used to select training candidates. To improve effectiveness, more emphasis should be placed on training frontline sports instructors, especially in underdeveloped areas, and on providing targeted training for different groups of instructors, such as elderly sports instructors. Finally, various channels should be utilized to train all kinds of sports instructors, establishing a talent pipeline and learning

from advanced experiences in other provinces to enhance the training of sports instructors in our province.

4.5 Strengthen the Construction of Sports Social Organizations

Firstly, efforts should be made to cultivate mass sports organizations. This includes increasing the scale and number of these organizations. The government should reduce the barriers for establishing such organizations, enabling them to legally participate in the construction of sports public services. Additionally, the government should adopt a more flexible approach, delegating certain social sports activities to these organizations, while providing policy and financial support. A suitable legal and regulatory system should be established. Secondly, efforts should be made to promote the institutionalization of sports organizations. The "one team, two titles" model no longer meets the needs of today's sports development, as it leads to resource inefficiency. Therefore, we need to accelerate institutional reforms and provide strong support from relevant authorities.

4.6 Improve Physical Fitness Monitoring Services

A long-term dynamic monitoring mechanism should be established to track the physical fitness changes of the general population across the province. Different age groups have distinct physical characteristics, and therefore, different monitoring indicators should be chosen for them. Regular physical fitness assessments and scientific fitness guidance should be provided. Additionally, relevant databases should be established to support future fitness plans and related scientific research.

4.7 Improve Sports Information Services

Efforts should be made to organize sports media teams at the national and provincial levels to provide comprehensive coverage of major events and activities in the province. This includes promoting the construction of "WeChat, Weibo, and Apps," expanding publicity channels, and enhancing new media efforts. The Gansu Provincial Sports Bureau's website, Gansu Sports Vision publication, and the WeChat official account should continue to be improved, alongside joint collaborations with Gansu TV’s National New Sports program and the Lan Zhou Morning News to create a multi-platform media presence. A partnership with Daily Gansu Net to build the Gansu Sports Headlines network media platform should also be explored to increase coverage through various new media channels.

5 CONCLUSION

This study, through an in-depth analysis of the current situation of the sports public service system in Gansu Province, found that the province has achieved certain results in promoting public services for nationwide fitness. Specifically, the achievements are as follows: (1) The implementation of policies and regulations has gradually deepened, such as the promotion of the "Gansu Province Sports Event Management Implementation Measures," which has effectively improved the transparency of event information and promoted widespread public participation; (2) The quality of public sports services has significantly improved. Gansu's sports public service satisfaction has entered the "satisfied" range and ranks third in various public service sectors within the province, indicating an increasing recognition of public sports services by the people; (3) Gansu Province has successfully hosted several large-scale sports events, such as the Lanzhou Marathon and Gannan Tibetan Legends, enhancing the reputation and influence of Gansu's sports culture. However, Gansu still faces several urgent issues in the construction of its sports public service system: (1) Although there have been efforts in policy and regulation, the legal system remains incomplete and lacks long-term guarantees and regulatory mechanisms for sports public services; (2) Financial investment is still insufficient, especially in economically underdeveloped areas, where the uneven distribution of sports public service resources affects the universality and fairness of the services; (3) The construction and operation management of sports venues need to be strengthened, particularly in suburban and remote areas, where sports facilities are lagging and unable to meet the growing sports needs of the public; (4) The construction of the social sports instructor team also faces weaknesses, as there is a lack of systematic training mechanisms, leading to the professional level and service quality of the instructors falling short of expectations.

CONFLICT OF INTEREST

The authors have no relevant financial or non-financial interests to disclose.

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CONSTRUCTION AND APPLICATION OF CHINESE-ENGLISH BILINGUAL SCIENCE AND TECHNOLOGY DYNAMIC TERMINOLOGY BASE BASED ON THE DEMAND ORIENTATION OF NEW QUALITY PRODUCTIVITY

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Abstract: In the context of fierce global technological competition and deepening cross-cultural integration, the construction of a Chinese-English bilingual scientific and technical terminology database is of great significance for promoting technological exchange and enhancing international academic discourse power. However, existing bilingual terminology databases face numerous challenges, including slow update rates that fail to keep pace with rapid technological advancements, limited coverage that results in uneven inclusion of terminology across different fields, and insufficient semantic accuracy that hinders the precise dissemination of technological information. Additionally, the modern Chinese terminology system has largely absorbed vocabulary through English translation, which, while reflecting a trend of language integration, also poses challenges to ensuring terminology consistency. Furthermore, traditional translation technologies struggle to handle the complexity and variability of scientific and technical terms, affecting translation efficiency and quality. From the perspective of cross-cultural communication, differences in language expression across cultures increase the difficulty of accurately translating scientific and technical terms, as exemplified by the lack of uniform standards for translating Traditional Chinese Medicine (TCM) terminology into English. Moreover, the development of big data and artificial intelligence (AI) technologies imposes new requirements on terminology database construction, and how to effectively integrate these technologies into terminology database updates and management remains an area to be explored. Therefore, it is imperative to improve and refine Chinese-English bilingual scientific and technical terminology databases to better meet the demands of the times.
Keywords: Chinese-English bilingual terminology database; Technological exchange; Natural language processing (NLP); Terminology consistency

1 INTRODUCTION

In today's rapidly advancing global technological landscape, English academic literature and scientific and technical terminology have become the core mediums for knowledge dissemination and technical exchange. With the deepening of international technological cooperation and the growing demand for cross-language information exchange, the construction of English scientific and technical terminology databases has become particularly urgent. Despite existing terminology databases such as the European Union Terminology Database, UNTERM, and the terminology database of the Institute of Scientific and Technical Information of China (ISTIC) achieving certain successes in data collection and information technology applications, they still fall short in terms of update rates, coverage, and semantic accuracy, limiting their service efficiency. Against this backdrop, the construction of a dynamic English scientific and technical terminology database holds significant value for cultural and cross-cultural communication. As China's international influence continues to rise, the demand for disseminating Chinese cultural terminology abroad is also growing, and dynamic terminology databases can provide critical support for this purpose. Furthermore, dynamic terminology databases can capture terminology changes in real-time, reduce translation errors, and enhance the precision of communication. Academic discourse power is an important component of international influence and has significant implications for constructing a nation's international security environment[1]. Currently, China's modern linguistic research still requires strengthening in terms of international academic discourse power, and its influence in the international linguistic community and contributions to universal linguistic theories need to be improved[2]. Future research will focus on how to utilize cutting-edge technologies such as artificial intelligence, big data, and cloud computing to optimize data management, expand application scenarios, and promote the construction of dynamic English scientific and technical terminology databases. This will enhance their role in technological exchange, academic research, education and training, and industrial innovation, providing a solid foundation for global technological progress and knowledge diffusion.

2 CURRENT STATUS OF CHINESE-ENGLISH BILINGUAL SCIENTIFIC AND TECHNICAL TERMINOLOGY DATABASE CONSTRUCTION

In today's Chinese linguistic context, apart from traditional terminology, a large number of modern terms are primarily introduced and absorbed through English translation[3]. This phenomenon reflects the trend of language exchange and

integration under globalization and also highlights the status of English as a global lingua franca. In the modern Chinese terminology system, while traditional local terms are preserved, many newly emerging professional vocabulary and concepts are mostly introduced through English translation. This phenomenon of terminology borrowing not only showcases the interaction and integration between languages but also reflects the impact of English on other languages during the process of globalization.

From the perspective of some existing terminology databases, the European Union Terminology Database, as the official terminology database of the EU, covers fields such as law, agriculture, and technology, including Chinese and English terms. Its terminology data is sourced from EU internal legislation and policy documents and is widely used in international technological cooperation and academic research. The United Nations Terminology Database (UNTERM), led by the United Nations, includes terminology from fields such as international affairs, environmental protection, and technology, with data sourced from previous sub-databases and various UN documents and meetings[4]. The terminology database of the Institute of Scientific and Technical Information of China (ISTIC) focuses on the collection and management of Chinese-English bilingual terminology, covering key technological fields such as artificial intelligence and new energy. These bilingual scientific and technical terminology databases serve as bridges for efficient communication between governments and international organizations and are important information resources for global scientific research and technological development. They help overcome language barriers and strengthen international technological exchange and cooperation through their rich data.

Existing bilingual scientific and technical terminology databases are constructed using modern technologies and equipped with diverse functionalities to enhance user experience. In terms of database construction methods, Lexikon, developed by the U.S. company ENLASO, is a database-driven web application platform that allows different users to create, manage, and publish multilingual vocabulary libraries. It includes automated translation processes and adopts Unicode-compliant language technologies to dynamically support various language combinations, making it suitable for large terminology database projects. T-Manager represents a terminology management approach based on Excel spreadsheets, which can automatically analyze terminology in the Excel environment, manage terminology in real-time, import terminology from external tools, and provide core functions such as terminology unification. As a paid software, SDL MultiTerm is renowned for its powerful terminology extraction capabilities. Although its high cost may limit the use of users with limited budgets, it remains an attractive option for professional institutions seeking efficient and precise terminology management solutions[5].

In terms of storage technology, most existing bilingual scientific and technical terminology databases adopt relational database or cloud storage technologies, enabling multi-user access and real-time updates. In terms of retrieval technology, most existing terminology databases enhance the accuracy of terminology matching by using contextual examples, and some databases have already integrated machine translation and terminology management functions to support dynamic terminology updates and automatic alignment.

Despite the achievements of existing bilingual scientific and technical terminology databases in data sources, technological implementation, and application scenarios, the continuous increase of technological vocabulary in various professional fields has raised higher requirements for the precision of terminology translation and the speed of the review process. This trend not only reflects the rapid pace of technological development but also emphasizes the importance of ensuring terminology consistency and timeliness in cross-language communication[6]. Manual collection and organization struggle to keep up with the frequent emergence of new concepts in technological fields, leading to lagging updates and insufficient coverage. Multi-source data integration causes fragmented terminology definitions, exacerbating standardization conflicts. Traditional terminology databases face generational gaps in multiple aspects. Facing the globalization of technology, building a dynamic Chinese-English bilingual terminology database requires breaking through three major technological bottlenecks: terminology consistency, intelligent translation, and agile iteration. This has become the core demand for the construction of next-generation technological language resource systems.

3 NECESSITY OF CHINESE-ENGLISH BILINGUAL SCIENTIFIC AND TECHNICAL TERMINOLOGY DATABASE CONSTRUCTION

Terminology, as the vocabulary representing concepts in professional fields, plays an irreplaceable role in information exchange[7]. With the development of the information age, international academic exchange and research cooperation have become increasingly frequent, and information sharing between different countries and regions has become crucial. The significant linguistic differences between Chinese and English can easily lead to ambiguities or misunderstandings in the translation of professional terminology. As a key knowledge resource, terminology information is crucial for promoting technological innovation, deepening academic exchange, and supporting decision-making processes. Constructing a terminology database is not only an effective means of systematically managing and maintaining these important terms but also provides an efficient platform for information resource sharing across fields and regions[8]. Against this background, the issue of how to construct a Chinese-English bilingual terminology database becomes particularly important[9]. In the current context, the necessity of constructing a Chinese-English bilingual terminology database is mainly reflected in the following two aspects.

