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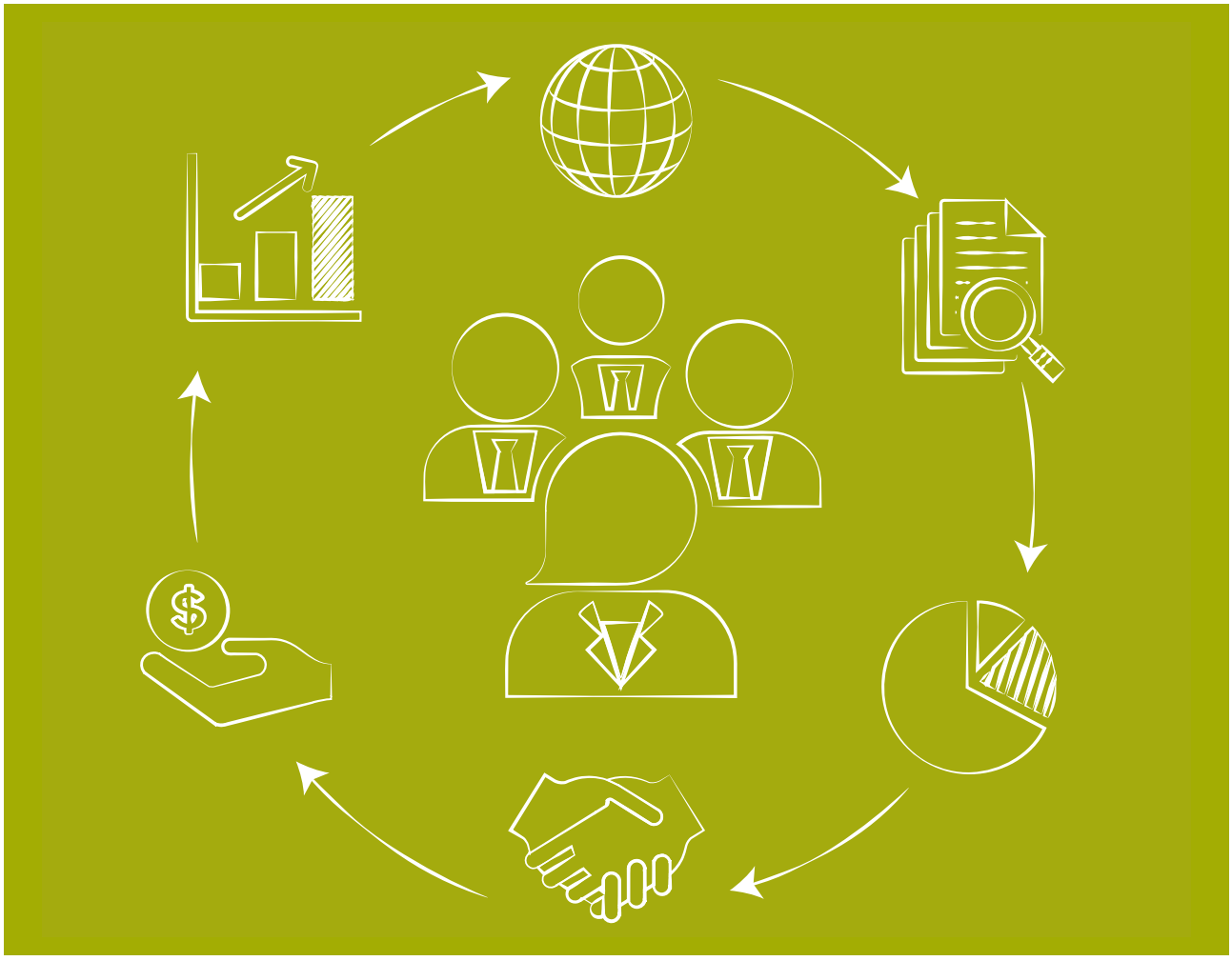

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INDEXATIONS

https://doi.org/10.17993/3cemp.2024.130153

/SUMMARY/

https://doi.org/10.17993/3cemp.2024.130153

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https://doi.org/10.17993/3cemp.2024.130153

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IMPACT OF SOCIAL MEDIA SITES ON THE DEVELOPMENT OF INLAND TOURISM IN SAUDI ARABIA: A FIELD STUDY ON A SAMPLE IN SAUDI ARABIA

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ABSTRACT

The study's objective is to examine the effects of social media usage on domestic tourism in Saudi Arabia and determine the factors that contribute to these effects. To accomplish this goal, we will analyze data regarding users' utilization of social media platforms and their influence on their responsible conduct towards domestic tourism. This analysis will be done by administering 886 questionnaires tailored to each user, the study also seeks to determine the elements influencing user response to this information, including age, gender, education, culture, socioeconomic status, and environmental factors. Amos will utilize equations to analyze the data. The study discovered a statistically significant correlation between the utilization of social media platforms to promote domestic tourism in Saudi Arabia and the variations in impact based on gender and educational attainment.

KEYWORDS

Social Media, Inland Tourism, Saudi Arabia.

INDEX

https://doi.org/10.17993/3cemp.2024.130153.15-34

1. INTRODUCTION

Social media is one of the most significant technological innovations of the last decade, and it has seen a dramatic development in use and diffusion worldwide. Among the sectors that have greatly benefited from this development is tourism, specifically the development of inland tourism. Saudi Arabia is one of the most essential destinations in the world, with a rich cultural and historical heritage and many beautiful natural sites. [5]. The development of social media has played a significant role in promoting domestic tourism and informing people about the Kingdom's contribution. The tourism industry's development considers the tourist destination's social and cultural environments, particularly its perceptions [25][30]. It considers tourism a promising sector in providing local employment opportunities and raising and promoting tax revenues. [25].

Tourism development has gained global recognition as a catalyst for economic growth, agriculture, energy development, and poverty alleviation. Although scientists disagree with empirical research, tourism development is widely believed to lead to economic growth [24]. Tourism participates in the growth and development of the State, primarily by bringing in multiple economic values and benefits and by helping to build the value, image, and identity of the brand in the region. As a significant contributor to economic growth [18], however, we must also face the potential challenges and problems that may arise from using social media to develop inland tourism. The dispersion of information, the spread of false news, the negative impact on privacy and safety, and the challenges of controlling the reputation and quality of destinations may arise. [39].

This study will contribute to a better understanding of the impact of social media sites on the development of inland tourism in Saudi Arabia. It will provide practical recommendations and suggestions to promote the effective use of these platforms in promoting local destinations. It will also contribute to guiding governmental and private efforts to strengthen the domestic tourism sector and achieve sustainable development in Saudi Arabia. Hence, the problem of the following:

Do social media sites have a statistically significant impact on the development of inland tourism in Saudi Arabia?

This scientific article aims to study the impact of social media sites on the development of inland tourism in Saudi Arabia. The various impacts of these platforms on the tourism sector will be analyzed, as well as how their practical use in promoting local destinations can be enhanced. A comprehensive research methodology, including a quantitative analysis of available data, was used, and previous studies and research on the impact of social media on inland tourism were also reviewed.

The importance of studying the impact of social media on the development of inland tourism in Saudi Arabia is to promote inland tourism. The development of domestic tourism is essential for strengthening the local economy and diversifying Saudi Arabia's sources of income. By understanding the impact of social media sites,

https://doi.org/10.17993/3cemp.2024.130153.15-34

promotion and marketing strategies for inland destinations can be improved, and demand can increase. In addition to raising community awareness, social media can play an essential role in raising awareness of Saudi Arabia's culture, heritage, and natural beauty among the community. By sharing personal images and experiences, national affiliation and pride can be enhanced, and interest in internal tourism can be enhanced. Impact on the local economy: Strengthening domestic tourism leads to increased spending in tourist areas, shops, restaurants, and local hotels. The contributes to the creation of new jobs, the strengthening of the local economy, and the improvement of the local population's standard of living.

Furthermore, the development of tourism infrastructure, where increased attention to inland tourism can enhance investment in tourism infrastructure, and famous tourism trends can encourage private and government participation to improve infrastructure, including developing tourism roads, facilities, and monuments. Finally, private sector development can enhance the role of the private sector in developing inland tourism. Hotels, tourist companies, and other facilities can use social media to promote tourism offers and services and attract more visitors.

The study of the impact of social media on the development of domestic tourism in Saudi Arabia aims to achieve several objectives, the most important of which is to understand the impact of social media. The study aims to explore and analyze how social media can influence tourism behavior and interest in domestic tourism in Saudi Arabia. The study will attempt to understand the patterns, trends, and impact of these platforms on destination selection and travel decisions. Improving promotion and marketing strategies: The study will analyze data and capture patterns and trends in the use of social media to promote internal tourism. This knowledge will be used to improve marketing strategies, promote internal destinations, and raise awareness and demand. Measuring the impact of social media on inland tourism: The study will assess the results and practical impact of social media in promoting inland tourism. Research and analysis tools will be used to measure the increase in demand for inland tourism and to identify the factors influencing this increase.

The results show that social media sites are crucial in promoting domestic tourism in Saudi Arabia. Local travelers can share experiences and destination information through these platforms and obtain valuable recommendations and tips [4]. In addition, tourism institutions and stakeholders can use social media sites to promote performances and events and raise awareness of the Kingdom's cultural and natural heritage. [34]

This article was divided into five parts arranged as follows: first, introduction, Second, Literature Review. Thirdly Methodology. Fourthly, Results and Discussion. Finally, it contains a summary of the findings and recommendations and a search horizon.

https://doi.org/10.17993/3cemp.2024.130153.15-34

2. LITERATURE REVIEW

Several studies covered the subject in various aspects, including the reference to the relationship between inland tourism and its impact on the quality of life. Study [25] Effects of tourism on residents' quality of life in Saudi Arabia: An empirical study, which examined the effects of tourism on the quality of life of residents of Saudi Arabia and identified a range of critical derivatives that could be affected by tourism. This article discussed four main dimensions that precisely define the scope of tourism: economic, social, cultural, and environmental; with the analysis of empirical data from Saudi Arabia, these dimensions are being tested about Saudi Arabia's broader demographic variables through a questionnaire from a sample of 775 locals living in the Makkah Al-Mukarramah area. A simple regression analysis was carried out, and a test (v) was conducted to examine the study hypotheses. A regression analysis showed that tourism had a rather direct impact on the population's quality of life. Analysis of test t showed that many demographic factors were primarily linked to the four dimensions of tourism. Also, a study [29] concluded that the participants had been granted leave as the primary motivation for choosing to spend their vacations locally; a recent study [34] investigates the impact of tourism on fostering economic growth in Saudi Arabia. The study utilizes annual time series data spanning from 2003 to 2019. The study employs fundamental statistical techniques such as correlations, unit root testing, and Johansen joint integration testing. The researchers are conducting tests on the decrease in joint integration and the Granger causality test to validate the correlation between tourism and economic growth. The findings indicate a significant and enduring correlation between economic growth and several aspects of tourism, including tourism profits, tourism expenditures, and tourist arrivals. Specifically, the number of tourists visiting a destination is closely associated with economic growth. This study conducted by Rehman and Alnuzhah [38] focuses on examining the relationship between tourism and economic growth. To determine the motives for travel or the intentions of tourists. The catalysts identified showed that "participation in new adventures has increased tourist knowledge and flight from routines has been the most important reason for visiting Saudi tourists in the Ha'il area. The cluster analysis results show that "relaxation" is the highest catalyst for tourists visiting Hail. Studies focused on social media, most notably Alqahtani & Saba, 2014, which were conducted through 646 online surveys and used for data analysis. The study conducted the Tokidi working analysis, structural equation modeling, and multi-cluster analysis to test hypotheses through SPS and AMOS. The results also showed that "the credibility of information" significantly affects "knowledge image," "emotional image," and "behavioral intention." The results also indicated that participants using Twitter and different platforms to search for emerging destinations had partially influenced the model. It contributes to understanding the factors affecting the images of emerging destinations through social networking platforms and influencing tourists' intentions to visit emerging destinations. This proposition is consistent with a study [19], which refers to the use of social media for e-commerce between small companies in Saudi Arabia through various sites, and a study [40], which argues that Internet and information technology are not critical factors for successful marketing of small and

https://doi.org/10.17993/3cemp.2024.130153.15-34

medium-sized businesses from the point of view of the Saudi Arabia tourism industry. What characterizes our study is that all studies have focused on an essential factor, namely, the underlying motives or factors affecting internal tourism, without considering their development factors.

3. METHODOLOGY

The research explains in detail how the study is designed, and data is collected and analyzed. This method includes the description of the sample used, the measurement tools used, and the statistical analysis methods.