3.1 Necessity of Disseminating Chinese Cultural Terminology

With the continuous enhancement of China's national strength and its rising international status, the influence of Chinese culture around the world is expanding day by day. An increasing number of international scholars and professionals are showing a strong interest in fields such as Traditional Chinese Medicine, philosophy, and arts. Terminology, as a medium of communication, carries rich cultural, customary, and emotional connotations. Therefore, understanding the cultural implications, customs, and emotional expression patterns behind the language is crucial for accurate communication[10]. From the perspective of China's cultural heritage, the traditional Chinese culture, with a history of five thousand years, encompasses numerous aspects such as music, chess, calligraphy, painting, traditional literature, classic documents, festivals, architecture, opera, language, medicine, folk crafts, martial arts, regional culture, clothing, food, antiques, mythology, traditional music, and couplets. Since the late Ming Dynasty, with the arrival of Western missionaries like Matteo Ricci, who first translated the "Four Books" into Latin, the transmission of Chinese culture to the West began. Subsequently, many sinologists, such as Julius Mohl and James Legge, contributed to the translation and research of Chinese classics, making works like the "Book of Songs" and the "Analects" gradually known to the world[11]. While these efforts have produced accurate and detailed translations, such as those found in foreign sinological literature and international websites, there have also been cases of one-sided interpretations or mistranslations. This not only highlights the obstacles in terminology expression but also reveals the challenges of cultural communication. Therefore, constructing a Chinese-English bilingual terminology database is of great significance for accurately passing on traditional culture.

3.2 Necessity of Promoting Cross-Cultural Communication and Accurate Cross-Language Translation

In an increasingly globalized world, exchanges and cooperation between different countries and regions are becoming more frequent. As the lingua franca of international communication, English plays a key role in technology sharing and business cooperation. However, the highly specialized nature of the chemical industry leads to significant regional differences in terminology systems. Even English-speaking technical experts struggle to understand professional expressions across different regions. The short cycle of technological iteration and the emergence of new processes continuously demand updates to translators' knowledge reserves. Ordinary translators find it difficult to keep pace with the rapidly evolving knowledge systems, which limits the efficiency of cross-cultural collaboration. Currently, the number of professional translators in the chemical industry is far from meeting actual demands[12]. Against this backdrop, how to effectively and accurately convey information under the norms of high technological requirements and strict safety standards becomes particularly important. Moreover, since the chemical industry typically operates in global markets, enterprises need to interact frequently with overseas customers, suppliers, and partners. A Chinese-English bilingual terminology database can simplify communication in formal settings such as business negotiations and contract signings, as well as provide substantial assistance in daily technical support and services[13].
In the context of cross-cultural communication and cross-language translation, Traditional Chinese Medicine (TCM) is another field of significant influence. In recent years, traditional Chinese medicine has gained increasing attention and recognition worldwide. With growing interest in TCM theories and technologies from the international medical community, the translation of TCM into foreign languages has become increasingly widespread. After more than a decade of relentless efforts by Chinese TCM translators, remarkable progress has been achieved[14]. Additionally, an increasing number of international friends are developing a strong interest in TCM, hoping to improve their health, seek alternative therapies, or gain a deeper understanding of this ancient system of wisdom through learning and experiencing TCM. However, there has been no unified standard for the mutual translation of TCM terminology in Chinese and English. This situation has led to the existence of multiple English translations for the same Chinese term, which may stem from different understandings of the term or the adoption of varying translation strategies[15]. To unify translation standards and reduce ambiguity, the construction of a Chinese-English bilingual terminology database is particularly urgent.

4 FEASIBILITY OF CHINESE-ENGLISH BILINGUAL SCIENTIFIC AND TECHNICAL TERMINOLOGY DATABASE CONSTRUCTION

As a bridge for technological languages, the construction level of a Chinese-English bilingual terminology database directly impacts the efficiency and depth of international technological exchange and knowledge dissemination. However, existing terminology databases still have many shortcomings in terms of update speed, coverage, and semantic accuracy, making it difficult to fully meet the demands of the dynamic productivity context. With the development of artificial intelligence, big data, and cloud computing technologies, it is now technically feasible and practically possible to construct a dynamic, broadly covered, and highly semantically accurate Chinese-English bilingual terminology database. This chapter analyzes the supporting technologies, data sources, management mechanisms, and application prospects.

4.1 Technological Innovation Provides Robust Support for Bilingual Terminology Database Construction

Technological innovation and development are the pillars of constructing a Chinese-English bilingual terminology database. Advances in artificial intelligence, particularly in natural language processing (NLP) and deep learning models, enable terminology databases to efficiently update through automatic term extraction and semantic analysis. With the help of language models such as BERT and GPT, terminology can be precisely extracted from a vast amount

of scientific and technical literature and industry reports, and its contextual semantics can be deeply analyzed to ensure accurate term meanings. Additionally, AI can dynamically correct translation errors through feedback mechanisms and optimize term definitions based on user data, driving the continuous evolution of the terminology database.

The application of cloud computing and big data technologies provides strong data processing and storage capabilities for terminology databases. Terminology databases based on cloud architecture enable global real-time access and updates, while big data technologies can analyze global technological trends in real-time, predict and capture the emergence and popularity of new terms. Distributed storage technologies allow for efficient management of massive data and stable support for multi-user concurrent access. Multimodal technologies upgrade traditional text-based terminology databases to integrate various forms of terminology resources, such as images, audio, and videos, providing users with more intuitive and multidimensional understanding of terms, such as showcasing the practical application scenarios of terms through medical imaging or technical drawings.

In terms of management mechanisms, dynamic updates and quality assurance are key. Automated systems support flexible update strategies for terminology databases based on the needs of different fields. Real-time update mechanisms continuously mine new terms through dynamic corpora for immediate inclusion and synchronization, with user feedback data also serving as a basis for updates to ensure alignment with actual needs. For quality assurance, a multi-level review mechanism is established, with initial screening relying on AI and final reviews conducted by domain experts and linguists to ensure professional standards. A version management system is introduced to track change records, facilitating version comparison and problem tracing.

A dynamically updated Chinese-English bilingual terminology database has broad application prospects in fields such as technological exchange, academic research, education and training, and industrial innovation. In technological exchange, the terminology database helps researchers overcome language barriers and enhance the efficiency of international cooperation. In academic research, it is an essential tool for paper translation, report writing, and standard document preparation. In education and training, open terminology resources contribute to the popularization and promotion of technological languages. In industrial innovation, the terminology database provides linguistic support and knowledge assurance for the international development of enterprises, particularly in high-tech fields.

4.2 Diversified Data Sources Enhance the Authority and Comprehensiveness of the Terminology Database

The data sources of a terminology database determine the breadth and depth of its content, requiring multi-channel acquisition. Domestically, reliance can be placed on authoritative institutions such as the Chinese Academy of Sciences and the Standardization Administration of China to systematically collect terminology resources in key supported fields, ensuring scientific authority. Internationally, cooperation with terminology databases such as those of the EU and the United Nations can introduce international resources to expand coverage. Dynamic corpora are key to maintaining up-to-dateness, collecting the latest academic papers, industry reports, and technological news to capture emerging term changes in real-time. User participation is also an important source, with the construction of online platforms encouraging researchers, experts, and users to submit terms and definitions, leveraging crowdsourcing verification to ensure data quality. Furthermore, open data sharing policies provide valuable resources, utilizing global open data platforms to reduce collection costs and enhance data diversity and practicality.

4.3 New-Quality Productivity Driving the Technological Vision for Terminology Database Construction

In the thriving context of new-quality productivity, cutting-edge technologies such as artificial intelligence, big data, and cloud computing bring new opportunities for the construction of Chinese-English bilingual terminology databases. The following subsections detail the specific applications of these technologies in terminology database construction.

4.3.1 Dynamic real-time monitoring technology: the "radar" for capturing term updates

Dynamic real-time monitoring technology is an important tool for empowering terminology database construction through new-quality productivity[16]. It is based on web crawler technology and machine learning algorithms to achieve real-time listening and automatic data collection from multiple well-known field-specific websites and literature inclusion sites. In today's rapidly evolving technological landscape, academic journal websites (such as IEEE Xplore, ACM Digital Library), professional forums (such as Stack Overflow, Reddit's technology sections), and industry news websites (such as TechCrunch, Wired) are all important sources of new terminology.

Specifically, the process begins by identifying target websites and using web crawler technology to periodically visit these sites, obtaining their HTML code and parsing it into text data. During the data processing phase, machine learning algorithms play a crucial role. By training on a large amount of annotated term data, a term recognition model is established. For instance, convolutional neural networks (CNNs) can be used for feature extraction of text, combined with recurrent neural networks (RNNs) for sequence modeling, effectively improving the accuracy and recall rate of term recognition[17]. This technology can promptly capture new terms, ensuring the timeliness of the terminology database, significantly enhancing monitoring efficiency, reducing labor costs, and enabling the database to update in a timely manner to meet the needs of researchers and industry practitioners for cutting-edge technological terms.

4.3.2 Intelligent monitoring and term extraction technology: the smart "probe" for mining terms

Intelligent monitoring and term extraction technology is one of the core technologies based on AI algorithms[18]. It primarily utilizes natural language processing techniques combined with machine learning algorithms to achieve precise

extraction of new terms and the acquisition of related information. Natural language processing techniques can conduct in-depth analysis of text, including lexical, syntactic, and semantic analysis.

During the lexical analysis phase, text is segmented into individual words or phrases using tokenization technology, while part-of-speech tagging is performed to determine the grammatical category of each word, which helps identify vocabulary with term characteristics, as scientific and technical terms typically appear in the form of nouns or noun phrases. Syntactic analysis is used to examine the grammatical structure of sentences, determining the dependency relationships between words to further understand the semantics of the text.

Semantic analysis is the key component of this technology. Using deep learning algorithms such as the BERT (Bidirectional Encoder Representations from Transformers) model, text can be semantically encoded to obtain semantic representations[19]. By comparing these semantic representations with existing terminology databases, new terms can be identified, and related information such as term definitions and contextual usage can be extracted. When extracting new terms, clustering techniques from machine learning algorithms can also be employed to group similar terms, facilitating classification and management while preventing duplicate extraction, thereby improving the accuracy and efficiency of term extraction.

4.3.3 Real-time translation and multilingual support technology: the "bridge" for crossing language barriers

Real-time translation and multilingual support technology is an important application of AI in terminology database construction[20]. It leverages neural machine translation technology to achieve real-time translation of terms across multiple languages. Neural machine translation technology constructs large-scale neural network models that learn and train from massive parallel corpora to automatically translate text.

The application of this technology in terminology databases enables real-time translation of English terms into multiple other languages, such as Chinese, French, German, Japanese, and vice versa. This not only expands the multilingual coverage of the terminology database, meeting the needs of users from diverse linguistic backgrounds and promoting international academic exchange and technological cooperation, but also enhances the accuracy and standardization of terms in the database through cross-linguistic comparison and validation. For instance, during the translation process, the system can reference multiple authoritative term translation resources to optimize and adjust translation results, ensuring accuracy and professionalism.

5 APPLICATION PROSPECTS OF CHINESE-ENGLISH BILINGUAL TERMINOLOGY DATABASES

The generative artificial intelligence industry, represented by large models, is a key driver of new-quality productivity development. The construction of Chinese-English bilingual terminology databases is particularly important in today's context of globalization and rapid technological advancement[21]. These databases not only promote international academic exchange, eliminate language barriers for researchers, and ensure precise and consistent term usage but also significantly improve the quality of scientific and technical document translation. Looking to the future, Chinese-English bilingual terminology databases will play important roles in digital education, upgrading translation tools for technical documents, and the construction of research infrastructure in humanities, driving technological development and innovation.

5.1 Application Space for Promoting Academic Exchange and Overcoming Research Language Barriers

Chinese-English bilingual databases play a significant role in enhancing the international influence of Chinese academic journals. Against the backdrop of deepening globalization and increasingly frequent academic exchange, Chinese academic journals urgently need to strengthen their international influence to better serve global researchers. For example, some bilingual materials from Sun Yat-sen University's plant specimen database have entered the international computer network and can be accessed from terminals worldwide. Researchers can remotely retrieve the required information from any terminal screen[22]. Chinese-English bilingual databases provide strong support for the internationalization of Chinese academic journals by offering bilingual information, efficient retrieval and analysis tools, and convenient full-text linking services.

The construction of bilingual terminology databases also helps enhance China's discourse power in global ecological governance. The construction of a bilingual terminology database for the "Ecological Protection and High-Quality Development of the Yellow River Basin" relies on digital bilingual terminology database construction. Using SDL Multiterm Extract terminology management software, parallel text resources are imported, and bilingual terminology entries are structured for storage. Tasks such as term extraction, storage, annotation, coding, definition, and setting are completed, integrating domestic and international resources related to the ecological protection and high-quality development of the Yellow River Basin. While learning from advanced foreign governance experiences, this initiative strengthens China's discourse power in ecological governance and better disseminates Chinese wisdom[23].

5.2 Supporting Technological Education and Facilitating Knowledge Transfer

Chinese-English bilingual terminology databases serve as digital tools to enhance the quality and efficiency of translation education. Future qualitative research in education will increasingly rely on big data and artificial intelligence technologies, focusing on using new technologies to enhance human intuition, experience, and deep thinking rather than simply outsourcing these uniquely human capabilities to machines. Therefore, the establishment of Chinese-English bilingual databases can greatly support the development of technological education[24].

The application of Chinese-English bilingual terminology databases promotes international cooperation and knowledge sharing in technological fields. Taking the creation and application cases of bilingual parallel terminology databases in the field of water conservancy engineering as an example, it is found that such databases provide linguistic support for the dissemination and exchange practices in the field of water conservancy engineering, improving work efficiency and offering references for terminology database construction in other technological fields. The bilingual terminology database for water conservancy engineering has already been promoted and implemented in translation classrooms and translation practice internships, with positive results. During the exchange and translation project implementation in the field of water conservancy engineering, the assistance of computer-aided search engines can quickly locate target terms, maintaining the uniformity of professional terminology, improving work efficiency, and reducing the burden of information retrieval and memorization for relevant personnel[25]. This is of great significance for both the teaching and practice of translation professionals and for research on arch dam seismic design in the field of water conservancy engineering.

6 CONCLUSION

In the context of globalization and rapid technological development, the construction of dynamic Chinese-English bilingual terminology databases holds significant importance. Empirical evidence shows that by integrating cutting-edge technologies, these databases effectively address the shortcomings of traditional terminology databases, significantly enhancing the accuracy of term identification and translation, and providing robust support for cross-cultural technological exchange. These databases offer notable advantages, not only promoting the widespread dissemination of Chinese cultural terminology and allowing the world to better understand Chinese culture but also improving the efficiency of cross-industry technological cooperation, breaking down information barriers, and driving the transformation and upgrading of translation education, providing new pathways for cultivating translation professionals suited to the times. Looking to the future, dynamic Chinese-English bilingual terminology databases will evolve toward intelligence and scenario-based applications, deeply integrating multimodal data and industry models to expand application scenarios and enhance technological language services. In academic exchange, they can assist Chinese academic journals in gaining international recognition and boosting their global influence. In the field of technological education, they provide high-quality resources for translation teaching, cultivate versatile talent, and promote international cooperation and knowledge sharing in technological fields. The construction of these terminology databases is a key to breaking through challenges and advancing technological and cultural exchange, holding significant strategic value for enhancing China's international discourse power and building an international technological ecosystem.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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INTEGRATED DEVELOPMENT STRATEGY OF RED GENEALOGY RESOURCES AND CULTURAL TOURISM INDUSTRY IN THE JIANGNAN REGION

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Abstract: As a distinctive cultural tourism resource, the red genealogy culture of the Jiangnan region has become an important trend in the modern development of cultural tourism. Researching the development path of red genealogy culture and the red tourism industry in Jiangnan requires clarifying the significance of integrating red genealogy culture with red tourism industry resources, analyzing the challenges encountered in the integration process, and exploring effective integration strategies. This will contribute to the coordinated development of the region's economy, society, and culture, ensuring the preservation of red genealogy culture, promoting revolutionary spirit, and fostering the prosperity of the cultural tourism industry.
Keywords: Jiangnan region; Red genealogy; Cultural tourism industry; Integrated development

1 INTRODUCTION

In recent years, increasing attention has been given to the cultural heritage and revolutionary spirit embedded in red genealogy culture[1]. Existing studies, such as the compilation of joint directories of genealogies, the establishment of specialized genealogy research centers[2], and the construction of digital resources[3], have provided strong theoretical support for the preservation and dissemination of genealogical culture. However, these studies have primarily focused on genealogy compilation and academic research, with relatively limited exploration of its practical dissemination. The first Genealogy Exhibition Festival held in Fuyang[4] has contributed to the social promotion of genealogical culture, yet it still relies on traditional methods.

In the Jiangnan region, red genealogy culture, as a rich historical resource, urgently needs to be closely integrated with the red tourism industry and modern communication technologies to enhance its cultural influence and appeal. This paper explores how emerging technologies can drive the digital development of red genealogy culture while facilitating its deep integration with the red tourism industry. This integration can create new development momentum and provide strong support for the cultural tourism economy in the Jiangnan region. By promoting the synergy between genealogy resources and the tourism industry, this research aims to establish a new pathway for the inheritance and innovation of red genealogy culture.

2 THE IMPORTANCE OF THE "RED GENEALOGY + RED TOURISM" INTEGRATED DEVELOPMENT MODEL IN THE JIANGNAN REGION

2.1 Highlighting the Cultural Heritage of Jiangnan's Red Tourism Attractions to Enhance Their Unique Appeal

The Jiangnan region boasts numerous red tourism attractions, many of which are closely linked to red genealogy culture. Examples include the Nanjing Massacre Memorial Hall in Jiangsu Province, the Changzhou Genealogy Museum and Changzhou Local Chronicles Museum in Changzhou, and the Mao Ancestral Hall in Qingyang Village, Jiangshan, Zhejiang Province. The historical and cultural value behind these sites forms a unique highlight in the development of the region's cultural tourism industry. As cultural tourism continues to thrive nationwide, the Jiangnan region must leverage its regional characteristics and advantages to stand out.

Integrating red genealogy into red tourism attractions can provide these sites with compelling narrative contexts and historical backgrounds, making them more vivid and immersive. By uncovering historical events and family stories within red genealogies, customized tourism routes and interpretation materials that reflect Jiangnan's cultural essence can be developed. Additionally, various interactive experiences such as stage plays, dramas, and live-action role-playing activities can be created to bring the revolutionary spirit of the ancestors to life. This approach enhances tourists' engagement and understanding of red genealogy culture. Through the utilization of red genealogy resources, the red tourism industry in Jiangnan has experienced significant growth, not only facilitating the transformation and upgrading of tourism but also highlighting the unique "red" identity of Jiangnan. This greatly strengthens the region's cultural tourism appeal.

2.2 The Innovative Development of Red Genealogy Culture Facilitates Their Synergistic Growth

Although red genealogy culture possesses profound historical significance and educational value, traditional methods of inheritance are often confined to family members or specific groups, making it difficult to achieve widespread

dissemination and deep public engagement. Therefore, it is necessary to make it more accessible, contemporary, and diversified, ensuring its innovative development and creative transformation.

Integrating red genealogy culture with red tourism serves a dual purpose. On one hand, red tourism provides a broad platform for the dissemination of red genealogy culture. Through tourism, red genealogy culture can be presented in a more vivid and intuitive manner, allowing visitors to absorb revolutionary culture imperceptibly. For instance, the "Ten Thousand Theater" project in Jinzhai County, Anhui Province, has created immersive, metaverse-driven, and youth-oriented red theatrical performances, such as *Lixia* . These innovative methods not only expand the audience base of red genealogy culture but also enhance its emotional and educational impact.

On the other hand, red genealogy culture adds new dimensions and highlights to red tourism. By incorporating historical events and personal stories from red genealogies into tour routes, explanatory materials, and on-site performances, visitors can experience "education through entertainment, learning through interest, and internalizing values through engagement"[5]. This approach enriches the ways in which red culture is presented at tourism sites. Additionally, red genealogy culture can inspire the development of themed souvenirs, cultural and creative products, and memorabilia, offering unique cultural merchandise and services that not only meet tourists' needs but also drive economic consumption and industrial growth.

2.3 The Integration of Both Sectors Promotes Cultural and Economic Development in the Jiangnan Region

The Jiangnan region holds a significant place in China's revolutionary history, having produced numerous red figures and revolutionary families. However, in past development efforts, Jiangnan's red resources have often been scattered and isolated, lacking unified management and planning. This has resulted in inefficient utilization of red tourism resources, making it difficult to achieve large-scale impact. Integrating red genealogy culture with red tourism offers a practical solution for optimizing and consolidating red genealogy resources in the region, promoting coordinated regional development.

From the perspective of cultural synergy, red genealogy culture acts as a bridge connecting various red tourism sites, fostering interconnectivity among Jiangnan's red resources. Honoring revolutionary families and studying red genealogies not only evokes a deep sense of cultural confidence among the people[6] but also strengthens red cultural education. More importantly, in the context of the modern era, this initiative serves as a crucial step toward elevating Jiangnan's spiritual and cultural development. Furthermore, using red genealogy culture as a foundation, the region can establish a new platform for cultural exchange, encouraging interactions between different red cultural initiatives and further enhancing regional cultural integration and innovation.