3.1. STUDY MODEL:

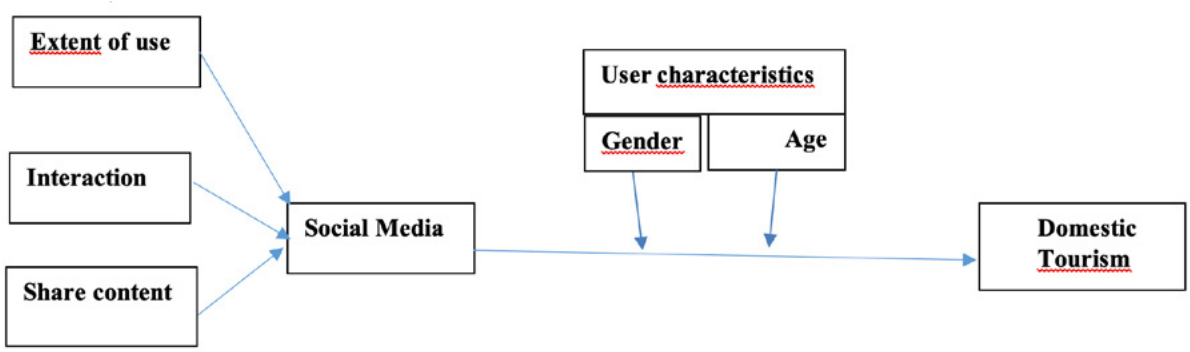

Figure 1. Model of Study

The usage of media has an impact, on domestic tourism with age and gender playing a role in how people interact and share content. The more individuals use media the more likely they are to come across materials, travel guides and recommendations for domestic tourism destinations and activities. This exposure can influence their decision making process. Inspire them to explore tourism options. Interacting with tourism related content on media through liking, commenting and sharing can also contribute to spreading information about tourism destinations and experiences. Positive interactions with content can generate interest among individuals making them more likely to consider tourism as a leisure option. Users who actively share content related to tourism contribute to word of mouth promotion by exposing their circles to information about local attractions, events and accommodations. When this shared content comes from trusted peers or influencers, within ones network it carries greater credibility and influence.

Different age groups may have patterns of using media and engaging with domestic tourism content. Younger generations, like Millennials and Generation Z are often more tech savvy and active on media. They rely heavily on platforms like media for planning trips finding inspiration from posts created by users and influencer recommendations. On the hand older age groups may not use media as much when it comes to travel planning but could still be influenced by content shared by friends or family members. Gender also plays a role in how people engage with tourism content

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on media. Research suggests that women tend to share and interact with travel related content frequently than men. This means that marketing strategies targeting social media users should focus on using user generated content, testimonials and captivating visuals to capture their interest in tourism experiences. Overall it is crucial for tourism marketers and policymakers to understand the factors that influence social media usage and engagement behaviors taking into account differences such, as age and gender. This understanding will help them effectively utilize media platforms to promote tourism initiatives.

3.2. STUDY VARIABLES:

3.2.1. SOCIAL MEDIA SITES:

Social connection is being facilitated through the Internet and the global network. Nevertheless, the swift proliferation of web features in the social realm, coupled with the affordable nature of online data storage, has enabled the provision of user-centric online spaces to Internet users. These spaces can be filled with user-generated content and offer numerous possibilities for interlinking, thereby facilitating the formation of virtual social networks. Social media services rapidly became a commercial and social phenomenon by capitalizing on the underlying necessities [37]. The most prominent social media platforms include Facebook, Twitter, Instagram, and TikTok. The word "social network" will be the initial concept mentioned while discussing the question: What is social media? The response could be deemed unambiguous. Facebook and Twitter are both prominent social media platforms. The reference is from Boyd and Brennan's work published in 2006. In the past decade, there has been significant growth in intricate, diverse, and highly engaged interactions between firms and their customers via social media platforms. Companies utilize social media platforms to enhance their reach to customers in different locations [15] and improve their brand perception [35]. As customers now view social media as a source of marketing information rather than just a promotional tool, it has become crucial for marketers to effectively utilize social media and its capabilities to control, analyze, and predict customer behavior. In order to gain a competitive edge and produce exceptional results [27], although corporate social media presents significant opportunities, there is currently a lack of a definitive definition or comprehensive framework to effectively incorporate social media into marketing strategies and fully comprehend the nature and function of social media marketing strategies [12]. Social media platforms serve as channels in marketing, enabling individuals to establish connections and exchange information and emotions. The reference is from Kaplan and Haenlein, 2010. Social media initiated three essential market developments initially. Social media enables companies and customers to engage in previously unattainable communication. Communication is facilitated through various platforms like Facebook, small blog sites like Twitter, and content communities like YouTube. These platforms enable social networks to form around shared interests and values [23].

https://doi.org/10.17993/3cemp.2024.130153.15-34

Additionally, "social media" and “[31]” refer to internet platforms or mobile phones that utilize content-focused techniques and user interaction [10 Page:17]. These platforms allow for two-way interaction through user-generated content and facilitate communication between users. [28]. Social media differ from traditional sources or static websites, as they are communication channels that enable users to generate and share their content and engage with information. Such platforms include Facebook, Twitter, Instagram, YouTube, and Google Plus.

3.2.2. HOME TOURISM AND THE FOUNDATIONS FOR ITS DEVELOPMENT:

Tourism literature frequently represents the factors influencing tourism as driving and attractive forces. The underlying principle of this concept is that individuals engage in travel due to the impetus of their internal motivations and the attraction of external factors related to the destination's characteristics. [7]. The two aspects that influence the decision-making process in travel are "payment" and "pull." Payment factors refer to the social and psychological motivations that enable a person to travel. At the same time, attractions are the specific aspects that draw a person to a particular destination when making a travel decision [7]. In the case of Saudi tourists, their attractions are primarily based on cultural and religious values. These facts indicate that Islamic culture strongly influences Saudi society, Dean. The study further substantiates the correlation between push and pull factors. In contrast to international tourism, which relies heavily on global regulations and colossal infrastructure, local tourism asserts that it has developed and is self-sufficient without substantial investments and marketing. It was suggested as a suitable substitute for international travel in response to external events like disasters and crises. [41]. The tourist industry in the KSA is a burgeoning sector seeing tremendous expansion. It is a critical priority in the Kingdom's vision for 2030. It contributes to the Kingdom's historical and heritage assets and its natural and cultural variety. The country is considered the birthplace of the Islamic religion, which adds to its appeal to travelers. [13].

3.3. STUDY COMMUNITY AND SAMPLE:

The research community consists of individuals residing on the northern border. Simultaneously, the researcher disseminated the resolution electronically using diverse communication channels for the sample study. There were 856 genuine replies available for analysis, around 10% to 20% of the total population [25]. The responses indicate the State of the community in thousands and are highly suitable for this study.

The study hypotheses are derived from the model:

The Galati hypotheses were derived from model 6. The initial primary proposition is that the respondents' responses indicate a positive trend for the studied variables.

https://doi.org/10.17993/3cemp.2024.130153.15-34

Second fundamental premise: H0: There is no statistically significant correlation between social media and the development of internal tourism in the sample, with a confidence level of 5%. This premise assumes the existence of three sub-suppliers.

H01/ There is no statistically significant correlation between the extent of social media usage and the growth of domestic tourism in the study sample, with a confidence level of 0.05.

H02/ There is no statistically significant correlation between the engagement on social media and the development of inland tourism in the study sample in terms of trust.05

H03/ There is no statistically significant relationship between the extent of engagement with social media content and the advancement of indoor tourism in the study sample in terms of trust.05

The third hypothesis posits that there are no statistically significant disparities between the research variables as a result of the social type variable in the study sample, with a confidence level of 5%. The fourth hypothesis posits that there are no statistically significant alterations between the study variables that can be ascribed to the age variable of the study sample, with a confidence level of 5%. The study employed the quantitative methodology [22] to examine data, obtain outcomes, and explain the associations and impacts among different variables in the study. In addition, extrapolation was used to examine and convey the results to the study community.

Educational instrument

Data collection from the study sample mainly relies on identification, which involves distributing surveys to people on the northern border through various communication channels. A total of 886 responses were obtained. Form 23 consists of three paragraphs, outlined as follows:

Section I: Personal details: This section focuses on acquiring students' personal information, including their gender, age, educational qualifications, and preferred contact methods.

Part II consists of the independent variable, social media, encompassing 15 paragraphs.

Part III includes the subsequent variable: The text consists of eight paragraphs and focuses on e-marketing. A pentagram ladder has been employed for the resolution.

https://doi.org/10.17993/3cemp.2024.130153.15-34

4. RESULTS AND DISCUSSION

Validation of form and method of statistical analysis

The method of validation was verified by administering The survey to a panel of experts. Several paragraphs underwent modifications, including additions, reformulations, and insertions. Therefore, the questionnaire was completed, and the stability of the research tool was assessed using the Alpha Crombach coefficient, which yielded a value as indicated in Table 01.

Table 1. Item-Total Statistics

principal variable	Subvariables	Number	Alpha Cronbach's
Social Media	Extent of use	5	0.93
	Interaction	5	0.92
	Share content	5	0.92
domestic tourism		8	0.91

Source: SPSS Outputs.

The results in table 01 specify that the persistence factor for each paragraph is 0.90, which exceeds the accepted reliability degree of 0.70. This factor suggests that the results are acceptable for scientific research. Furthermore, the overall measure of 0.92 indicates a high level of persistence in resolution.

Natural distribution test.

For a sufficiently high sample size, it is possible to infer the original distribution by applying the Central Limit Theorem, which assumes a normal distribution [9]. Among the statistical procedures employed, the Statistical Programme SPSS (24) has been utilized to perform the necessary statistical analyses utilizing the subsequent statistical tools:

- Performing calculations for mean and standard deviation.
- A correlation factor used to calculate the coefficient of interpretation.
- Calculate the values of f and t to ascertain the veracity or falsity of the hypothesis.
- Utilization of a multiple linear regression model.
- Studying the moral differences between study variables.

https://doi.org/10.17993/3cemp.2024.130153.15-34

Testing hypotheses and discussing results

The initial fundamental assumption is that the interviewees' trends positively correlate with the study variables. In order to verify this idea, the calculating averages are derived from the following:

Table 2. Descriptive Statistics

	Min	Max	Mean	St. Dev
Q1-5	1,2	5	3,842	1,046
Q6-10	1	5	4,018	1,0144
Q11-15	1	5	4,21333	0,92933
W1-4	1	5	3,37	0,8115
W5-8	1	5	3,81	0,84375
extent of use	2	5	3,8397	0,75504
interaction	1,4	5	4,0187	0,7691
share content	1,2	5	4,0485	0,78069
domestic tourism	1	5	3,2164	0,66586
social media	1,53	5	3,969	0,69153
N	886			

Source: SPSS Outputs.

Table 2 displays all variables' mean and standard deviation, allowing for the following observations: By applying the maximum range calculation approach, we can determine the threshold/level at which 5.4 divided by 3 is 1.33. Consequently, we may classify values from 1 to 1.33 as weak, 1.34 to 3.67 as medium, and 3.68 to 5 as strong. The social media variable had an overall calculation average of 3.97, indicating its relative importance for third-level (strong) researchers. The variable's standard deviation was less than 1 [14], suggesting there is weak dispersion in the sample responses. This deviation aligns with the findings of Glassy [16], Jacobs et al. [21], and Alghizzawi et al. [3], regarding the influence of social media on the effectiveness, precision, and user-friendliness of information. However, it contradicts the Nielsen & Schrøder [36], study conclusions, which have been more applicable to news rather than social media in the countries examined. Furthermore, it contradicted a study [1] that found a prevailing inclination among the participants to utilize social media platforms.

The mean level of domestic tourism was computed to be 3.2164, categorized as level II (average), with a standard deviation of less than 1. This discovery is consistent with a study carried out by Bogari et al. [7], which found "cultural value" and "religious" elements as the primary drivers for Saudi tourism. These characteristics include

https://doi.org/10.17993/3cemp.2024.130153.15-34

elements such as cultural, religious, advantageous, cognitive, social, economic, familial collaboration, attention, leisure, and accessibility to amenities. The citation is derived from the publication of Mufeed and Gulzar, [32]. This finding corroborates the initial premise, which posits that the interviewees had a favorable inclination towards the research variables. Additional information regarding this matter will be presented in the results section. The second primary hypothesis states that no statistically significant relationship exists between social media and the development of inland tourism in the sample used for the study at specified level of confidence. The number is 05, correlation analysis is necessary to address the issue of multiple linear correlation. It involves assessing the correlations between the four independent and dependent variables. This evaluation helps determine the extent of correlation between the independent and dependent variables. The table below displays the correlations between each independent variable and the dependent variable and the correlations between each independent variable and its corresponding counterpart.

Table 3. Matrix of correlations between variables

	extent of use	interaction	share content	social media	domestic tourism
extent of use	1				
interaction	487	1			
share content	310	324	1		
social media	106	480	408	1	
domestic tourism	362	509	610	567	1

Source: SPSS Outputs.

Table 4. Correlations between study variables

(domestic tourism) / (social media)	Correlation value	Significant level
extent of use	0.36	0
interaction	0.50	0
share content	0.61	0

Source: SPSS Outputs.

The table indicates a moderate association between the dimensions of social media and inland tourism. Nevertheless, there exists a disparity in the correlation between different elements within this relationship. The feature of inland tourism that holds the most tremendous significance is the sharing of material, with a connection factor of 0.61. This factor is closely followed by interaction, which has a connection factor 0.57. Ultimately, the level of usage is accompanied by a low correlation

https://doi.org/10.17993/3cemp.2024.130153.15-34

coefficient. The value is 0.36. These findings align with multiple notable investigations [2], which have arrived at three primary conclusions:

1. Many individuals utilize social media technology to gather information about appealing locations they desire to visit in Amman.

2. The majority of survey participants assert that negative encounters shared on social media regarding a specific destination influence their travel choices.

3. Numerous respondents emphasize the necessity for the Ministry of Tourism of the Sultanate of Oman to employ additional social media platforms, aligning with the findings of our study and a separate study [20], which determined that individuals now have the means to exchange knowledge, perspectives, and experiences through online communication. Furthermore, its influence extends to shaping the behavior of other users during the purchase process, in addition to a study conducted by [33].