From the perspective of economic synergy, red genealogy culture injects new momentum into the coordinated development of Jiangnan's regional economy. By excavating the historical events and personal stories within red genealogies, the sharing and complementarity of resources can be realized. Linking various red tourism sites together enables the creation of unique tourism routes and thematic products, fully unlocking the potential of Jiangnan's tourism industry. By further exploring the cultural and humanistic value embedded in red genealogy, Jiangnan can integrate red culture with tourism, cultural industries, and education, forming a unified and sustainable industrial model. These measures significantly enhance the economic efficiency of the cultural tourism sector and may serve as an important guiding force for the future economic development of the region.

3 CHALLENGES IN THE INTEGRATION OF RED GENEALOGY RESOURCES AND THE CULTURAL TOURISM INDUSTRY

3.1 Balancing the Development and Protection of Red Genealogy Resources

Red genealogy resources are primarily preserved in ancestral halls, libraries, and museums, where they are professionally stored and protected. Even for purposes such as genealogical research and cultural studies, strict regulations govern their display and reproduction, ensuring that they are neither lost nor damaged. Due to this high level of confidentiality, tourists have very limited access to red genealogy culture and lack the autonomy to engage with it.

At the same time, if genealogy resources are developed without proper oversight, some individuals and media outlets may distort history and defame revolutionary figures merely to attract attention. This not only undermines the seriousness and credibility of red genealogy culture but also creates misconceptions and misinterpretations of family histories among the public. Furthermore, excessive commercialization of genealogy culture may erode its spiritual value, reducing it to a mere marketing tool. Such irresponsible exploitation could result in significant negative consequences, including damage to the sense of pride and identity associated with Chinese cultural heritage.

3.2 Lack of Diversity in Communication Forms and Channels

The Jiangnan region has a long-standing tradition of compiling genealogies. To this day, it boasts the largest collection and revision of genealogical records in the country. However, market research shows that when tourists visit the former residences or memorial halls of revolutionary families, they rarely gain insight into their genealogical culture. This is largely due to the insufficient emphasis placed on red genealogy resources by cultural communication entities in Jiangnan.

Figure 1 The Director of the Genealogy Provided an Explanation to the Members

Currently, the dissemination of red genealogy culture in the region primarily relies on traditional promotional methods, such as genealogy exhibitions, lectures, and collaborations with libraries and schools, as shown in Figure 1. While this practice neglects the use of new media and modern communication techniques. This singular approach results in a narrow audience reach, limiting the influence of red genealogy culture. Consequently, it struggles to attract young people and external visitors, making it difficult to achieve widespread social recognition. Furthermore, the lack of modern communication methods hinders the transmission of red genealogy culture in the digital era, preventing it from reaching its full potential in contemporary inheritance and development.

3.3 The Urgent Need to Optimize Development Strategies and Operational Models for Cultural and Tourism Resources

At present, the integration of red genealogy culture with the tourism industry remains largely confined to static displays in scenic areas or venues. The exhibition content remains unchanged for years, lacking innovation, and there are only a few dedicated guides to provide in-depth explanations.

This operational model fails to fully explore and leverage the unique appeal of red cultural resources to attract tourists and stimulate consumption. Moreover, it does not engage visitors through vivid storytelling or interactive experiences, which are essential for fostering emotional resonance and helping them appreciate the historical significance, spiritual value, and social impact of red culture. If the development of red genealogy resources does not align with the market demands of the tourism industry, their integration will likely yield minimal results and may even be counterproductive.

4 PATHWAYS FOR INTEGRATING JIANGNAN'S RED GENEALOGY RESOURCES WITH THE TOURISM INDUSTRY

4.1 Injecting New Vitality into the Inheritance of Red Genealogy Culture

By leveraging the red tourism industry and positioning red genealogy resources as a core element, modern innovation and developmental approaches should be employed to explore and preserve traditional cultural resources dynamically. This will enhance their unifying power and emotional appeal.

The first priority is to deepen the excavation of red genealogy resources. Currently, the inheritance of red genealogy culture is hindered by a singular transmission approach, an underdeveloped management system, and a lack of public awareness. To address this, modern information technology should be utilized to digitize genealogy collections, such as by creating digital museums and cloud-based exhibition halls for red genealogies. This would provide readers with more convenient and efficient access to genealogical services, promote diversified reading engagement, enrich cultural connotations, and drive innovative development.

Next, after accumulating a substantial body of red genealogy resources, efforts should be focused on their transmission. The following measures can be implemented：

4.1.1 Enhancing the environment of tourist sites

The tourism environment serves as a crucial medium for visitors to connect with the historical context of the revolution and experience the essence of revolutionary culture[7]. Renovating the former residences of revolutionary pioneers and memorial halls of red families can transform these sites into key venues for Red history education. This ensures that the history recorded in red genealogies is not merely confined to old documents or archives but is also vividly presented in tangible, physical spaces.

4.1.2 Deepening the exploration of genealogy culture

Through field research and document collection, touching family letters, family traditions, and ethical codes embedded in red genealogies should be compiled into volumes or adapted into easy-to-recite poems. This approach makes it easier for future generations to learn, understand, and inherit the essence of red genealogy culture.

4.1.3 Securing government support and improving the management system

Strengthening communication and cooperation among the government, society, and cultural institutions will create a powerful synergy to promote the integration and inheritance of red genealogy culture. Additionally, initiatives such as selecting “Most Beautiful Families” and “Five-Good Families” can serve as exemplary models for incorporating red genealogy culture into family education. This would help establish an inheritance model led by the government, supported by society, and practiced within families.

Furthermore, in order for red genealogy culture to generate commercial value when integrated with the cultural tourism industry, it must undergo some degree of adaptation. However, this adaptation should have clear boundaries. "Whether one cherishes and respects classics or exploits and desecrates them for utilitarian purposes serves as a crucial benchmark for evaluating the values of the adapter, as well as the limits of adaptation." Therefore, when industrializing red genealogy culture, it is essential to conduct scientific assessments to balance its contributions to both social spiritual civilization and material civilization. Carefully selecting appropriate genealogy resources for integration with the tourism industry will ensure that cultural tourism becomes the optimal platform for showcasing red genealogy culture.

4.2 Establishing an Interactive Cultural Tourism Platform

How can red genealogy culture move beyond obscurity[8]? Its integration with the tourism industry must rely on an interactive, multi-dimensional, and innovative exhibition platform.

4.2.1 Developing thematic historic towns

Selecting traditional architectural sites with well-preserved red family histories—such as Meijia Courtyard and the Family Legacy Museum in Yangzhou, or Yingchunqiao Chongxianfang and Qingguo Alley in Changzhou—can help establish red genealogy-themed historic towns. By maintaining their original historical features while introducing reasonable tourism development, these sites can build strong brand identities and offer immersive tourism experiences.

4.2.2 Designing interactive cultural activities

Interactive cultural activities can significantly enhance visitor engagement with red genealogy. For instance, organizing genealogy knowledge sessions where visitors learn about the history and significance of family heritage can foster a deeper understanding. Additionally, hands-on workshops on genealogy compilation allow participants to explore their own family histories, creating a personal connection to the past. Family story-sharing events provide an opportunity for visitors to share their own family’s revolutionary stories, making the experience more personal and emotionally impactful. These activities engage visitors and promote an active, participatory exploration of red genealogy, enhancing their overall experience.

4.2.3 Innovating storytelling methods

Innovative storytelling methods can breathe life into revolutionary history. Performance-based storytelling, such as opera, drama, and role-playing, allows visitors to experience historical events and figures in a dynamic way. Through live performances, visitors can emotionally connect with the struggles and triumphs of historical figures, turning abstract facts into a compelling narrative. Role-playing, in particular, offers a hands-on approach, where participants embody characters from the past, allowing them to experience history from a first-person perspective. These interactive performances help to humanize historical events and provide a memorable, immersive experience for visitors.

4.2.4 Exploring digital display methods

Digital technology plays a crucial role in modernizing cultural communication. Incorporating red genealogy elements into museum exhibits, virtual reality experiences, and interactive theater can attract younger audiences and expand the reach of red genealogy. Live-streaming or short videos on social media platforms can engage a global audience by offering dynamic content. The "Internet + Red Genealogy + Tourism" model brings new life to the tourism industry, combining historical storytelling with modern technology. Digital platforms can also provide virtual tours, allowing visitors to explore red genealogy content remotely, further expanding the reach and accessibility of this cultural heritage.

4.2.5 Leveraging cutting-edge technologies

AI can help organize vast genealogy databases and create structured knowledge graphs for better information accessibility. VR can reconstruct historical scenarios, allowing tourists to virtually “travel” back to revolutionary times and experience red family stories firsthand. The combination of AI and VR would create a smart and immersive red genealogy cultural experience, enhancing visitor engagement and promoting innovative cultural heritage transmission in the digital era.

The development of virtual digital exhibitions and cloud genealogy databases further expands the reach of genealogy culture. For example, in Figure 2, the Dongjia Genealogy Museum had already launched a virtual digital exhibition. These initiatives break the limitations of traditional museum spaces, enabling visitors worldwide to explore family histories online. Through 3D modeling and dynamic interactions, users can access detailed information and actively participate in family story explorations. Additionally, cloud genealogy databases allow centralized storage of historical family records, facilitating convenient retrieval and continuous updates. By leveraging big data analysis, cloud platforms can also provide personalized recommendations to increase audience engagement.

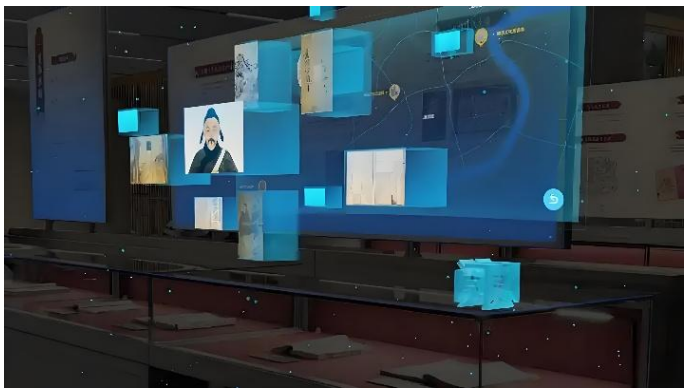

Figure 2 The Dongjia Genealogy Museum Launched a Virtual Digital Exhibition

4.3 Expanding Communication and Operations through New Media

Scholars generally believe that "family genealogy is a record that clarifies bloodlines, organizes generational sequences[9], and documents the historical development of a family." The significant value of genealogies spans multiple disciplines, including clan systems, socioeconomics, and family education. However, genealogy had not been closely linked with literature until the turn of the 21st century, when it began to serve as a resource for literary creation[10].

Similarly, to ensure that red genealogy resources reach a wider audience, they can be creatively adapted into diverse literary and artistic forms while maintaining core ideological themes and historical integrity. One approach is to integrate literary red genealogies with the cultural tourism industry. This could include compiling concise and engaging red story collections, composing rhythmic and impactful red-themed poetry, and using vivid language to depict the turbulent revolutionary era. Additionally, red genealogies can be adapted into short films, documentaries, dramas, and musicals to recreate those historical moments through visual and performing arts, allowing audiences to experience history as if they had traveled back in time.

Leveraging the efficiency and broad reach of new media platforms is essential. For example, short videos of red stories, illustrated articles, and H5 interactive pages can be published on social media and video-sharing platforms to attract younger audiences with engaging and dynamic content. Scenic spots can also host interactive or promotional events, such as establishing free stamp collection stations or offering ticket discounts and souvenirs to visitors who dress up as historical figures and create promotional videos.

To further enhance visitor engagement and a sense of belonging, marketing campaigns can be launched on new media platforms. Activities such as red story submission contests can encourage visitors and internet users to share their personal or family revolution-related stories. Red-themed photography competitions can also be organized, allowing tourists to capture the unique charm of red tourism sites through their lenses. These initiatives mobilize public participation, enabling the collection of additional red stories and visual materials while simultaneously increasing awareness and influence.

4.4 Thoughtfully Designed Tourism Routes and Cultural Products

Based on Jiangnan's red genealogy resources, tourism routes with distinct thematic characteristics should be designed. Key historical events, important figures, and significant moments from red genealogies should be arranged chronologically and geographically to form coherent and educational travel itineraries. For instance, locations related to Zhou Shuiping, Li Da, and the Changzhou Three Heroes can be organized into a "Marxism's Entry into Jiangnan" route. Another example is the design of a "Tracing the Footsteps of Revolutionary Forebears" route, linking the Mao Clan Ancestral Hall in Qingyang Village, Jiangshan, Zhejiang Province, with the Li Zhenqian Martyrs' Memorial Hall in Xuzhou, Jiangsu Province, and Gongpu Road in Changzhou, Jiangsu Province.

Additionally, diverse tourism routes can be developed to cater to different visitor groups and interests. For example, research-oriented travel routes can be tailored for young students, family-friendly routes for parents and children, and in-depth exploration routes for history and culture enthusiasts.

Developing creative and culturally rich tourism products is also a key aspect of enhancing visitors' travel experiences. The distinctive figures and historical scenes from red genealogies can be transformed into unique souvenirs such as collectible figurines, character dolls, themed badges, and commemorative stamps. Furthermore, digital products related to red culture can be developed, such as red genealogy mobile apps, red story e-books, and red-themed script-based role-playing games. By leveraging modern technology and entertainment formats, these initiatives can enrich visitors' interactive experiences. These products are not merely physical souvenirs; they also serve as emotional bridges between tourists and the destinations they visit.

5 CONCLUSIONS

This study focuses on the integration of Jiangnan's red genealogy resources with the cultural tourism industry, analyzing the interaction and coordinated development between red genealogies and red tourism. To address the challenges of merging red genealogy with the tourism sector, future efforts should strengthen cross-disciplinary collaboration, improve the management and protection mechanisms for red genealogy resources, promote digital transformation, and enhance the vitality and market competitiveness of red genealogy culture through innovative operational models.

Through this analysis, two key insights emerge. First, red genealogy culture plays a crucial role in enhancing the appeal of red tourism sites, stimulating cultural innovation, and contributing to regional economic development. Second, the study explores how modern information technology and multi-dimensional interactive platforms can expand the dissemination of red genealogy culture. Particularly, with the strong support of new media and digital technology, red genealogy culture can be presented in a more vivid and intuitive manner, significantly enhancing its appeal to visitors. Furthermore, the practical strategies proposed—integrating Jiangnan's abundant red resources with local cultural characteristics—provide feasible solutions for the innovative development of red tourism.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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AN EMPIRICAL STUDY ON CYBERBULLYING AND MENTAL HEALTH AMONG ADOLESCENTS IN LUZHOU: FROM THE PERSPECTIVE OF ATTACHMENT THEORY

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Abstract: Based on the attachment theory framework, this study empirically investigates the relationship between cyberbullying and mental health, as well as its underlying mechanism, among adolescents in Luzhou City through questionnaire surveys and statistical analyses. Results reveal a significant positive association between the frequency of cyberbullying victimization and levels of loneliness and depression, indicating that cyberbullying exerts a notable negative predictive effect on adolescent mental health. Parental attachment and peer attachment both demonstrate significant negative correlations with loneliness and depression, suggesting that secure attachment relationships serve as protective factors against psychological risks. Hierarchical regression analyses further show that parental attachment significantly moderates the impact of cyberbullying on mental health, whereas the moderating effect of peer attachment remains non-significant. This research extends the application of attachment theory to the context of adolescent cyberbullying, offering dual theoretical contributions: it explicates the buffering role of family attachment in mitigating cyberbullying effects and empirically validates the protective function of attachment relationships in mental health. The findings provide a scientific foundation for educational authorities to design attachment-oriented interventions while offering actionable strategies for strengthening parent-child relationships at home and optimizing school-based mental health programs. This study thus holds critical theoretical and practical significance for enhancing regional adolescent mental health through evidence-based policy and intervention development.
Keywords: Adolescent cyberbullying; Mental health; Attachment theory; Parental attachment; Peer attachment; Moderating effects

1 INTRODUCTION

1.1 Background of the Study

With the rapid development of mobile communication technology, smartphones have become an important part of teenagers' lives. As of June 2023, the size of China's Internet users reached 1.079 billion people, and the Internet penetration rate reached 76.4%, of which the proportion of Internet users under the age of 10 and 10-19 years old was 3.8% and 13.9% respectively[1]. There is a clear trend of youth mobile phone use at a younger age, but their physiology and psychology are not yet mature and they are easily influenced by the online environment. Cyberbullying, as an emerging online harmful behavior, has become an important factor threatening the mental health of teenagers. Cyberbullying is characterized by strong concealment, rapid dissemination and wide influence, which has serious negative impacts on adolescents' mental health, such as increasing loneliness and depression. However, there is a relative lack of research on the relationship between cyberbullying and mental health among adolescents, especially in terms of empirical studies in Western China[2]. Taking adolescents in Luzhou City as the research object, this study explores the relationship between cyberbullying and mental health and its influence mechanism based on the attachment theory perspective, to provide a scientific basis for the regional education department to formulate adolescent cyberhealth policies and mental health interventions[3].

1.2 Significance of the Study

This study has important theoretical and practical value. At the theoretical level, this study introduces attachment theory into the field of adolescent cyberbullying, explores the moderating effects of parental attachment and peer attachment on adolescent mental health, expands the scope of application of attachment theory, and provides a new perspective for understanding the psychological mechanisms of adolescent cyberbullying[4]. At the practical level, this study reveals the negative impact of cyberbullying on adolescents' mental health through empirical analyses, providing a scientific basis for education departments to develop targeted mental health interventions. Meanwhile, the results of the study also provide useful guiding suggestions for families and schools, which help to enhance the mental health of adolescents and promote their healthy growth.

2 LITERATURE REVIEW

2.1 Cyberbullying and Adolescent Mental Health

Cyberbullying refers to malicious attacks, insults, threats, or the dissemination of false information through the internet, which significantly negatively impacts adolescents' mental health. Research indicates that cyberbullying is significantly associated with non-suicidal self-injury among adolescents, with depression and parent-child communication acting as mediators and moderators [5]. Victims of cyber bullying often exhibit higher levels of loneliness, depression, and anxiety [6]. The hidden and anonymous nature of cyberbullying makes it difficult for victims to obtain timely social support, further exacerbating psychological trauma [5]. Studies have shown that cyberbullying not only affects adolescents' mental health but can also lead to long-term psychological trauma, such as decreased self-esteem, loss of confidence in life, and even suicidal behavior [7]. Therefore, in-depth research on the relationship between cyberbullying and mental health is crucial for preventing and intervening in cyberbullying among adolescents.

2.2 Attachment Theory and Its Application to Adolescent Psychological Development

Attachment theory, initially proposed by British psychologist John Bowlby in the early 1950s, emphasizes the importance of early attachment relationships for individual development. Attachment relationships are psychological representations formed through interactions with others, influencing adolescents' thoughts, emotions, and behaviors [8]. Research shows that secure attachment relationships help adolescents establish positive attachment patterns and maintain good mental health[9]. Insecure attachment relationships can lead to anxiety and helplessness in intimate relationships and may even cause depressive symptoms [10]. The application of attachment theory in adolescent psychological development provides a new perspective for understanding adolescents' mental health issues and helps reveal the mechanisms between cyberbullying victimization and mental health among adolescents [11].

2.3 The moderating Role of Attachment in Cyberbullying and Mental Health

The moderating role of attachment relationships in the relationship between cyberbullying and mental health has attracted attention. Research shows that parental and peer attachment have protective effects on adolescents' mental health. Parental attachment provides emotional support and a sense of security, helping to alleviate the psychological stress caused by cyberbullying [12]. Peer attachment, through social support and emotional comfort, reduces adolescents' loneliness and depression [13]. However, existing research has explored the moderating role of peer attachment. This study will delve into the moderating effects of parental and peer attachment in the relationship between cyberbullying and mental health, providing theoretical support and practical guidance for preventing and intervening in cyberbullying among adolescents[14]. By revealing the protective mechanisms of attachment relationships, this study will offer valuable guidance for families and schools, contributing to enhancing adolescents' mental health levels[15].

3 RESEARCH METHODOLOGY

3.1 Subjects of the Study

Junior high school and high school students in Luzhou City, Sichuan Province were selected as the subjects of this study[16]. The specific sampling process was as follows: first, one municipal district and one county were selected by simple random sampling from the three municipal districts and four counties in Luzhou City; subsequently, one junior high school and one senior high school were randomly selected from these two districts. Stratified sampling was conducted within the sampled schools, with two to three classes being selected in the first, second, and third years of junior high school, and in the first, second, and third years of senior high school[17]. The estimated sample size was 1,000, and about 400 valid questionnaires were collected. The sample covered students of different grades in junior high school and senior high school, and the ratio of male to female was balanced[18]. The study was conducted in strict compliance with ethical principles, and the purpose of the study and confidentiality measures were explained to the participants and their guardians, and their informed consent was obtained.

3.2 Research Tools

The questionnaire used in this study was designed concerning mature scales at home and abroad and combined with the actual situation of adolescents in Luzhou City. The questionnaire mainly includes the following parts:
1. Demographic variables: including basic information such as gender, age, and family structure.
2. Cyberbullying scale: The Olweus Cyberbullying Questionnaire (OBVQ) was used to measure cyberbullying suffered by adolescents in the past six months.
3. Mental Health Scale: The Depression, Anxiety and Stress Scale for Adolescents (DASS-21) was used to measure the depression, anxiety and stress levels of the study participants.
4. Parental Attachment Scale: The Parental Attachment Scale (IPPA-P) was used.
5. Peer Attachment Scale: The Peer Attachment Scale (IPPA-Peer) was used.
In the process of questionnaire preparation, special attention was paid to the reliability and validity test of the scales, and relevant psychologists were invited to review the scales to ensure the applicability and scientificity of the scales[19]. At the same time, reactive questions were set in the questionnaire to exclude perfunctory responses from the subjects and to improve the authenticity of the data.