The document outlines the goals, anticipated achievements, criteria for success, and metrics for evaluating performance during the two years, as shown in Table 05.

Table 5. Regression analysis of variance (ANOVA)

	The sum of squared variance.	Degrees of freedom.	Mean square variance.	Calculated F value	Moral level.
Regression	13.232	1	13.232	59.222	0
Residuel	13.182	59	223		
Total	26.414	60	-		

Source: SPSS Outputs.

The above table shows that Fisher's calculated value (59.222) and the corresponding level of morale (0.000) are estimated to be statistically significant. This estimation means rejecting the primary zero hypothesis and accepting the central alternative premise based on a statistically significant impact of social media on the development of internal tourism at the moral level (0.05.) of the sample in question. This result is consistent with Al-Badi et al. [2] and Bogari et al. [7].

Partial hypotheses test: The F test may be misleading because it tests the overall mentality of the model. In order to test the partial hypotheses, the T-test has been adopted to test the mentality of each of the model's teachers individually at a moral level (0.05 >=a). Table 06 below shows the following:

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Table 6. Testing the significance of regression coefficients according to the student statistic

	B	Std. err	BETA	T	SIG
C	287	449	-	639	-
extent of use	111	96	125	1.159	0.251
interaction	157	108	173	1.458	3
share content	404	108	387	3.755	0

Source: SPSS Outputs.

In order to explain the results of the above table, it is necessary to detail in detail the partial assumptions to be tested, which will be presented as follows:

Sub-Hypothesis 01:

Hypothesis H0: There is no discernible effect that is statistically significant of use on domestic tourism at a significance level of 0.05 at the institution under consideration.

Alternative Hypothesis H-1: There is a statistically significant impact of use on domestic tourism at a moral level (0.05.) in the institution in question.

The above table shows that the regression factor for the independent variable (economic dimension) was (0.111), the corresponding standard value is (0.125), and the corresponding T value is statistically unethical, with the calculated level of morale (0.251) being more significant than the approved level of morale (0.05), meaning acceptance of the zero hypothesis that there is no statistically significant effect of use on domestic tourism. This study agreed with the study [2] regarding the unenforceability of the use in the development of inland tourism while with the study [17], which social media have proved to be a significant means of communication that has spread throughout the region. Tourism is one of the sectors that has benefited most from the Internet. As a result, social media have become an integral part of any central or government tourism promotion and planning.

Sub-Hypothesis 02:

There is no statistically significant impact on domestic tourism at a moral level (0.05.) in the institutions in question.

Alternative Hypothesis H-1: There is a statistically significant impact on domestic tourism at a moral level (0.05.) in the institutions in question.

The above table (06) shows that the regression factor for the independent variable was (0.157), the corresponding standard value was (0.108), and the corresponding T value was (1.458), statistically unethical, with the calculated level of morale (0.003) being lower than the approved level of morale (0.05), meaning acceptance of the alternative hypothesis that there is a statistically significant influence on domestic

https://doi.org/10.17993/3cemp.2024.130153.15-34

tourism. This results is our agreed study [20] that social media have created new opportunities for interaction and communication among people. Today, online communication lets individuals exchange knowledge, views, and experiences. Its impact also goes further by influencing other users; behavior in the decision process [17] and, through the presence of the Internet in today's world, has also tended to be one of the most effective marketing and advertising tools. Social media has proved to be a significant part of the tourist industry.

Sub-Hypothesis 03:

The non-H_0 hypothesis: There is no statistically significant impact on domestic tourism at a moral level (0.05.) in the institutions in question.

- Alternative Hypothesis H_: There is a statistically significant impact on domestic tourism at a moral level (0.05·) in the institutions in question.

Table (06) shows that the regression factor for the independent variable (ethical dimension) was (0.404), the corresponding standard value is (0.108), and the corresponding T value (3.755) is statistically moral, with the calculated level of morale (0.000) being lower than the approved level of morale (0.05.iii.), meaning that the zero hypothesis and acceptance of the alternative hypothesis based on a statistically significant impact on domestic tourism are rejected, this was the case with several studies, most notably [2][7]. However, after the elimination of the extent of use because it does not affect the dependent variable (community competence sharing) in the sample in question, because the corresponding level of morale is greater than 5%, in which case we must delete the two former independent variables and re-analyze the statistically, the following results are shown:

Table 7. Summary of the Regression Model

R	R^2	R^2-Ajus	Standard error
702	493	475	481

Source: SPSS Outputs.

Table 8. ANOVA Test

	The sum of squared variance.	Degrees of freedom.	Mean square variance.	Calculated F value	Moral level.
Regression	13.02	2	6.51	28.195	0
Residuel	13.39	58	231		
Total	26.41	60			

Source: SPSS Outputs.

https://doi.org/10.17993/3cemp.2024.130153.15-34

Table 9. Testing the significance of regression coefficients according to Student statistics

	B	Std. err	BETA	T	SIG
C	210	418	-	501	-
interaction	474	107	454	4.432	0
share content	347	93	382	3.725	0

Source: SPSS Outputs.

The Mathematical model:

Through the deployment curve extracted from SPSS, we found that the study follows the linear model shown in the following equation:

$$Y_i = \beta_0 + \beta_1 * X_1 + \beta_2 * X_2 + \beta_3 * X_3 + \beta_4 * X_4 + \cdots + \varepsilon_i \qquad (1)$$

Whereas : Y_i is a Domestic Tourism, and X_1 is Interaction, and X_2 is Share Content, ε_i is Error term, and $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4$ is parameter of model.

And The final linear regression model becomes as follows:

$$Y_i = 0.21 + 0.474 * X_1 + 0.347 * X_2 \qquad (2)$$

5. CONCLUSION

The statistical analysis conducted using the Social Science Statistical Package Programme (SPSS) yielded the following findings: The first significant hypothesis posited that the importance of social media and domestic tourism variables supported the interviewees' positive attitudes towards the study variables. These results align with Glassy [16], Jacobs et al. [21], and Alghazawi et al. [3], who emphasized the impact of social media on the efficiency, accuracy, and ease of information use. However, this contradicts the findings of Nielsen & Schrøder [36], who found television more influential in news consumption than social media in the countries under study. It contradicted a study [1] that found a consistent pattern among the study participants to utilize social media platforms.

The findings on domestic tourism align with a study conducted by Bogari et al. [7], which identified "cultural value" and "religious" factors as the primary motivations for Saudi tourists. These factors were considered more significant than others, such as cultural, religious, beneficial, knowledge, social, economic, family group work, attention, relaxation, and convenience of facilities. Additionally, the study by Mansur and Mumuni [29] highlighted the importance of distinguishing between internal and external tourism in Saudi Arabia, which is consistent with the patterns observed in our study. Notably, our findings also support the notion that non-religious aspects of

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tourism are gaining prominence, as indicated by previous research on the subject. Mufeed and Gulzar [32]

This study's primary hypothesis suggests a statistically significant relationship between social media dimensions and overall domestic tourism. The statistical analysis revealed that the null hypothesis (H0) was unsupported, and the alternative hypothesis (H1) was accepted. This accetance means that social media significantly impacts domestic tourism in the sample study. Additionally, the study found that various practices influence domestic tourism.

By sharing personal images and experiences, people have encouraged each other to explore beautiful places and diverse cultures in the Kingdom. Social media has also made it easier for tourists to disseminate helpful information and advice about travel and accommodation in different places. It has also promoted awareness of Saudi cultural and historical heritage [38], increasing people's willingness to explore more local destinations. [11]. These efforts have significantly improved domestic tourism in the Kingdom in recent years. [41]. The number of visitors arriving at indoor tourist sites and interest in local events and festivals has increased. This increase in turn, has contributed to the strengthening and developing the local economy.

In short, social media have played a crucial role in stimulating domestic tourism in Saudi Arabia. It provided opportunities to promote destinations and provide better information and communication. As technology evolves and social media improves, we can expect a brighter future for internal tourism in Saudi Arabia. Strengthening cooperation between the tourism sector and social media can achieve tremendous success and sustainability in this area.

Therefore, social media's power must be invested in promoting domestic tourism while maintaining responsibility and accuracy in disseminating information. To continue to explore and promote the diversity of destinations in the Kingdom of Saudi Arabia and to contribute to the achievement of the 2030 Vision for the Development of Tourism as a Vital and Sustainable Sector that promotes the local economy and reflects the beauty and heritage of the Kingdom.

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EFFECTIVE HUMAN CAPITAL FORMATION FROM THE PERSPECTIVE OF BUSINESSMEN AND TRAINING EXPERTS IN SOUTHERN MEXICO

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ABSTRACT

The objective of determining the factors that contribute to achieve an efficient process of Human Capital Formation (HCF) according to the opinion of training experts and businessmen from the state of Yucatán. The information was obtained through a validated instrument by experts in the area. 17 businessmen and 18 HCF experts from Yucatan were interviewed. The interviews were made during the period of July-November of the year 2021. The businessmen stated that perspective the capital formation processes do not work because they are not made for their needs in terms of their line of business and/or size, and government programs are generic and not very adaptable to their requirements. A few of them stay close to their membership chambers because the majority don't see relevance benefits. The experts mention that it is difficult to train company personnel because there is not enough time to fully complete the activity and the expensive of the training. However, they agree that HCF is an extremely important activity as a differentiating element and is essential for the permanence and growth of enterprises.

KEYWORDS

Small and medium-sized enterprises, human capital, effective training, human capital formation factors.

INDEX

https://doi.org/10.17993/3cemp.2024.130153.36-54

1. INTRODUCTION

Companies are entities made up of resources, which can be human, financial, and material that exist and have a constant co-dependence and interrelation. The Resource-Based Strategy (RBS) considers as values of a company: assets, capabilities, competencies, organizational processes, its attributes (presence, information, knowledge, among others) that stimulate it to create and develop strategies to be more efficient and effective, i.e., these resources can be grouped into financial, physical, human, and organizational capital [1].

Nowadays, when talking about economic reactivation, after the pandemic caused by the SARSCOV 2 virus we experience an economic instability that affected the world, therefor the Human Capital proved to be the most asset that an organization can count on, due to its ability to adapt to new conditions and to acquire new learning and innovate in the way of carrying out its activities. Although the goal of an organization is the production of goods and/or services, which are carried out through tools and machinery and require financial resources to be acquired, the truth is that this objective could not be achieved without the intervention of human resources.

2. PROBLEM STATEMENT

According to the [2], companies can be classified according to the number of workers in them and the amount of their annual sales. Through these criteria, micro, small, medium, and large companies are presented for the economic sectors, but it is convenient to include the nano companies (which starts with one human element and evolves with it). More than 90% of the Mexican business economy is supported by MSMEs (micro, small and medium enterprises), microenterprises represent 94% of the total, 4.7% are small, 0.8% are medium-sized and 0.2% are large, according to the [3], this is why there is an urgent need to develop management strategies that increase the life span and promote their growth.

According to the data obtained, in the last 5 years (between 2014 and 2019), [3] observed an increase in registrations of 615,295 establishments, an average annual growth of 2.1%, this increase provides a positive outlook for the economic growth of the country, although the main challenge is to ensure their permanence in the market and not necessarily the opening, because, according to [4] in Mexico, more than 200,000 companies open operations per year, but 65% close before two years; 50% go bankrupt in the first year and 30% in the second, 10% manage to survive in the first 10 years, i.e., so this is an annual decrease of 22.6%".

In Mexico, small companies employ 14.7% of the country's workers, medium-sized companies 15.9% and their income corresponds to 16.1% and 21.9%, respectively, of the national total. It is important to highlight that 99.8% of the organizations that exist in Mexico are MSMEs, which is why this sector is a priority for the support of government programs with the objective of achieving their survival and consolidation [3]. The national average lifespan of a MSME is 7.7 years; in the case of the State of

https://doi.org/10.17993/3cemp.2024.130153.36-54

Yucatán it is 9.1, a higher figure compared to the national average and the other 31 entities in the country. This research was conducted in the State of Yucatan, since according to [5] this region is in the 5th place nationally in the marginalization index, having a high degree of marginalization, 6% of the inhabitants of 15 years or more is illiterate and 31.55% of the population of 15 years or more does not have basic education studies, this provides an overview of the development of Human Capital which this geographical area has.

The personnel hired in the SMEs in Yucatan, in general, tend to have a low level of schooling. We found that people in the State do not have the academic elements that facilitate the acquisition of new knowledge and skills to increase the Human Capital in a company. The low level of schooling is reflected in the percentage of the economically active population, 69.68% with incomes below 2 minimum wages.

These data show a great area of opportunity for the development of the State through the strengthening of Human Capital in the SMEs, which will contribute to the growth and consolidation by increasing their productivity, and therefore activate local economies.

There are 98,478 companies in Yucatán, representing 2.3% of the national total. Of these, 95.6% are micro-enterprises, small companies have a 3.6% share, and medium and large companies represent 0.7% and 0.1%, respectively. The growth of companies in Yucatan has been 2.8% annually according to data from the [6]. Companies aim to generate profits, so they implement strategies that result in their growth and consolidation.

There is a great diversity of strategies and the complexity of these vary depending on factors such as the target market, the company's line of business, its age and positioning, the capacity of its leaders, etc. These reasons make it difficult to determine a single strategy that an SME should follow to achieve its development and permanence in the market.

Yucatecan companies hardly document, disseminate or record their experiences, so this information is not used to create new knowledge or replicate successful methodologies. There is no validated and quality material to create guides, information, or success stories. This means that by applying an unsuccessful strategy there is a loss of time, money and resources that often results in the closure of SMEs. [7] mentions that when a company generates its own instruments from its experiences of success and failure, it generates through this flow of information, feedback that correctly applied has an impact on the use of resources and the efficiency of its processes and activities.

Yucatecan companies to achieve their organizational purposes, grow and consolidate require optimal performance in all areas, it is for this reason that the Human Capital (HC), that intangible asset, is a foundation on which companies must base the exercise of their activities, as it involves all areas and processes within the organization.

https://doi.org/10.17993/3cemp.2024.130153.36-54

This is difficult, especially because there is currently a complicated economic situation, because of the COVID-19 crisis, which caused many companies to reduce their workforces, cut their budgets and eliminate activities that they mistakenly consider as non-essential or that do not contribute to the achievement of the proposed objectives, such as Human Capital Formation (HCF).

According to [8] the demands in the labor field are increasing due to globalization, which demands qualified personnel who not only focus their efforts on the local or national market, but also on the international market, SMEs are immersed in this situation and although investment in Human Capital is considered expensive, intellectual capital is recognized as fundamental to generate value in companies, thanks to the benefit obtained in training innovation and knowledge. Likewise, it is proposed to link all personnel throughout the organizational structure and make them participants in the business strategy, to take advantage of their capabilities in the development of the organization.

Considering the above, the study of human resource management is inevitable, and it is also necessary to determine indicators to measure its effectiveness to take full advantage of it. The competitive success of SMEs depends on the ability of their workers to adapt to change, the efficient performance of their activities, teamwork, and the satisfaction of their personnel [8].

Another contribution of [8] is that they consider that the difficulties faced by the company due to the lack of specialization or HCF are: the lag of growth and development, due to the lack of knowledge of the skills and capabilities of its personnel for the development of competitive advantages and to generate added value. Its recruitment processes are less formal than those of large corporations, and this means that the personnel hired on several occasions have little training, in addition to the fact that the personnel have limited information for the exercise of the position; performance evaluations are moderately applied, all of which impacts its competitive capacity.

SMEs are less able to attract the best trained personnel, considering the salaries offered, which translates into greater investment in training so that they can perform their jobs efficiently and subsequently be exposed to a talent drain.

3. METHODOLOGY

For the purposes of the project, a qualitative approach with phenomenological design was proposed since the experiences of the study subjects were described and analyzed with respect to the scope of a specific phenomenon (Hernández-Sampieri & Mendoza, 2018). The objective of this research was to know the perception that the study subjects have about the HCF, the study method was inductive with field work, interviews were used to collect the information, making an interview guide as an application instrument.

https://doi.org/10.17993/3cemp.2024.130153.36-54

The design of the methodology was phenomenological, since the topics of study were oriented towards "the essence of experiences, what several people experience in common with respect to a phenomenon or process [9,10]". The information was collected through the application of the instruments made up of 37 and 19 questions; 35 interviews were conducted considering two groups of key informants: in the first, 17 entrepreneurs of SMEs in the State of Yucatan that implemented Human Capital Formation actions were considered, of which four belong to the primary sector, five to the secondary sector and eight to the tertiary sector, and in the second, experts from the State that are dedicated to providing training services to Yucatecan SMEs, of which we considered private sector training companies (13) that provide training in this area, independent consultants (2), government agencies (1), business groups (1) and business incubators (1). The first group of informants are geographically located in the municipalities of Motul, Muxupip, Progreso, Baca and Merida, all belonging to the State of Yucatan; as for the group of experts, all belong to the City of Merida.

Interviews were conducted remotely using Google Meet videoconferencing software, and when possible, these interviews were recorded, provided there was prior authorization from the interviewees. Since the interview is "a technical instrument that takes the form of a colloquial dialogue" [11] and with the pandemic being present and the existence of reduced mobility, it was the instrument of greatest value at this stage of the study.

A report was generated with the data obtained in the diagnosis by means of the applied instruments, this information was divided into quantifiable or measurable data and opinion or experience data. It should be noted that these instruments were validated through the judgment of experts, including specialists in strategic analysis and sustainable development, regional development, and business and enterprise, who evaluated the importance, relevance and accuracy of the instruments used.

The measurable responses were used to establish a frame of reference and visualize the context in which the SMEs find themselves in terms of the HCF in the State. As for the perception responses, these contributions were concentrated in two convergence matrices, to define the characteristic and useful elements that, in the opinion of the businessmen and experts, make the HCF effective.

4. RESULTS

The results of the opinion survey showed that the Yucatecan businessmen emphasized that the organization chart should strengthen the vulnerable areas detected in HCF, such as strategic planning, innovation and technology and quality. The reasons for training from this perspective arise from the search for a differentiation to generate competitive advantage, specialization and updating, being this the stimulus for compliance with the regulations established by the different levels of government. It should be noted that planning, strategic, quality, marketing and productivity benefit the fulfillment of organizational purposes and innovation, in

https://doi.org/10.17993/3cemp.2024.130153.36-54

contrast technology and human capital are elements that have limited the growth of these.

Entrepreneurs consider that they are updated as planned in their training program and when it is required to include new knowledge to increase the value and competitiveness of SMEs. They mention that only 10% of Senior Management are integrated in this process of strengthening Human Capital. The time allocated to the planning and delivery of training depends on the contracted company or the offer of the government agencies or chambers that represent them. The training is planned considering the Learning Needs Assessment (LNA), of the workers and the duration varies from 3 days to one week.

Figure 1. Factors that determining the type of HCF.

Figure 1 shows a series of factors mentioned that are considered to establish the type of HCF required; according to the responses, management initiative is the most common among the study groups, followed by the business line or activity of the company, and a learning needs assessment is the third most frequent item. Other factors are also mentioned in general, but these are not as common.

For their part, training experts consider that 33% of the responsibility for defining HCF needs lies with management, 22% with partners and shareholders, and 11% with human resources and employees, according to their experience in providing this service.

As in the interview with the employers, it was established that the management positions are the ones that decide most of the time on training needs. This situation is recurrent and therefore the involvement of the whole organization in the definition of needs should be considered. Of the responses obtained, only 11% involve the company's personnel.

https://doi.org/10.17993/3cemp.2024.130153.36-54

This way of making decisions may be due to different circumstances, for which it is advisable that before formalizing and carrying out the programming, the opinion of the workers to be trained be taken into consideration and, according to the information gathered, analyze it and verify the feasibility of including it in the planning of the HCF, in this way the efficiency and compliance with the objectives set could be increased.

According to these results, the HCF process comes mostly from managerial needs. In the context of SMEs, the owners or managers have the mission of seeking elements that allow them to improve the existing conditions in the company; sometimes, this situation causes growth to be asymmetric and for this reason they seek to correct the weaknesses they consider the company may have or improve the area that can give them a better position in the market.

However, this same dynamic does not contribute to a continuous flow of information between workers and management. It is necessary to implement mechanisms that better distribute the elements to decide the type of HCF needed and, above all, to actively involve all the elements of the company.

According to the data obtained, the HCF experts interviewed determine the needs of each SME in the HCF in different ways. In 61.1% of the cases, it is done through a DNA, depending on the business line or the company's own activities in 16.7%. Also, in 11.1% of the cases the type of training is determined by request of the partners, in 5.6% by governmental obligations to be fulfilled, and in 5.5% of the cases these experts already have pre-established HCF programs.

The companies describe that an HCF program must have good planning, as well as effective organization and coordination as indispensable attributes. In addition to these attributes, there must be control techniques in the company that allow the trained personnel to be evaluated and to be able to perform efficiently. We must mention that the HCF must be avant-garde, having a sensitive vision for the human part, managing to integrate all the human elements in the productive processes.

Even though SMEs recognize the importance of HCF, it is not always possible to establish programs in a feasible manner, since there are factors that hindered the training process (Figure 2), among these factors are time availability, a lack of understanding between the parties, or that there was not enough material to teach. In accordance with the above, it is necessary to establish fast and effective communication channels to reach a consensus and thus schedule the sessions for the personnel, this requires that those in charge of carrying out this action have direct contact with all the parties involved and thus consider all the needs of those involved in the process. Next, the businessmen interviewed noted that they considered the fee established for the contracted training service to be fair, and as for those received from government institutions and/or chambers of affiliation, they believe that they meet the objectives set, although they did identify deficiencies.

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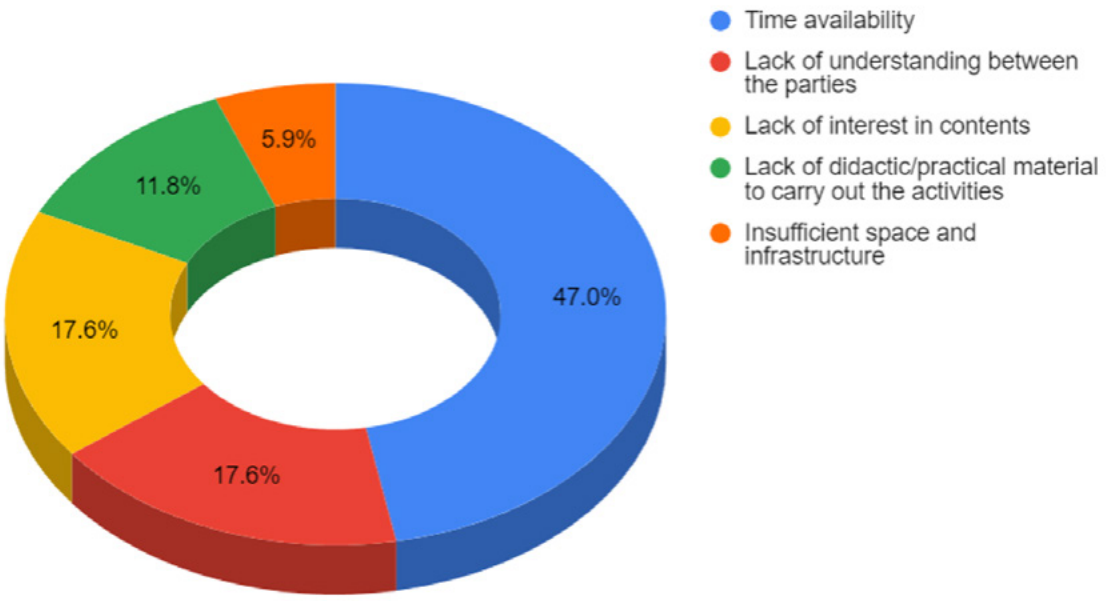

Source: Own elaboration.

Figure 2. Limitations observed by the experts in the delivery of Human Capital Training.

In Figure 2, the limitations observed by the experts at the time of implementing the HCF were availability of time (47%), lack of understanding between the parties (17.6%), lack of interest in the contents (17.6%), lack of didactic/practical material for an efficient performance of the personnel to carry out the programmed activities (11.8%) and lack of space and infrastructure (5.9%). Entrepreneurs are aware of the importance of training their personnel; however, it is difficult to organize the personnel so that it can be carried out efficiently. There is a need to establish effective strategies for planning and implementation to achieve training objectives.

Figure 3 shows a graph with a list of elements that the interviewed businessmen considered important by the training experts to define the program and carry out the Human Capital Formation. In this sense, before defining them, it is advisable to establish criteria that can give a specific weight in the organization, according to the objectives to be achieved and the impact on the achievement of organizational purposes and productivity. Companies requesting a HCF should keep in mind to determine the most important criteria to be met in a HCF and thus ensure the effectiveness of the process.

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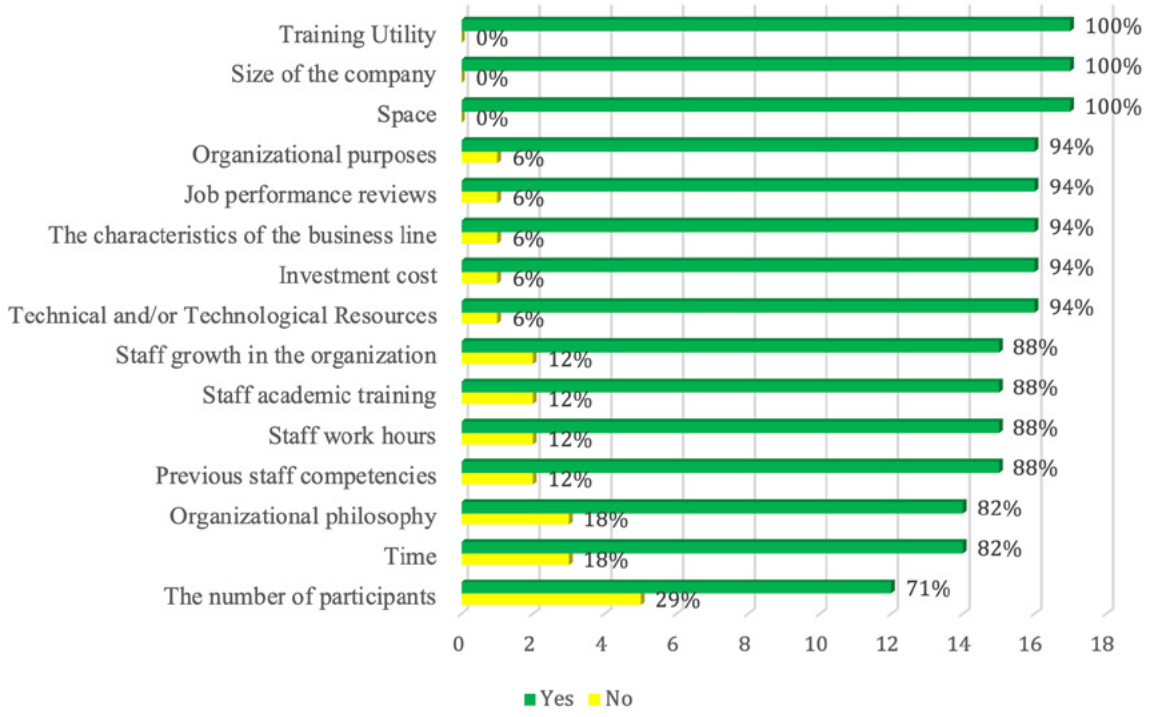

Source: Own elaboration.