3.3 Data Collection and Processing

The data collection was carried out in a combination of online and offline methods. Online, electronic questionnaires were distributed through the Questionnaire Star platform, and offline, students were organized to fill out paper questionnaires with the assistance of school psychologists[20]. The data collection period was from 10th September to 30th September 2024. After data collection was completed, data cleaning was first performed to eliminate invalid samples [21].Subsequently, data were entered, screened and statistically analyzed using SPSS 26.0. The main analysis methods included descriptive statistical analysis, correlation analysis, regression analysis, etc., to test the research hypotheses and reveal the relationship between variables.

4 RESEARCH RESULTS

4.1 Relationship between Cyberbullying Victimization and Adolescent Mental Health

The study found that the frequency of cyberbullying victimization among adolescents is significantly correlated with mental health issues. Specifically, the higher the frequency of cyberbullying victimization, the higher the levels of loneliness and depression among adolescents. The data showed that 36.5% of the participants had experienced cyberbullying at least once in the past six months, with verbal insults being the most common (22.8%). The current status of mental health showed that 15.2% of the participants scored at the critical level on depression, 18.4% showed a high degree of anxiety, and 21.6% scored high on loneliness. The correlation analysis showed that cyberbullying victimization is significantly positively correlated with depression, anxiety, and loneliness ($r=0.41$, $p<0.01$), indicating that cyberbullying has a significant negative impact on adolescents' mental health.

4.2 The Moderating Role of Parental Attachment and Peer Attachment

The study further explored the moderating role of parental and peer attachment in the relationship between cyberbullying and mental health. The results showed that parental attachment has a significant moderating effect, while the moderating effect of peer attachment was not significant. **Specifically**, adolescents with high levels of parental attachment showed lower levels of psychological distress when exposed to cyberbullying, while the impact of peer attachment was more complex. This indicates that parental attachment has a stronger protective effect on adolescents' mental health, while the impact of peer attachment may vary depending on the context.

5 DISCUSSION

5.1 Mechanisms of Cyberbullying's Impact on Adolescent Mental Health

Cyberbullying negatively impacts adolescents' mental health through multiple mechanisms. First, the anonymity and concealment of cyberbullying make it difficult for victims to obtain timely social support, thereby exacerbating psychological trauma. Second, cyberbullying leads to negative self-perceptions among adolescents, which in turn trigger depression and loneliness. Additionally, the persistence and wide dissemination of cyberbullying make it difficult for victims to escape, further increasing the psychological burden. Therefore, cyberbullying not only affects adolescents' immediate mental health but can also lead to long-term psychological trauma.

5.2 The Protective Role of Attachment and Its Implications

Attachment relationships play an important protective role in the relationship between cyberbullying and mental health. Parental attachment, by providing emotional support and a sense of security, helps adolescents cope with the psychological stress caused by cyberbullying. Research shows that adolescents with high levels of parental attachment exhibit lower levels of psychological distress when exposed to cyberbullying. This finding highlights the important role of the family in adolescents' mental health and suggests that families should strengthen parent-child interactions and establish secure attachment relationships. Additionally, schools and communities should provide support to help adolescents build positive peer relationships and enhance psychological resilience.

5.3 Limitations and Prospects of the Study

This study has some limitations. First, the sample is mainly concentrated in urban schools in Luzhou City, with fewer data from rural adolescents, affecting the representativeness of the results. Second, the study uses a cross-sectional design, making it difficult to determine causal relationships. Future research should expand the sample to include more rural areas and use longitudinal research designs to more accurately reveal the dynamic relationship between cyberbullying and mental health. Additionally, future studies should further explore the moderating mechanisms of attachment relationships, incorporating more mediating and control variables to refine the theoretical model.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions of the Study

This study reveals the significant negative impact of cyberbullying on adolescents' mental health and confirms the moderating role of parental attachment. The results show that the higher the frequency of cyberbullying victimization, the higher the levels of loneliness and depression among adolescents. At the same time, adolescents with high levels of parental attachment exhibit lower levels of psychological distress when exposed to cyberbullying. These findings provide a new perspective for understanding the psychological mechanisms of cyberbullying and offer theoretical support for prevention and intervention efforts.

6.2 Policy Recommendations

Based on the study results, it is recommended that education departments strengthen mental health education and improve adolescents' internet literacy and coping abilities. Schools should offer targeted mental health courses and provide psychological counseling services to help adolescents build positive attachment relationships. Families should enhance parent-child communication and establish secure attachment relationships to provide emotional support for adolescents. Additionally, the government should improve relevant laws and regulations, strengthen the supervision and punishment of cyberbullying, and create a healthy internet environment.

6.3 Directions for Future Research

Future research should further explore the moderating mechanisms of attachment relationships, incorporating more mediating and control variables to refine the theoretical model. At the same time, future studies should expand the sample to include more rural areas and use longitudinal research designs to more accurately reveal the dynamic relationship between cyberbullying and mental health. Additionally, research should focus on the various forms of cyberbullying and their different impacts on mental health to provide a basis for developing more effective intervention measures.

COMPETING INTERESTS

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THE DIGITAL AND INTELLIGENT TRANSFORMATION PATH OF HERITAGE TOURISM BASED ON CULTURAL CAPITAL THEORY

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Abstract: Based on the Cultural Capital theory proposed by Pierre Bourdieu, this study proposes "digital cultural capital" as the fourth form, and constructs the model of "capital form-technological empowerment-power reproduction" (C-T-P) to explore the path of digital transformation of heritage tourism. The research extends the theory of cultural capital and provides a new path for the transformation of heritage tourism. The study extends the theory of cultural capital theory, provides a framework for interdisciplinary research, and offers a technology-driven operational path for policy and practice. In the future, it is necessary to deepen the research on the empowering effect of technology and the mechanism of globalization and collaboration, so as to realize the sustainable inheritance of cultural heritage.
Keywords: Cultural capital theory; Digital and intelligent transformation; Heritage tourism; Technology empowerment; Power reproduction

1 THEORETICAL RECONSTRUCTION: CORE DIMENSIONS OF THE CULTURAL CAPITAL THEORY

1.1 Definitions and Amendments

Originally proposed by French sociologist Pierre Bourdieu, cultural capital theory holds that cultural capital exists in three basic forms: embodied, objectified and institutionalised. Embodied cultural capital refers to the cultural knowledge and skills acquired by individuals through long-term learning and internalisation; objectified cultural capital is manifested in materialised cultural products, such as books and works of art, etc.,and institutionalised cultural capital is the cultural qualifications accredited by formal institutions, such as academic certificates or professional titles[1].
In the context of the age of digitalisation, the traditional theory of cultural capital needs to be further extended. This study proposes to add a new digital form (digitalised) as the fourth form of cultural capital. Digitalised cultural capital refers to the transformation of traditional cultural capital into interactive, storable and reproducible digital assets through digital technology. This form not only retains the value of the original cultural capital, but also enhances its dissemination, interactivity and innovativeness through technological means, providing new theoretical support for the transformation of heritage tourism.

1.2 Adaptation of Key Concepts

Cultural Capital Accumulation - Digital Intellectualisation technologies need to serve the reproduction of local cultural capital. In the context of digital intellectualisation, the accumulation of objectified cultural capital is no longer limited to the production and preservation of physical entities, but extended to the digital realm. Digital intellectualisation technologies (e.g. 3D scanning, blockchain, etc.) can efficiently complete the digital reproduction of local cultural capital while ensuring its authenticity and authority. This technology-driven accumulation approach offers the possibility of wide dissemination and value enhancement of cultural capital.

1.3 Problems: Fields and Habits

Conflict of fields: The heritage tourism field is often centred on the logic of 'education' and 'cultural heritage', while the technology field favours 'efficiency' and 'user experience'. "user experience". This difference may lead to confrontation between the two in cooperation, for example, technological solutions may ignore cultural depth, while cultural preservation may exclude technological innovation.
Reinventing habits: In traditional heritage tourism, tourists' habits are mostly "assive acceptance" - listening to explanations, looking at exhibition panels and taking photos. However, digital technology can intervene in tourists' behavioural patterns and change their traditional habit of "passive visiting". For heritage tourism, AR guides and interactive games can stimulate tourists' sense of active participation, transforming them from "spectators" to "experiencers" or even "co-creators".

2 LITERATURE REVIEW

2.1 Development and Expansion of Cultural Capital Theory

Cultural capital theory was proposed by French sociologist Bourdieu, and its core idea is that cultural capital exists in three forms: embodied, objective and institutionalised, and influences the social status and power distribution of an individual through education and social interaction[1]. With the advent of the digital age, scholars have begun to explore the evolution of cultural capital in the new technological context. For example, Hargittai puts forward the concept of "digital cultural capital", emphasising how digital skills and resources can be transformed into social power[2]; Ragnedda further points out that digital technology promotes the plurality of forms of cultural capital by reconfiguring the way culture is produced and disseminated[3].

In terms of Chinese research, Wang Ning proposes a localised reproduction path for cultural capital in the context of Chinese cultural heritage preservation practices, emphasising the importance of community participation in cultural transmission[4]. Li Jun, on the other hand, analyses the application of digital tools in the preservation of local knowledge, pointing out their potential to alleviate intergenerational ruptures[5].

2.2 Application of Digital Intelligence Technology in Heritage Tourism

Digital-intelligent technologies (e.g. virtual reality, blockchain, artificial intelligence, etc.) offer new paths for the transformation of heritage tourism. Kidd through a museum case study, notes that virtual reality technology can enhance the immersive experience of visitors while reducing the physical wear and tear of artefacts[6]; Lombardo and Pietroni explore the use of blockchain in cultural heritage authentication, with emphasising the contribution of its immutability to copyright protection[7]. In addition, Gretzel et al. suggest that intelligent recommendation systems enhance visitor engagement through personalised services, an idea that has been validated in the digitisation practices of the Palace Museum[8].

Among the practical examples in China, the "Digital Dunhuang" project of the Dunhuang Research Institute has realised the digital conservation of murals through high-precision scanning and a global sharing platform[9], while the AR tour system at the Liangzhu ancient city site has strengthened the educational function of cultural heritage through technological empowerment.

2.3 Interaction between Cultural Capital and the Tourism Economy

The economic transformation of cultural capital is an important issue in heritage tourism research. Throsby put forward the theory of "cultural value chain"[10], emphasising that cultural heritage needs to be released through creative industries and market mechanisms. Richards further pointed out that digital derivatives (e.g., NFT) provide new scenarios for the sustainable development of cultural heritage[11]. In China, Zhang Chaozhi analyses the role of cultural tourism integration policies in promoting the economic transformation of cultural heritage[12], emphasising the bridging role of digital tools; while the successful case of cultural creation in the Forbidden City demonstrates the path for cultural capital to achieve a win-win situation for both social and economic benefits through market-based operation[8].

3 ANALYTICAL FRAMEWORK: THE FOUR-DIMENSIONAL PATH OF CULTURAL CAPITAL TRANSFORMATION

Based on the expansion of Bourdieu's theory of cultural capital and the reconstruction of the context of digital intelligence, this study proposes the Capital-Tech-Power (C-T-P) model, which systematically explains the practical path of digital intelligence in heritage tourism from the four dimensions of embodiment, objectification, institutionalisation and digitisation. Transformation of Heritage Tourism in the four dimensions of embodiment, objectification, institutionalisation and digitisation.