Figure 3. Elements that company stated that training experts considered when conducting the HCF.

Figure 4 shows the reasons why Yucatecan companies would consider hiring HCF services again, because it provides the company with benefits such as:

1. Increased competitiveness.
2. Keeping up to date.
3. State-of-the-art in terms of market changes and governmental and fiscal requirements.
4. Increased productivity by providing employees with more tools to be more efficient in their work.
5. Motivation and commitment of employees to the company to see their professional growth.
6. Improvement in the job adaptation process for new personnel.
7. General changes beneficial to the company.

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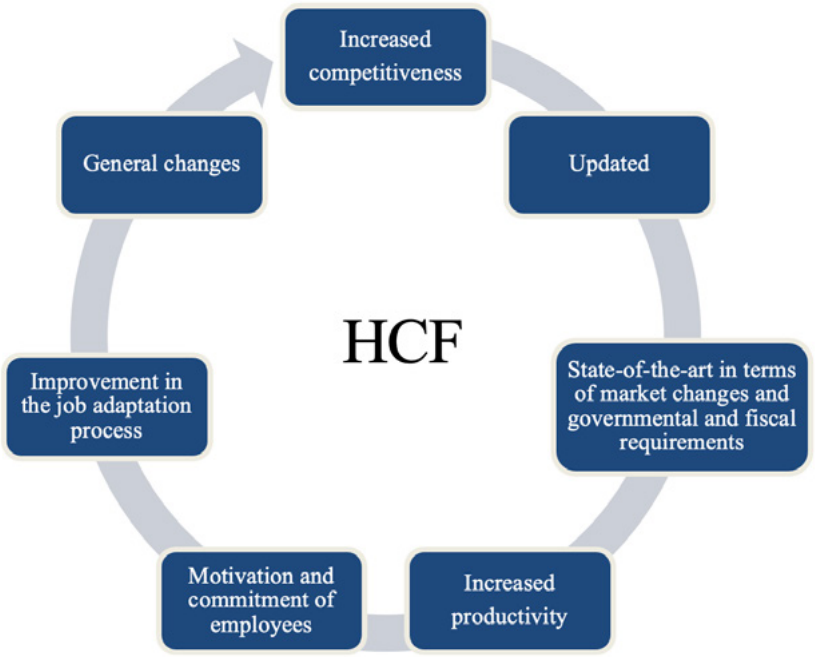

Source: Own elaboration.

Figure 4. Reasons why companies consider hiring HCF services again.

In the information obtained, the reasons why companies would not require a HCF again are mentioned, among the causes are that they do not have the time available and that workers do not feel encouraged by the results obtained. Regarding the fact that they would request training again, 88.2% mentioned that they would do it again and only 11.8% would not do it.

Source: Own elaboration.

Figure 5. How companies determine HCF needs.

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Human Capital Development needs are determined in the companies (Figure 5) through performance evaluations of personnel, according to their knowledge or handling of the products, as well as through observation and analysis of the processes to determine failures or opportunities for improvement in the services provided.

HCF is also required when new personnel are integrated into the company or when there are new administrative processes. Entrepreneurs recognize the needs of the company in the training of talent, but it is only carried out when it is necessary and according to what was stated by them, a continuous training process that guarantees and increases the Human Capital in the company in a progressive and constant manner was not observed.

Regarding the perception of the HCF received from the chambers and business associations to which they are affiliated, according to their line of business, the businessmen consider that these types of services are important and in general they are up to date and well-focused on the problems of the companies. The service provided by these institutions is excellent. They determine that they have an adequate overview and diagnosis of the reality of the organizations and have the means to provide an excellent service to the SMEs that request it.

The entrepreneurs interviewed mentioned some differences in HCF between a private and a government company: private companies develop a program tailored to the needs required, compared to government companies, which have established and generalized programs. They argue that both types of training are useful depending on the company's situation and something they consider important is the personnel in charge of delivering it, as it can largely determine the success or failure of the training process. Entrepreneurs see both types of training as viable, so it should be determined by other criteria such as cost or training time, to evaluate whether the program would adapt to and meet the needs of the company.

Regarding the effectiveness of training provided by companies or organizations outside Yucatán, businessmen consider that, although there are highly prepared companies and trainers in the state, it is always beneficial to have an external perspective that enriches and provides knowledge about practices carried out in other regions. This allows taking advantage of and adapting these practices in the organizations, considering the situation and context of small and medium-sized enterprises (SMEs) in Yucatan. It was detected that the main reason for seeking training with external agents lies in broadening the panorama and updating knowledge, which contributes to improving the company's competitiveness in its sector.

The businessmen interviewed also expressed their opinion on the use of educational platforms or repositories as effective and useful tools for training, highlighting that their greatest advantage lies in the ease of organizing workers' schedules, agendas, and activities, as well as the possibility of conducting training

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with people located in different places. However, they remark that the importance of face-to-face training should not be underestimated, since the dynamics are different. It was observed that employers are willing to use these modalities due to the advantages they offer, but it is important to consider that face-to-face training is necessary, especially for technical or practical topics.

Entrepreneurs point out that when planning the HCF, the trainer needs to know the strengthening needs of the company, the contents to be developed and the type of training requested. In addition, they need to know the number and schedules of the people who will take the training, the time available and some of them also indicate that they need to know the company's processes and policies. It is observed that in these answers the data requested are of a general nature and in detail of the topic to be developed, there is no mention of the work of joint development with the company of the topics to be addressed.

The businessmen determine that an effective HCF program must follow an adequate planning, organization, development and coordination, with the objective of optimizing the company's resources and time and respecting the employees' schedule; establish control mechanisms that promote an efficient performance and the personal achievement of the employees intrinsically and extrinsically related to the labor impact, so that their professional growth and development is measurable and the achievement of the planned objectives in the area where they work and the effectiveness in the implementation of the training is also measurable; to have an updated, visionary, humanistic and sensitive approach, that is to say, to be pertinent and avant-garde, capable of preparing the workers for the changes of the market without forgetting the human side in the process; in the same way that it is useful to solve the problems that the organization is facing and to integrate its personnel in the productive processes.

The answers indicate that the characteristics that should be taken into account when carrying out an HCF process according to their vision are: technical considerations should be made to define and delimit the topics; it is also important that the training uses techniques that allow the transmission and acquisition of knowledge and skills according to the established objectives; the instructor or instructors should consider the skills of the people to adapt the teaching strategies. The contents must be planned and updated to adapt them to the company's requirements. All this considering the time constraints of the organization and the number of people to be trained, as well as the space, tools, equipment, and infrastructure required for a proper implementation.

As can be seen, combining all these elements has a high degree of complexity, resulting on many occasions in which the objectives proposed in the planning are not completely achieved. The implementation of HCF is often done to solve an immediate need, however, there is no recurrent methodology and above all, there is no evaluation of the form and substance of the implementation of the process, to determine the degree of acceptance it has had with the personnel and if there is a

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change that allows this knowledge to be definitively established or that achieves a real and profound impact on the way the company's operations are carried out.

According to the training experts, for an HCF to be effective it must be followed up, however, they mentioned that 45% did it once, 27.3% constantly, 9.1% two or three times and 18.2% never. To this end, the criteria established at the time of planning this activity are the establishment of schedules and/or timetables, determination of objectives and analysis and selection of personnel to be trained.

These factors largely determine the strategy to be followed to establish a well-defined plan in terms of time and content, so the importance of analyzing the requirements is paramount in this phase of the HCF. The experts were consulted to find out what criteria they use to determine the time and space required to develop the proposed training, obtaining the following points to highlight: the contents to be developed, the time available for training, the space and equipment that can be used and the budget allocated. Based on these elements, the planning of the training to be carried out should be made, keeping in mind that there must be a balance that allows achieving the objectives set to achieve the effectiveness of the training.

The experts determine that the spaces, method and tools they use to implement the HCF are: courses, workshops and diploma courses in institutes, private, public institutions, business chambers and in some cases within their training center (considering the dependence of the informants), they are carried out through visual presentations in rooms or training areas with didactic material and/or equipment, to do practical exercises, if it is machinery it is carried out in situ; remote training is also considered with the use of platforms and digital repositories; some require trained instructors or autonomous learning is also promoted; the choice depends on the available resources, time and budget of each organization.

According to the experts, they mentioned that there is no single way to carry out the HCF process. As part of the analysis carried out, although there is an important variety of methods available, no methodology was observed to define which method is the most adaptable to the topics to be developed and the personnel that will carry out the training. It is of utmost importance to establish this on a recurring basis as this will increase the possibility of success in this process.

To carry out the analysis and determine the HCF needs, the informants (experts) involve the direction, management and heads of areas and Human Resources. It is most frequently observed that to determine the company's need for HCF, the decision is made by the highest hierarchical structures in a company, leaving the operational part or the clients in second place. This can make the training process ineffective, because in the absence of good communication between the actors who make the decisions and those who execute them, these determining elements are often not considered. It is advisable to include all the parties involved in this process on a recurring basis to know and delimit the real needs to be solved with this process.

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In the design of content for the HCF, the following are considered important: the profile of the personnel and the needs of the client. Regarding the personnel profile, the most representative and frequently mentioned are: work performance, knowledge, skills and abilities, willingness to learn, needs for improvement and attitude, the profile of the collaborator and his willingness to change. In this section, we reflect on the importance of the approach between who receives it and who benefits, the latter being one of the most important purposes of the existence of companies, customer satisfaction, which in this case is achieved with effective personnel training; Human Capital, values and profile of the collaborators are considered with the objective of making the most of these resources and maximizing their capabilities and skills to be more productive for the organization.

5. DISCUSSION

The main interest shown by entrepreneurs in Human Capital Formation arises because of observing that, by investing in this area, and achieving an improvement in the company's personnel, the quality of the products or services offered is increased, improving competitiveness in the environment, and giving the customer greater final satisfaction. [12] considers that the benefits obtained with the Training is the potentiation of the organizations through the improvement of the performance, which allows them the achievement of the established objectives. We must bear in mind that knowledge is currently the most asset of a company.

Analyzing the contributions of [13], in [14,16] and the entrepreneurs interviewed in this research, it is observed that there is a common denominator, that the education of people (Human Capital Formation), contribute to the economic growth of companies, in innovation, productivity, adaptation to the environment, in the willingness and involvement of employees and the impact is reflected in productivity and process improvement [17,18]. It must be highlighted that the leadership style influences the choice and motivation of the collaborator, work performance and therefore the innovation factor that can trigger the generation of new products and services [19]. However, the economic, social, and other needs presented by Human Capital in its work performance and its desire to continue learning through the training provided by current companies are associated with a desire for ongoing educational development. This leads to the specialization of personnel, thereby contributing to productivity and economic development [20]. In other countries, such as China, investments are made in innovation, technology, and science with the aim of boosting not only the economy of the main cities but also provinces and small cities. This investment impacts also in the attraction and formation of innovative talents with higher education (Human Capital), leading to an economic growth of the regions, stemming from the training and specialization of Human Capital concentrated in these regions [21]. This serves as an example of envisioning the future, focusing not only on individual companies but also on the global contribution of the human element within organizations, in their respective locations. These efforts further solidify the country's vision. It is necessary to invest in Human Capital because this is the backbone of promoting economic

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development and technological progress. There are simulations that indicate that the economic growth rate of a region that invests in the development and innovation of human capital is more than 80% in some cases [22]. It is necessary for companies and governments to direct this effort towards personnel, consolidating their capital, as the essence of achieving position and consolidation, in this case Mexico, the place of study of the present economic units.

In this regard [23] point out that to choose the type of training, all options should be considered, both external and internal, evaluating both to define the needs of the company [24]. Considering the experience and skills of the participants, knowing the materials at our disposal. All this will allow us to calculate the benefits and costs to be incurred. We will also be able to determine the time required to achieve the proposed objectives. As established by the [25], in its article 153-B "the purpose of training will be to prepare newly hired workers and others interested in filling vacancies or newly created positions." In that sense, training provides and strengthens new knowledge to Human Talent, which leads to better performance in the workplace [26].

6. CONCLUSIONS

In relation to the results of the Capital Formation programs, the interest shown by the entrepreneurs in learning about new tools to achieve the consolidation and growth of their companies, while at the same time achieving the professionalization of their processes, was identified.

On the other hand, in the implications of the training process, the nature of the service was detected: public or private. In the search for solutions that allow them to achieve these improvements in Human Capital, businessmen turn to private companies as the main source of training in the first instance, which, due to their nature, have the capacity to adapt to the needs of time, experience in the subject and business line, and to be able to train the necessary number of people who require this service. However, these types of entities have systems that are not very flexible, and the company must adjust its resources to the established conditions, which becomes complicated and inefficient.

An additional reason is that public agencies and chambers develop programs with the aim of covering as many business lines as possible, so that the information obtained is not necessarily adapted to the needs of the company and if it does so, it is incipient or general in nature, so it does not achieve a deeper understanding of the issues and solutions required by the participants.

Yucatecan entrepreneurs associate effective training with: an innovative and humanistic approach, having a direct or indirect relationship between work and the achievement of objectives, productivity-oriented instructional design, and solving problems relevant to the business context.

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The experts interviewed point out that for the HCF to be effective, the profiles of the trainees must be analyzed, considering the objectives set, as well as the strategies to achieve them in the medium and long term. Strategic planning and time availability for the training period must be considered. New paradigms can be created to improve the processes and activities performed. Always bearing in mind the needs and achieving a human development in the trainees. Integral participation should be encouraged, including the company's leadership positions, since they encourage participation and attachment in the different hierarchies. An effective training must be entertaining and enjoyable, and the instructors must have an effective communication and it is desirable that they are passionate about the topics presented.

Training must be carried out with a genuine interest in the employee's growth and have a positive impact on the purpose of institutional achievements and/or productivity, be systematic, measurable (before and after, depending on the results obtained, adjustments are made in subsequent courses) and technical in the area to be trained. Other factors mentioned were competitiveness, level of innovation, market trends, competencies, skills, attitudes and desires of the Human Capital and budget.

This work presents the difficulties encountered in the development of human capital, identifies the points of greatest interest to be solved in order to achieve an improvement in the formation of human capital. This approach leads to the development of customized methodologies that allow the development of human capital in the state of Yucatan. An increase in the level of innovation resulting from human capital will allow a greater economic development of the state and the region, since innovation today more than ever is a value that allows a competitive advantage in the globalized world.

Businessmen and experts in human capital formation are aware of these problems and must actively contribute to solve them, since to a great extent the growth of their companies will be reflected in the improvement of human capital. Currently Yucatan has a unique opportunity with the near shoring and must take advantage of it and enhance it by using its available human capital and must develop and enhance it to be able to compete in the world.

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/03/

THE EFFECT OF PSYCHOLOGICAL CONTRACT FULFILLMENT ON WORKER PERFORMANCE AT SAUDI ARABIA UNIVERSITIES AND THE MEDIATING EFFECT OF ORGANIZATIONAL CITIZENSHIP BEHAVIOR

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ABSTRACT

This study investigates the role of psychological contract fulfillment as a mediator between worker performance and organizational citizenship behavior. The psychological contract encompasses the reciprocal anticipations and responsibilities that exist between employees and the company. Worker performance encompasses the manner in which employees carry out their job duties and accomplish performance objectives. Organizational citizenship behavior, being an optional habit, can significantly enhance employee performance beyond the formal job expectations. The study will be conducted within a specific organizational context, and data will be collected through a survey given to the academic and administrative staff at seven universities in Saudi Arabia. The hypotheses will be tested and the mediating role of organizational citizenship behavior will be explored through statistical studies, including mediation analysis. The results will contribute to a more comprehensive comprehension of the impact of psychological contract fulfillment on worker performance through corporate citizenship behavior, offering valuable insights for firms aiming to improve employee performance.

KEYWORDS

Psychological Contract Fulfillment; Worker Performance; Organizational Citizenship Behavior; Mediation Analysis.

J.E.L. CLASSIFICATION

M12, J24, I23, C30, D23

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INDEX

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1. INTRODUCTION

In today's highly competitive business environment, organizations face constant challenges and opportunities that require agile and high-performing employees. The dynamic change in the environment refers to the continuous and rapid shifts and transformations that organizations face in various aspects, such as technology, market conditions, customer preferences, and competition. This dynamic nature of the environment requires organizations and their employees to adapt and perform effectively to remain competitive and succeed. Universities and companies need dynamic performance to grow in today's rapidly changing environment. The field of education is constantly evolving with advancements in technology and shifting societal needs. Universities must continually update their programs and curricula to stay relevant and provide students with the knowledge and skills needed to succeed in the job market. Universities play a crucial role in advancing knowledge through research and innovation.

In this context, worker performance refers to the ability of individuals to respond and develop in a dynamic environment [29][30]. It involves being flexible, innovative, and proactive in identifying and capitalizing on opportunities and effectively managing and navigating through challenges and uncertainties. The need for worker performance arises from recognizing that static and rigid approaches are no longer sufficient to sustain success in a constantly changing environment. Organizations must embrace agility, adaptability, and continuous Learning to stay ahead of the curve and seize emerging opportunities. Organizations recognize that high-performing employees are a valuable asset [5].

Numerous studies explore various aspects of worker performance, including its determinants, measurement, and enhancement strategies. Worker or employee performance can be defined as individual behavior in the workplace and how well the worker executes the job duties and responsibilities [34]. It encompasses various dimensions, including the task performance, the contextual performance, and the counterproductive behavior [37].

By continuously seeking ways to enhance worker's performances, organizations can ensure they have the capabilities and agility to respond effectively to changing market conditions and technological advancements. The skills possessed by workers directly impact the overall organization's performance. Performance requires a culture of continuous Learning and skill development [26]. Workers must stay current with industry trends, acquire new knowledge, and develop new skills to remain effective in a changing environment. By investing in their skills, workers can contribute to their organization's performance and adapt to emerging opportunities.

The standard contracts are often rigid and fixed, specifying tasks and duties without flexibility for change and may not include specific provisions for acquiring new skills beyond the specified tasks [28]. Those contracts often face criticism for their inability to accommodate transformations and changes in the external environment. Some of

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the criticisms include a lack of flexibility, Learning and development constraints, and a Lack of wage and reward flexibility [45].

Social exchange theory emphasizes the reciprocal nature of social relationships within organizations and how perceptions of exchange influence employees' decisions to engage in dynamic performance [14][7]. By recognizing and promoting a positive social exchange, organizations can encourage and reinforce worker performance, ultimately fostering a positive work environment and enhancing organizational performance. Social exchange theory focuses on social relationships as exchanges of resources, where individuals engage in reciprocal interactions with the expectation of receiving benefits in return [11].

The psychological contract can provide a framework for understanding the reciprocal nature of the employer-employee relationship. The psychological contract refers to the unwritten set of expectations, beliefs, and obligations between employees and their organizations in the context of the employment relationship. It represents the mutual understanding of what each party expects from the other and what they perceive as their obligations and entitlements [12][36]. The psychological contract is not formal or legally binding but an implicit agreement that evolves through interactions, communication, and experiences between employees and the organization [15]. In the psychological contract, employees must develop new skills valued by the employer, successfully perform new tasks in return for opportunities and resources for career advancement, and take on increased responsibilities within the firm, enhancing long-time employability and promoting continuous Learning.

Thus, how does psychological contract fulfillment affect worker performance at Saudi Arabian universities?

Studies have demonstrated that meeting the expectations and obligations of the psychological contract can result in the development and strengthening of organizational citizenship behavior [24][10][36]. Employees are more likely to feel supported by the organization when they sense that their contributions are valued and their personal and professional growth is fostered. Therefore, does organizational citizenship conduct also serve as a mediator in the connection between psychological contract fulfillment and workers' performance at Saudi Arabian universities?

Hence, the objective of this study is to investigate the intermediary impact of organizational citizenship behavior and get a deeper understanding of how psychological contract fulfillment affects employee performance, as well as the role played by organizational citizenship behavior in this mechanism within Saudi Arabian universities. More precisely, the study seeks to examine the conduct a study on the structure of psychological agreements among employees at Saudi universities. Evaluate the extent to which employees demonstrate organizational citizenship behavior. Analyze the correlation between the fulfillment of psychological contracts and the performance of workers. Examine the influence of meeting the expectations outlined in the psychological contract on the performance of employees, both in terms

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of their direct work output and their indirect contributions to the business through behaviors that go beyond their formal job requirements. Enhance the current understanding of the correlation between the fulfillment of psychological contracts, organizational citizenship behavior, and worker performance, with consequences for the management of organizations and human resource practices.

This article was divided into five important parts: the introduction, the second part covering literature review and hypothesis, the third part focusing on materials and methods, the fourth part presenting the results and discussion, and finally the conclusion, which includes recommendations and future research prospects.

2. LITERATURE REVIEW AND HYPOTHESIS

2.1. PSYCHOLOGICAL CONTRACT FULFILLMENT AND WORKER PERFORMANCE

The concept of the psychological contract was introduced by Argyris [4] and further developed by Santos et al., [41]. Define the psychological contract as an "implicit agreement" resulting from mutual expectations between the organization and its employees [15]. The parties involved in the contract are not necessarily aware of these obligations [45]. Rousseau [38] made significant contributions to the understanding of psychological contracts. And defines the psychological contract as an employee's belief regarding mutual obligations, which creates the impression of obligation based on "promises rather than expectations" (such as fair pay, job security) and obligations towards the organization like loyalty, discipline, sacrifices [38]. The contract is a binding commitment to an exchange agreement between two or more parties [39], where the employee is aware of the obligations in the psychological contract without the explicit declaration of the organization [43][38]. The employees' perceptions of promises in the psychological contract depend on their understanding of the organization's practices and future intentions [8].

The psychological contract within employee-employee relationships can be classified into four broad forms. These forms can differ based on the nature of the expectations, obligations, and exchanges between employees and organizations [38] [22]. The relational psychological contract is based on loyalty and stability; the employee is required to support the organization and commit to its needs and interests in exchange for the organization's commitment to support the employee's well-being and interests. The employee is obligated to stay with the organization and fulfill their tasks, while the organization is committed to providing long-term employment and compensation.

The transactional psychological contract is based on a transactional relationship; the contract is usually short-term and limited; the employee is obligated to perform a limited and specific set of tasks, while the organization commits to limited participation

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in decision-making and limited contribution to training and self-development [43][38] [22][42].

In the Balanced Psychological Contract (Bpc), the organization commits to delegating responsibilities, granting access to information, providing tools for goal achievement, and offering opportunities for self-development. In return, the employee accepts the organization's goals, commits to demonstrating adaptability to achieve expected performance, and seeks to acquire necessary competencies, expand skills, or develop areas of work. This commitment is embodied through external employability development, internal advancement, and engaging in dynamic performance [42].

The Transitional contract is when the employee accepts a temporary position that meets immediate needs but is unsuitable for the long term. These contracts are often associated with organizations undergoing restructuring or change, where no expectations can be confirmed due to unclear directions or a future vision [43][38][42]. This contract presents no commitment from either party, so they do not constitute an accurate psychological contract [23].

Based on the above, the hypotheses would be as follows:

H1: Relational psychological contract fulfillment affects worker performance at Saudi Arabian universities.

H2: The transactional psychological contract fulfillment affects worker performance at Saudi Arabian universities.

H3: Balanced psychological contract fulfillment affects worker performance at Saudi Arabian universities.

2.2. PSYCHOLOGICAL CONTRACT FULFILLMENT AND ORGANIZATIONAL CITIZENSHIP BEHAVIOR

Organizational Citizenship Behavior refers to the discretionary actions and behaviors of individuals within an organization that are not explicitly part of their formal job description but contribute to the overall functioning and effectiveness of the organization. OCB-i includes helping colleagues, volunteering for additional tasks, showing courtesy, and offering suggestions for improvement [50]. These behaviors are not explicitly rewarded or mandated by the organization but contribute to the overall effectiveness, productivity, and well-being of the workplace [31][35].

When employees perceive that the organization values their contributions and supports their personal and professional development, they are more likely to feel supported by the organization. The employees engage in O.C.B. only when they perceive that their employment relationships are based on social exchange [35][31] and to reward their organizations for fair treatment. The fulfillment of the psychological

https://doi.org/10.17993/3cemp.2024.130153.56-79

contract can lead to the emergence and reinforcement of organizational citizenship behavior [24][10][36][2].

Multiple researches have identified a detrimental correlation between the violation of the psychological contract and the display of organizational citizenship behaviors [13][49][36]. Employees' motivation to engage in corporate citizenship activities may decrease if they perceive a breach of the contract, such as unmet promises or unfair treatment [13][36]. The findings highlight the significant impact of corporate commitments and promises in driving employees' behaviors and attitudes, based on the principle of reciprocity.

H4: The relational psychological contract fulfillment affects the organizational citizenship behavior at Saudi Arabian universities.

H5: The transactional psychological contract fulfillment affects the organizational citizenship behavior at Saudi Arabian universities.

H6: The balanced psychological contract fulfillment affects the organizational citizenship behavior at Saudi Arabian universities.

2.3. ORGANIZATIONAL CITIZENSHIP BEHAVIOR AND WORKER PERFORMANCE

The relationship between organizational citizenship behavior and worker performance has been a topic of interest in organizational psychology and management research. Research has generally found a positive association between OCB-i and worker performance. Worker performance encompasses various dimensions, including task performance, contextual performance, and counterproductive behavior [33].

Task performance refers to the extent to which employees fulfill their formal job requirements and achieve the objectives of their assigned tasks. OCB-i can have a positive impact on task performance through various mechanisms. Employees who engage in OCB-i may be more committed to their organization and have higher levels of job satisfaction, which can enhance their motivation and effort in performing their tasks. Additionally, employees who engage in OCB-i may also develop more robust social networks and positive relationships with colleagues, which can facilitate information sharing and collaboration, ultimately leading to improved task performance [1][37][29][30].