3.1 Embodied Capital Transformation: from Individual Memories to Public Digital Assets

In traditional heritage tourism, embodied cultural capital is mainly expressed as cultural resources accumulated by local communities through tacit knowledge such as oral history and traditional skills. However, the intergenerational transmission of such knowledge is facing serious challenges in the transformation of digital intelligence. The younger generation, affected by globalisation and urbanisation, has a reduced sense of identity with local culture, leading to the ageing of inheritors and the loss of knowledge. At the same time, residents generally lack the ability to use digital tools, making it difficult to transform personal memories into shareable digital resources and creating cultural silos.

To this end, participatory digital archiving and training in habituation have become important strategies. Through the development of low-threshold mobile tools, residents are able to record local knowledge in the form of voice and video, forming a dynamically updated public database. This process not only relies on technological empowerment, but also requires digital cultural workshops to raise residents' awareness of the symbolic value of technology and to emphasise the significance of their behaviour for cultural transmission. Technological tools such as Natural Language Processing (NLP) and cloud computing support the efficient integration of data, while community participation breaks the traditional "expert-driven" mode of discourse and facilitates the transformation of cultural capital into a democratised reproduction. In this process, symbolic capital incentives, such as the certification of "digital inheritors", further strengthen the subjective position of residents, forming a virtuous cycle of cultural preservation and community development.

3.2 Objectifying Capital Activation: from Static Display to Dynamic Circulation

In traditional heritage tourism, the traditional exhibition mode of objectifying cultural capital is limited by physical space and lack of interaction, resulting in low utilisation of cultural relics and difficulty in releasing economic value. Digital intelligence technology provides a new path to solve this problem. Through high-definition scanning and 3D modelling technology, cultural relics can be transformed into digital copies, breaking through the limitations of physical protection. The introduction of blockchain technology ensures the uniqueness and authority of digital assets and provides technical support for copyright management and revenue distribution.

The development of derivative products further expands the value boundary of cultural capital. The generation of digital collections and the design of virtual experience products enhance the mobility of cultural capital and energise the transformation of its economic value. For example, NFTs (non-homogenised tokens) are issued in limited quantities to give cultural relics a collector's attribute, while VR technology builds immersive scenarios that enable tourists to shift from passive viewing to in-depth participation. Enabled by technology, the protection and utilisation of cultural heritage forms a closed loop, which not only strengthens institutionalised authority, but also enhances social influence through market-based operation, realising the sustainable activation of cultural capital.

3.3 Institutionalised Capital Empowerment: from Decentralised to Collaborative Governance

The authority of institutionalised cultural capital relies on uniform standards and multi-party collaboration, but in practice it is often challenged by fragmentation of standards and conflicts of interest. Differences in technical standards across organisations lead to data silos, while competition between local governments, cultural institutions and technology companies over cultural narratives further exacerbates management dilemmas.

The establishment of cross-domain governance alliances has become a core strategy to address this issue. Coordinating stakeholders through multi-stakeholder committees and developing unified technical standards and data-sharing protocols can effectively integrate resources and improve management efficiency. Policy instruments (such as tax breaks and R&D subsidies) provide incentives for technological innovation. At the same time, the reproduction of symbolic power is embedded in the mainstream ideology through technological means. For example, incorporating national narrative symbols in AR tours or declaring the sovereignty of cultural heritage on digital platforms consolidates official discourse while balancing commercialisation with public needs. The combination of institutionalised synergy and symbolic coding provides an institutional guarantee for the standardised protection and innovative use of cultural heritage.

3.4 Digital Capital Innovation: from Generational Disconnection to Emotional Connection

The alienation of digital natives from traditional culture stems from the disconnect between traditional exhibition methods and emerging experiential needs. Young people seek interactivity, personalisation and entertainment, and static cultural presentations are difficult to stimulate their interest. The combination of gamified narratives and artificial intelligence technology provides a breakthrough direction. Location-based service (LBS) games combine offline exploration with virtual tasks to reshape the logic of cultural experience; meta-universe scenarios build an immersive historical space through virtual identities to enhance the user's sense of immersion.

Artificial intelligence is further contributing to the deepening of emotional connections. By analysing user data to generate personalised narratives or designing virtual characters with emotional feedback, technology is able to relate abstract history to individual lives. This process not only enhances tourists' sense of cultural identity, but also transforms them from passive consumers to active co-creators. With the empowerment of technology, the intergenerational transmission of cultural capital can be reconstructed, and young people can re-establish their connection with tradition through participatory experiences, thus promoting the living transmission of cultural heritage.

AI Emotional Connection: generating personalised historical stories based on visitors' social data (e.g. ancestry-associated school move stories) to achieve emotional internalisation of cultural capital.

3.5 Model Integration: Synergies in the C-T-P Framework

The core of the "Capital-Technology-Power-Production" (C-T-P) model lies in the dynamic linkage between the three. Technological tools not only facilitate the transformation of different forms of cultural capital (e.g., the migration of embodied knowledge to digital assets), but also reconfigure the chain of cultural production through efficiency improvement and model innovation. Blockchain authentication enhances the liquidity of objectified capital, AI algorithms optimise user experience, and meta-universe technology opens up new cultural consumption scenarios.

The balance of power relations is the key to the realisation of the model. The C-T-P framework has shown that the digital transformation of cultural heritage needs to take into account the multiple transformations of capital forms, the systematic empowerment of technological tools, and the dynamic adjustment of power structures. This theoretical model provides a systematic path for the sustainable development of cultural heritage, with both academic explanatory power and practical guidance value.

4 CONCLUSION

Taking Bourdieu's theory of cultural capital as a starting point and combining it with the background of digitalisation technology, this study systematically explores the transformation path of heritage tourism. Through theoretical reconstruction, it proposes "digital cultural capital" as the fourth form of cultural capital, and constructs the model of "capital form - technology empowerment - power reproduction" (C-T-P), which reveals the multi-dimensional transformation mechanism of cultural heritage in the era of digital intelligence.

At the theoretical level, this study breaks through the boundaries of traditional cultural capital theories by adding a new form of "digital cultural capital", which responds to the profound impact of digital technology on cultural production and consumption. The core features of digital cultural capital - interactivity, reproducibility and authentication - provide new perspectives for the global sharing and sustainable development of cultural heritage. Meanwhile, the proposal of C-T-P model, for the first time, incorporates the relationship between technological tools and power into the analytical framework of cultural capital transformation, revealing that technology is not only a means of efficiency enhancement, but also a core driving force for power reproduction. This theoretical integration makes up for the inadequacy of analyses of the relationship between technological empowerment mechanisms and power in existing studies, and provides a systematic framework for interdisciplinary research.

On the practical level, this study provides an operational path for the digital-intelligent transformation of heritage tourism. Firstly, through participatory digital archiving and community empowerment, tacit knowledge can be transformed into public digital assets, promoting the democratisation of cultural heritage; secondly, the application of technological tools (e.g. 3D modelling, virtual reality) breaks through the limitations of physical space and enhances the accessibility and interactivity of cultural heritage; thirdly, the establishment of institutionalised synergistic mechanisms effectively integrates resources from different parties and balances the contradiction between cultural protection and market-based development; lastly, innovative strategies for intergenerational transmission (e.g. gamified narrative and emotional computing) reconstruct cultural heritage through the active participation of young groups. Finally, innovative strategies of intergenerational transmission (e.g., gamified narratives and emotional calculation) have reconstructed the logic of living transmission of cultural heritage through the active participation of young people. These paths provide theoretical basis for policy makers and industry practitioners to help release the value and sustainable development of cultural heritage driven by technology.

In conclusion, the digital-intelligent transformation of cultural heritage is not only a product of technological iteration, but also a social process of reconfiguring cultural capital forms and power relations. This study provides a systematic solution for the sustainable development of cultural heritage through theoretical expansion and practical path analysis. In the future, we need to continue to explore the symbiosis between cultural heritage and digital civilisation, driven by both technological innovation and social demand, in order to realise the sustainable value of cultural heritage and intergenerational sharing.

COMPETING INTERESTS

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QUALITATIVE ANALYSIS OF RESTAURANT CONSUMERS' PERCEPTIONS FOR DIFFERENTIATION OF TARGET CLIENTS UNDER MULTI-CATERING CULTURE

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Abstract: The COVID-19 epidemic has rapidly changed the catering industry and food delivery platforms. Different food delivery platforms aim to different consumer groups, especially in metropolises, where different catering cultures interact. How to designate a targeted marketing strategy is vitally important for restaurant managers. Using the webQDA software and TripAdvisor network resources, we propose a qualitative analysis of consumers' perceptions to three Chinese restaurants in Milan. The results reveal the apparent divergence in target clients of different Chinese restaurants. Cultural background is one of the factors affecting customers' sentiments towards the food.
Keywords: Consumers' perceptions; Qualitative analysis; webQDA; TripAdvisor

1 INTRODUCTION

Food meets basic human needs and contributes to a sustainable element of destination tourism [1]. By investigating 24 countries, the YouGov team finds that Italian food is the most popular worldwide [2], and Chinese cuisine ranks second. The novelty of this study is that, since there are few studies concerning the interaction between these two typical cuisines from the view of qualitative analysis grounded on customers' perceptions, hence, through examining the survival of Chinese restaurants in Italy, we can better understand the conflict and coexistence of two distinct food cultures. Since Milan is one of the cities in Italy where the Chinese are concentrated and achieves a high reputation for tourism to attract tourists worldwide with multi-cultural backgrounds, the data from the Chinese restaurants in Milan is considered. Besides, a more realistic motivation for this research is that, due to the COVID-19 pandemic, takeaway mobile phone apps increasingly emerge, such as 'Foodora', 'Fork' mainly for Italian consumers, 'Bentobus', and 'Guagua' mostly for Chinese consumers. Therefore, restaurant managers need to distinguish their audience customers and invest limited resources in suitable apps. This study classifies consumers with network resources, discovers the characteristics of potential clients, and then helps managers to formulate appropriate marketing strategies.

This qualitative study is conducted with the webQDA software and TripAdvisor website. The suitability of webQDA in qualitative data analysis is verified [3]. Ribiero et al. apply webQDA to analyse customers' reviews to accommodation in Portugal on the website of Booking [4]. We extend this research to the catering field and perform the content analysis to classify and label the target clients under multi-catering culture. Additionally, the webQDA software is widely applied in the research of multiple disciplines, such as education [5], nursing [6], and philology [7].