Contextual performance, also known as extra-role performance or organizational citizenship behavior, refers to behaviors that are not directly related to an employee's formal job requirements but contribute to the organization's overall functioning. Motowildo et al., [30] suggest that contextual performance can contribute to a more harmonious work environment. While these behaviors may not consistently be formally recognized through the reward system, Smith et al., [46] acknowledge that

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they can positively influence supervisory ratings over time. The contextual performance is often seen as a form of OCB-i. Research has consistently shown a positive relationship between OCB-i and contextual performance. Employees who engage in OCB-i are more likely to go beyond their formal job requirements and engage in behaviors that benefit their colleagues and the organization. This behavior can improve team dynamics, increase cooperation, and enhance organizational performance.

Counterproductive behavior refers to actions that can harm the organization or its members. These actions include behaviors such as theft, sabotage, absenteeism, and workplace aggression [40]. Research such as Sypniewska [48] and Spector & Fox [47] have found a negative relationship between OCB-i and counterproductive behavior. Employees who engage in OCB-i are less likely to engage in counterproductive behaviors because they exhibit higher commitment, loyalty, and positive work attitudes. They are also more likely to be invested in the success and well-being of the organization, which can act as a deterrent to engaging in harmful actions.

H7: The organizational citizenship behavior affects the organizational citizenship behavior at Saudi Arabian universities.

2.4. THE MEDIATING EFFECT OF OCB-I BETWEEN PSYCHOLOGICAL CONTRACT AND WORKER PERFORMANCE

The mediating effect of OCB-i between psychological contract fulfillment and worker performance suggests that the relationship between psychological contract fulfillment and worker performance is partially explained by the extent to which employees engage in OCB-i. In other words, when employees perceive that their psychological contract is being fulfilled, they are more likely to engage in OCB-i, which enhances their overall worker performance.

Studies have provided evidence for this intermediate influence, indicating that when employees feel greater levels of psychological contract satisfaction, they are more inclined to exhibit organizational citizenship behavior directed towards individuals, resulting in enhanced worker performance.

H8: The mediating effect of OCB-i between Rcp and W.P. at Saudi Arabian universities.

H9: The mediating effect of OCB-i between TrCP and W.P. at Saudi Arabian universities.

H10: The mediating effect of OCB-i between Bcp and W.P. at Saudi Arabian universities.

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3. MATERIALS AND METHODS

3.1. DATA

3.1.1. SAMPLE SELECTION

The academic and administrative personnel representing seven (07) Saudi universities are Northern Border University, King Saud University, King Faisal University, King Khaled University, Qassim University, University of Hail, and University of Tabuk. The questionnaires were randomly distributed using the employees' emails in the selected universities.

3.1.2. SOURCES OF DATA

Four hundred twenty-three employees answered the questionnaire prepared to test the hypotheses of this study.

3.1.3. STUDY MODEL

The study is grounded in a theoretical framework that establishes a connection between the fulfillment of psychological contracts and worker performance. This connection is mediated by the role of organizational citizenship behavior, as depicted in Figure 1.

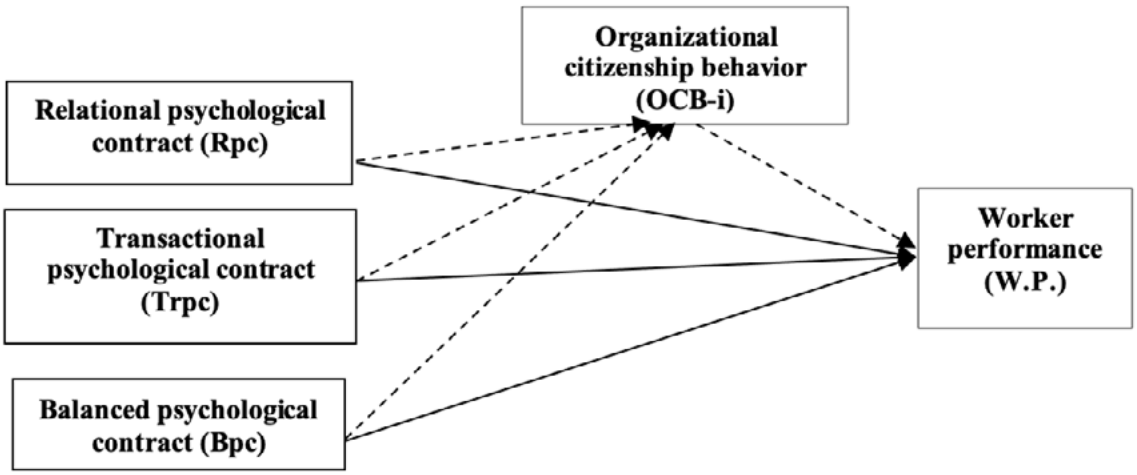

Figure 1. Model of OCB-i as a mediator between psychological contract fulfillment and worker performance.

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3.2. MEASURES

In order to examine the assumptions, original data was gathered from a sample comprising academic and administrative personnel from seven (07) Saudi universities. A questionnaire consisting of questions was designed to measure the study variables. A Likert scale ranging from "5= I agree strongly Agree" to "1= I strongly Disagree" assessed all construction aspects. The Rousseau [39] model was used to measure the psychological contract fulfillment, with four items for each: relational psychological contract (Rpc), transactional psychological contract (Trpc), and balanced psychological contract (Bcp). For the worker performance variable, Koopmans al. (2014) model was used, which utilizes three dimensions: task performance (Tskpr) (5 items), contextual performance (Ctxtpr) (8 items), and counterproductive behavior (CBve) (5 items). As for the mediator variable "organizational citizenship behavior, the model used was the Organizational Citizenship Behavior (OCBi) of Spector & Fox [47] and it consists of 10 items.

3.3. VALIDITY AND RELIABILITY

The Cronbach's alpha coefficient was computed to assess the reliability and internal consistency of the research instrument. Fornell and Larcker [18] state that a Cronbach's alpha value greater than 0.6 is deemed dependable, irrespective of the scale's item count. Table 4 displays the alpha Cronbach value for all variables tested, ranging from 0.69 to 0.92. Hence, this scale is dependable.

Table 1. Reliability Questionnaire Test

	N	Cronbach's Alpha value
OCBi	10	923
Tskpr	5	0.70
Ctxtpr	8	787
CBve	5	908
Bpc	4	847
Rpc	4	783
Trpc	4	755

Source: Data analyzed using SPSS

3.3.1. TOOLS

For testing the hypotheses of this study, a set of statistical methods were employed:

https://doi.org/10.17993/3cemp.2024.130153.56-79

- Cronbach's alpha reliability analysis assesses the internal consistency of a scale or measure.
- Confirmatory Factor Analysis (C.F.A.) examines the underlying structure of a set of observed variables and confirms the measurement model.
- Path analysis is used to identify the direct and indirect effects of variables by examining the relationships between them.

3.3.2. DESCRIPTIVE ANALYSIS

The questionnaire was distributed to academic and administrative staff at 07 Saudi universities. The responses were collected from 423 employees, and it was found that From the table, we can observe that the sample used in the study consists of 67.4% males and 32.6% females. Approximately 44% of the sample individuals have 5-10 years of experience, and 22.2% have work experience exceeding ten years. Moreover, the percentage of individuals belonging to each university in the sample is similar, ranging from 7.3% to 18.9%, and this avoids bias in the respondents' answers. Table 2 presents the displayed results.

Table 2. Personal statistics for the study

	N	P (%)
Gender :		
Male	285	67.4%
Female	138	32.6%
Experience:		
1 -5 years	140	33.1%
5-10 years	189	44.7%
> 10 years	94	22.2%
University of employment		
Northern border university	74	17.5%
King Saud University	31	7.3%
King Faisal university	54	12.7%
King Khaled university	42	10.00%
Qassim university	63	14.9%
university of Hail		
university of Tabuk		

Source: Respondents' answers.

https://doi.org/10.17993/3cemp.2024.130153.56-79

3.4. THE CONFIRMATORY FACTOR ANALYSIS:

Construct validity refers to the extent to which the dimensions of a model align with the data collected from the study sample and eliminate any measurement errors. This is assessed using confirmatory factor analysis (C.F.A.), and the results are as follows:

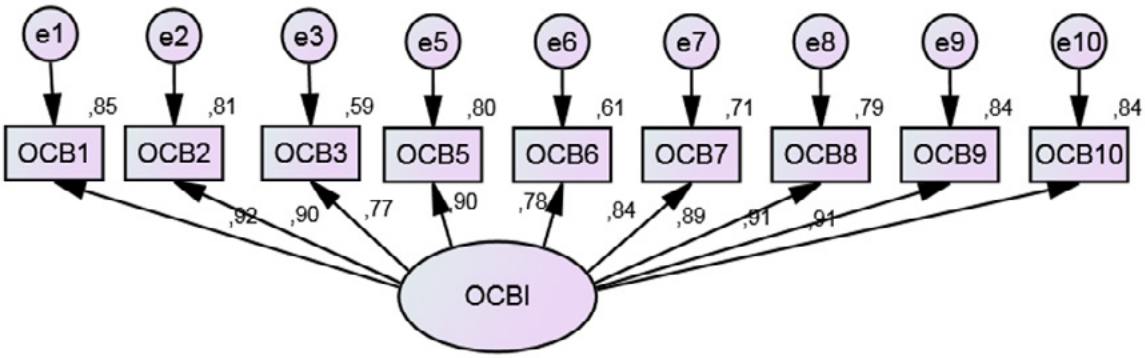

Figure 2. Confirmatory factor analysis (C.F.A.) for the organizational citizenship behavior

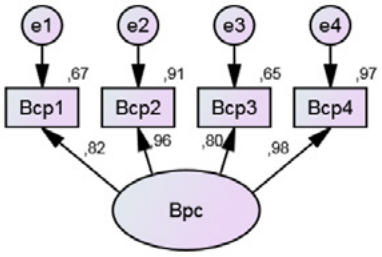

Figure 3. C.F.A. for balanced psychological contract

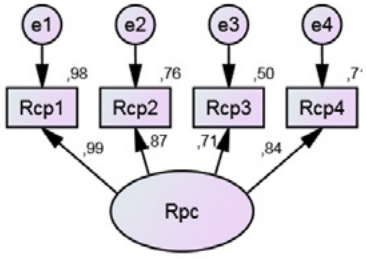

Figure 4. C.F.A. for Relational psychological contract

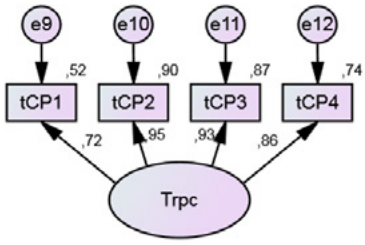

Figure 5. C.F.A. for Transactional psychological contract

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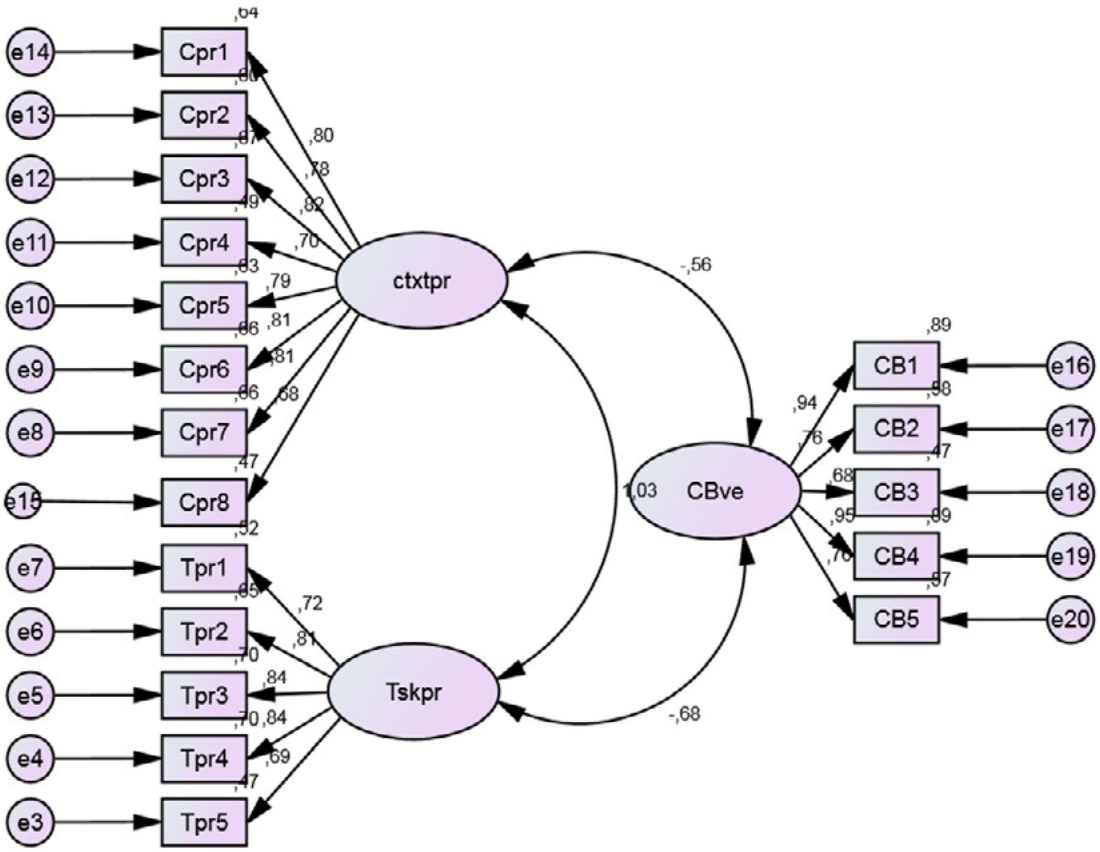

Figure 6. C.F.A. for the Worker performance

The four th item in the organizational citizenship behavior dimension was deleted because the standardized coefficient for the confirmatory factor analysis was less than 0.5 [20]. The confirmatory factor analysis was conducted after that, and the results shown in Figures 2, 3, 4, 5, and 6 indicate that all standardized coefficients for the confirmatory factor analysis are higher than 0.5. Therefore, it is valid for statistical analysis. A set of fit indices were used to ensure the model fit, as illustrated in Table 3.