In qualitative analysis concerning catering, two main approaches of data acquisition were adopted in previous literatures. One is through questionnaires and interviews to obtain behaviour information. With the in-depth interviews and a questionnaire in Spain, Cantarero et al. confirm the high correlation between cultural identity and food choices [8]. Chen & Huang proposed the questionnaires to investigate 565 visitors in Chongqing city of China [9], and reveal that food imposes a variety of effects in different stages of travel. The other approach is collecting the user-generated data with network resources. The rapid development of the Internet profoundly influences the tourism industry [10]. Customers prefer to express the emotions via online platforms, thus forming user-generated data, which has the advantages of accessible collection, low cost, and openness. Jia proposed 49,080 reviews and ratings of restaurants on Dianping.com, and concludes that taste [11], environment, and service are the most influencing factors on ratings. Yu et al. analyse the reviews on Yelp.com and conclude that the restaurant features the customers perceived are different [12]. As the world's largest travel review site [13], the user-generated data on TripAdvisor is approved by the relevant research. The idea of employing TripAdvisor for the qualitative analysis in food tourism is inspired by Lin et al. [14]. Comparing the 17,214 reviews of TripAdvisor in two regions, Taiwan region and Catalonia, they find that the satisfaction of restaurants holds the positive relationship with the number of reviews before the COVID-19 pandemic. Considering the rating and reviews on TripAdvisor simultaneously to qualitatively analyse the interaction of different food cultures is also one of the contributions of this research.

The paper is organized as follows. In Section 2, the method and data collection process are described. Section 3 provides the data analysis. Section 5 concludes the principal results and further discussion.

2 METHOD AND DATA

2.1 Guiding Questions and Objectives

Since the issue concerns restaurant customers' distinction, the following questions are proposed before the data processing.
Q1: Is there a structural difference in the general comments to Chinese restaurants by customers of different nationalities?
Q2: Is there a structural difference in evaluating different types of Chinese restaurants by customers of different nationalities?
Q3: Are there significant differences between customers' positive and negative comments on different Chinese restaurants?
With the above questions, this study explores the divergence of customers' comments on three types of Chinese restaurants: Xi'er, a buffet restaurant serving both Chinese and Italian cuisines; WangJiao, a popular adapted Chinese restaurant having four branches in Milan; Chongqing Impression, a Sichuan cuisine Chinese restaurant being preferred by local Chinese, thereby to identify the different target clients. Hence, managers can formulate effective marketing strategies when considering the delivery platforms for different audiences. The other objective is to identify the differentiation in positive and negative reviews of different types of restaurants, and to provide reasonable suggestions for managers in subsequent operations.

2.2 Data Collection

Backward from May 28, 2020, the most recent 25 observations for each restaurant on TripAdvisor are collected. Only the complete data, containing the nationality of the reviewer, the time of the review, the rating (1-5 points), and the apparent overall evaluation, are included in the data set. For discovering the differences in evaluations by customers from different countries (i.e., from different food cultures), local Italians, Chinese and other nationalities should be considered when selecting reviews. Since the research is operated in Milan, Italians make up 50% of total collections, and non-Italians account for about 50%, where at least contains one-third of Chinese customers. Figure 1 presents the basic statistical characteristics of the nationality of the selected data. The remarkable point is that Xi'er restaurant locates near Milan Central Station and serves tourists primarily. Therefore, foreign tourists account for a more substantial proportion of its reviews.

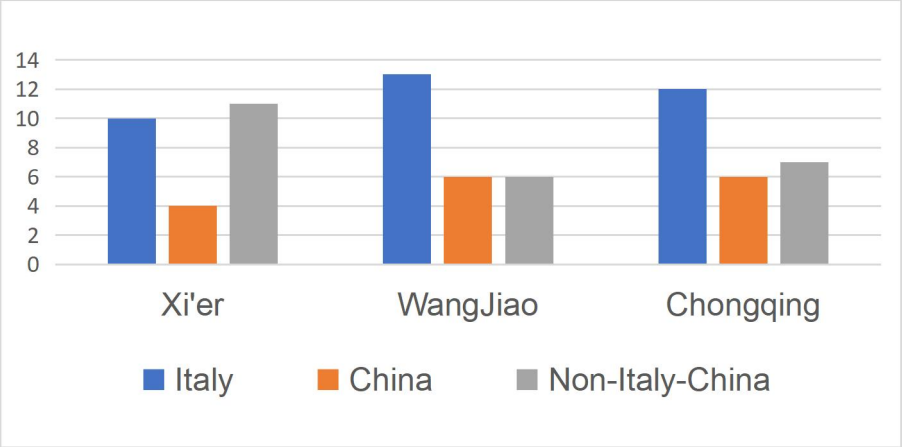

Figure 1 Proportion of Nationalities

2.3 Data Processing

The collected data is imported into webQDA as the internal resource. Descriptors are automatically generated by using restaurant (name of restaurants), date (time when the review was issued), country (reviewer's nationality), and rating (rating given by each reviewer, 1-5 points) as indicators. Then, the tree model is constructed to encode the three restaurants' overall evaluations, positive and negative comments.

3 RESULTS

After completing the above coding work, further data analysis through the matrix function and most frequent word function in webQDA is implemented.

3.1 Sentiment Analysis

The sentiment analysis through the ratings reflects the emotional changes of customers during the restaurant experience. The high or low scores indicate their praise or criticism of the restaurant. The role of sentiment analysis is to classify customers into different groups by emotional features of perceptions. The fact that sentiment analysis with ratings

makes the customer segmentation more accurate is confirmed in European markets [15]. In operations, we did manual marking of reviews and imported ratings into webQDA software, such that the matrix is generated.

First, the matrix is created to explore the differences in rating to overall Chinese restaurants of customers from different countries. Table 1 shows that the ratings of foreign tourists to Chinese restaurants are friendlier, mainly distributed at 3, 4 and 5 points. Since Italians are proud of the native food culture, their assessment of foreign catering is rigorous. 1 and 2 points appear in their ratings. Due to the familiarity with Chinese food, Chinese customers' evaluations are more objective and scattered at each level.

Table 1 Rating vs Country (Overall)

Rating \ Country	Italy	China	Non-Italy-China
1	4	2	0
2	2	1	0
3	5	1	4
4	17	5	12
5	7	7	8

Table 2 Rating vs Country (Xi'er)

Rating \ Country	Italy	China	Non-Italy-China
1	3	0	0
2	2	0	0
3	3	1	2
4	1	1	7
5	1	2	2

Then the same analysis is applied to different types of Chinese restaurants for checking the distinct differences among the target customer. In Table 2, some Italian customers give Xi'er low ratings since the restaurant also offers the Italian meals. Italians are highly loyal to their native cuisine and hard to accept the Italian meals made by Chinese restaurants. Conversely, foreign tourists' rating is much better. The following process with the most frequent words can indicate this disagreement between Italians and foreigners.

Table 3 Rating vs Country (WangJiao)

Rating \ Country	Italy	China	Non-Italy-China
1	0	2	0
2	0	1	0
3	1	0	1
4	9	3	4
5	3	0	1

Table 4 Rating vs Country (Chongqing)

Rating \ Country	Italy	China	Non-Italy-China
1	1	0	0
2	0	0	0
3	1	0	1
4	7	1	1
5	3	5	5

WangJiao, the new fusion with a lighter and sweeter flavour style, is deeply fascinated by the Italians. Table 3 presents that the Italians evaluate this restaurant highly, with 4 or 5, and no low ratings. However, the Chinese who live in Italy give some poor ratings because this adapted Chinese food loses its appeal. The Chongqing Impression restaurant is well known for its strong personality of Sichuan cuisine. Due to its authenticity, the Chinese appreciate it with the high scores, centred on 4 and 5 points. Meanwhile, highly contrary to the Italian food culture, Chongqing Impression obtains some comparably low ratings by the Italians who obey the native Italian eating habits, and some positive evaluations by the Italians who hold an open mind with the authentic Chinese food (Table 4).

3.2 Most Frequent Words

The most frequent words help to identify the main positive and negative comments. Figure 2 provides the most frequent positive comments for three Chinese restaurants. Xi'er restaurant is popular among foreign tourists because of the variety of food and affordable price, which meet the needs of major tourists. Keywords in WangJiao's positive evaluations are 'delicious' and 'food'. This adapted Chinese food with an exotic flavour satisfies the taste of local

Italians. The frequent positive comments of Chongqing Impression restaurant are 'authentic', 'original', 'Chinese', which mainly reflect the loyalty to native Chinese food culture.

Figure 2 Most Frequent Words of Positive Comments

Figure 3 shows the most frequent words of negative comments to these three restaurants. The main negative evaluations of Xi'er restaurant are 'food' and 'poor'. Typically, customers criticize the food quality in buffet restaurants. The most frequent negative comments on WangJiao focus on the hardware facilities and services. The waiting time is too long, and the restaurant is crowded. The negative evaluation in terms of dishes is mainly related to oil. As for the Chongqing Impression restaurant, significant negative comments are 'spicy' and 'informal', reflecting its characteristics, heavy oil, and strong taste. This feature will cause its evaluations to be highly diverse, but it also helps distinguish target consumers of Chongqing Impression more precisely.

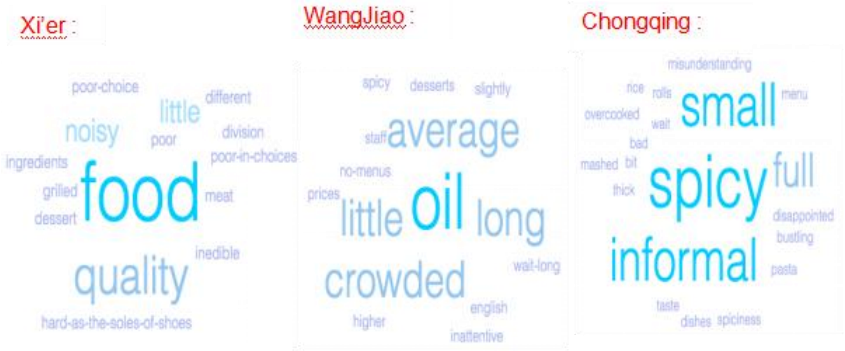

Figure 3 Most Frequent Words of Negative Comments

4 CONCLUSIONS

This study confirms an apparent divergence in target clients of different Chinese restaurants. This divergence emphasizes that the original cultural background affects customers' perceptions to restaurants under multi-culture of food, which should be an important factor for managers formulating the marketing strategy. Xi'er, the Chinese buffet restaurant, offers both Chinese and Italian meals, which can meet the needs of foreign tourists in pursuit of satiety and novelty. Hence, the location of this type of restaurant is better to close to stations. The marketing budgets should be more involved in the physical advertising of public transportation, such as airports and railway stations. Most customers of adapted Chinese restaurants like WangJiao are local Italians, so the marketing strategy of restaurant managers should focus on local popular takeaway apps, such as 'Foodora'. Authentic restaurants like Chongqing Impression mainly attract Chinese students living in Italy and Chinese tourists. Therefore, advertisements on some Chinese version apps, such as 'Bentobus', could be better. Meanwhile, considering the limited budget of overseas Chinese students and tourists, more discount marketing strategies should be formulated.

There exist some limitations in this study. The small amount of data may lead to some qualitative analysis deflections. Therefore, further discussion should focus on enriching the amount of data, including increasing the number of various types of Chinese restaurants in other European cities where Chinese gather and the number of selected reviews.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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