Table 3. Model Fit Summary

Fit index	Acceptable fit	Bcp	Rpc	Trpc	OCBi	WP
CMIN/df	< 5	2.766	2.112	2.689	3.551	3.654
RMR	≤ 0.08	26	23	25	72	76
CFI	≥0.9	930	951	943	913	901
RMSEA	<0.04	0.0033	0.0021	0.0031	37	38

Source: Output SPSS.

Table 3 displays the outcomes of model fit analysis. The CMIN/df ratio for each index reflects the degree to which the observed data align with the stated model, with an acceptable range serving as a benchmark. A lower CMIN/df ratio indicates a more optimal fit; in this investigation, the values were deemed satisfactory as they were below the threshold of 0.05 [20]. The Standardized Root Mean Square Residual

https://doi.org/10.17993/3cemp.2024.130153.56-79

(R.M.R.), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA) all obtained acceptable values, suggesting a strong correspondence between the observed data and the stated model.

4. RESULTS AND DISCUSSION

In this study, we want to examine if the forms of psychological contracts indirectly affect worker performance through organizational citizenship behavior. A path analysis model was employed to investigate the direct and indirect effects of a group of observed variables. The Rcp, Trpc, and Bpc are the independent variables; Wpr is the dependent variable, and the OCBi is the mediator variable. The research by Baron and Kenny [6] was one of the fundamental frameworks for how to test mediation. We proceed with the analysis as illustrated in Figure 7.

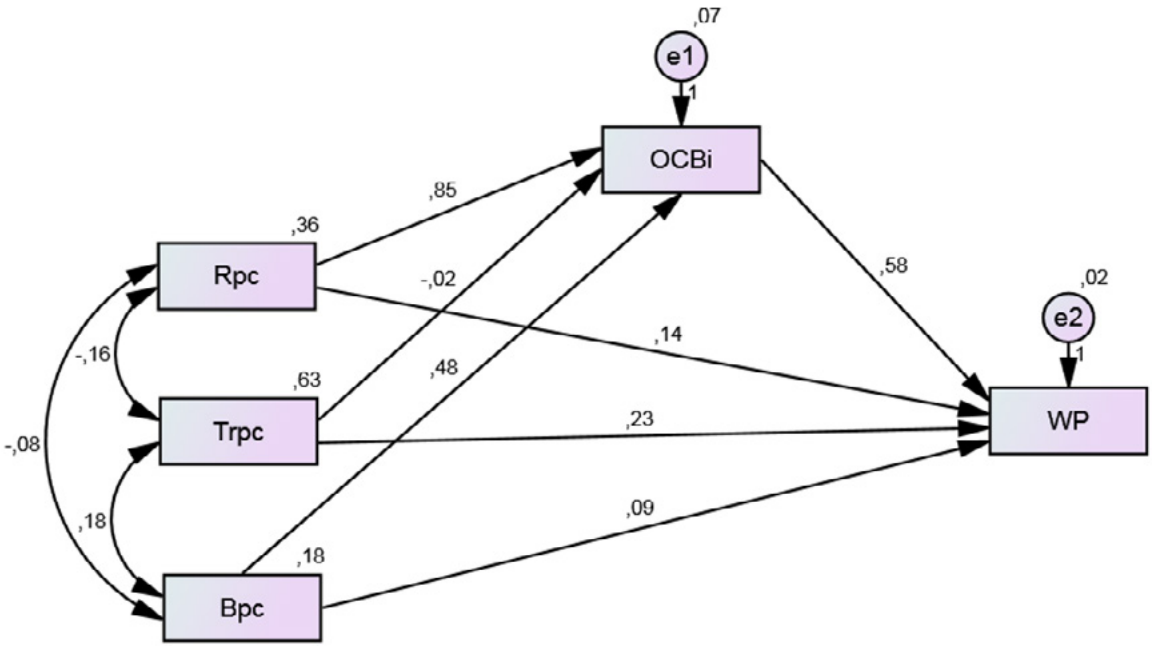

Figure 7. The standardized values for the impact of psychological contract forms on employees' performance through organizational citizenship behavior. *Source: Output Amos*

The relationships in Figure 7 can be translated through Table 4, which illustrates the direct and indirect effects of psychological contract fulfillment forms on employees' performance.

https://doi.org/10.17993/3cemp.2024.130153.56-79

Table 4. Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
OCBi	<---	Rpc	0,852	0,022	37,960	***	par_1
OCBi	<---	Bpc	0,475	0,035	13,425	***	par_6
OCBi	<---	Trpc	-0,020	0,019	-1,032	0,302	par_7
WP	<---	OCBi	0,578	0,025	22,681	***	par_2
WP	<---	Bpc	0,088	0,022	3,970	***	par_3
W.P.	<---	Trpc	0,228	0,010	22,909	***	par_4
WP	<---	Rpc	0,142	0,025	5,746	***	par_5

Source: Output Amos

4.1. THE DIRECT EFFECT ANALYSIS

The direct effect represents the direct relationship between the independent and dependent variables. In this study, the effects of Rpc, Trpc, and Bpc on worker performance are all significant; Table 4 demonstrates that the p-value is smaller than the significance level of 5%. Therefore, the regression analysis result indicated that Rpc, TRpc, and Bpc have a positive effect on W.P., where the regression coefficients were β_{Rpc}= 0.14, β_{Bpc}= 0.09, and β_{Trpc}= 0.23. The interpretation of these results can be attributed to the nature of each psychological contract. Based on these conclusions, it can be inferred that the H1, H2, and H3 are confirmed.

A long-term employment arrangement between employees and employers characterizes relational psychological contracts. These contracts are primarily established through trust, loyalty, and stability. La Porta et al. [25] explore the argument that a high level of trust enhances the employee performance of large organizations in 40 countries. Studies have found that loyal employees are motivated to perform at their best, contributing to higher productivity and overall performance [3] [32][16].

The transactional psychological contract defines employment arrangements as short-term or limited duration. This relationship is primarily focused on exchanging economic contracts, specified, limited, and narrow job involvement by the employee. According to Hassan [21] when employees have transactional psychological contracts, they only perform what they are expected to perform in the contract and, in return, receive the benefits accordingly.

A balanced psychological contract refers to the mutual agreement between an employer and an employee, wherein the employee expects career growth and advancement in return for their high performance on work assignments [17].

https://doi.org/10.17993/3cemp.2024.130153.56-79

4.2. THE INDIRECT EFFECT ANALYSIS

According to Table 4, the Rpc positively affects OCBi, as indicated by a regression equation, with p-value <0.05 and regression coefficient β_{Rpc}= 0.852. The results of this study align with many other studies that have demonstrated a strong impact of fulfilling the relational psychological contract on organizational citizenship behavior [44][51][9]. When employee perceives a firm relational psychological contract characterized by trust, mutual obligations, and support from their organization, they are more likely to engage in OCBi; this is because a favorable relational psychological contract fosters a sense of commitment, loyalty, and reciprocity between employees and the organization, leading employees to go beyond their formal job requirements and contribute voluntarily to the betterment of the organization. They engage in discretionary behaviors such as helping colleagues, offering suggestions for improvement, and participating in activities that enhance the organizational climate. Overall, a favorable relational psychological contract encourages and motivates employees to exhibit higher levels of OCBi. Based on these conclusions, it can be inferred that the hypothesis H4 is confirmed.

The effect of Bcp on OCBi is positive and significant, with p-value <0.05 and regression coefficient β_{Rpc}= 0.475. This result is consistent with many previous studies, such as Santos et al. (2024). In balanced psychological contact, the employee has the responsibility to develop his skills, while the employer has a responsibility to improve employees' long-term employability within or outside the organization; the employer provides training and advancement opportunities. Studies like Shih and Chen [44] have confirmed this relationship by explaining that the balanced psychological contract ensures that employees have a sense of job security, an emotional connection to the organization, and a defined reward system. Consequently, employees with a balanced psychological contract are more likely to engage in organizational citizenship behavior (OCBi) as they strive to maintain a mutually beneficial employment relationship characterized by fair rewards and obligations. The hypothesis H6 is confirmed.

Regarding the relationship between the transactional psychological contract and organizational citizenship behavior, table 4 shows that the p-value =0.302, which is higher than the significance level of 0.05, and the impact is not statistically significant. The transactional psychological contract may not significantly affect organizational citizenship behavior for several reasons. Firstly, the psychological contract is primarily based on a transactional exchange between employees and employers, where employees fulfill their job responsibilities in exchange for tangible rewards such as salary, benefits, and promotions. This type of contract focuses more on the formal obligations and specific tasks outlined in the employment agreement rather than fostering a sense of discretionary behavior or going above and beyond what is required. Secondly, the transactional psychological contract is often characterized by a limited scope of obligations and expectations, primarily centered on fulfilling contractual duties. This narrow focus may encourage employees to refrain from

https://doi.org/10.17993/3cemp.2024.130153.56-79

engaging in OCBi, which involves voluntary and extra-role behaviors that contribute to the organization's overall well-being. From this conclusion, the hypothesis H5 is rejected.

This study demonstrates further results; the effect of OCBi on W.P. is significant and positive, with p-value <0.05 and regression coefficient β_{Rpc}= 0.578; this is similar to other studies [31][27][19]. The increase in employee initiative behavior can increase W.P. This result can be explained by improved productivity among colleagues and the optimization of resources to align them with production objectives. Based on this result, the hypothesis H7 is confirmed.

4.3. THE MEDIATING EFFECT ANALYSIS

In order to test whether organizational citizenship behavior plays a mediating role between the fulfillment of the psychological contract and employee performance, this relationship will be tested using the bootstrapping method. This method does not require the data distribution to be expected, and it is suitable for both small and large samples. Unlike the Sobel test, this method can be applied to various sample sizes.

According to Table 5, the indirect effect of Rpc and Bpc on W.P. by the mediating effect of OCBi is significant (p-value <0.05) with the regressions coefficients 0.493 and 0.275. It should be noted that the effect of Rpc and Bpc increased from 0.14 and 0.09 to 0.49 and 0.27. Similarly, this result showed that organizational citizenship behavior partially mediated the relationship between relational and balanced psychological contracts on worker performance. Based on these results, the hypotheses H8 and H10 are confirmed.

On the other hand, the mediating effect between organizational citizenship behavior and employee performance through transactional psychological contracts is not significant. The p-value for this relationship is greater than 0.05, indicating a non-significant relationship between transactional psychological contracts and employee performance, and that means that hypothesis H9 is confirmed.

Table 5. Indirect Effects (Group number 1 - Default model)

	WP	OCBi	Sig		p-value
			Lower Bound	Upper Bound	
Trpc	-0.011	0.000	-0.035	0.190	0.417
Bpc	0.275	0.000	0.210	0.364	0.000
Rpc	0.493	0.000	0.404	0.606	0.000
OCBi	0.000	0.000	0.000	0.000	0.000

Source: Output Amos

https://doi.org/10.17993/3cemp.2024.130153.56-79

5. CONCLUSION

This study investigated the role of mediation in the relationship between the fulfillment of psychological contract forms and worker performance. The study's findings provide insight into the intricate connection between these two concepts and highlight the significance of taking into account mediating elements while comprehending their relationship.

The analysis demonstrated that the satisfaction of relational and balanced psychological contracts has a substantial and favorable influence on worker performance. This suggests that employees are more inclined to achieve higher levels of performance when they perceive that the organization is meeting their psychological contracts. Nevertheless, a more thorough analysis of the mediating impact revealed that O.C.B. plays a crucial role in this association. The mediating effect analysis revealed that Organizational Citizenship Behavior (O.C.B.) functions as a mediator between the fulfillment of relational and balanced psychological contracts and worker performance. When employees feel that their psychological agreements are being met, they are more inclined to participate in discretionary activities that go beyond their official job obligations. Engaging in behaviors such as assisting colleagues, willingly taking on extra responsibilities, and demonstrating commitment to the organization all contribute to enhanced employee performance.

These findings have significant ramifications for both research and practice. Gaining insight into the mediating influence of Organizational Citizenship Behavior (O.C.B.) can provide organizations with valuable knowledge regarding the significance of cultivating a favorable psychological contract environment. Organizations can boost worker performance by ensuring that employees view their psychological contracts as met, hence promoting higher levels of O.C.B.

Conversely, the analysis showed that meeting transactional psychological contracts has a substantial beneficial effect on employee performance. This suggests that when workers believe that their organization is fulfilling their transactional psychological contracts, they are more inclined to perform at a superior level. Nevertheless, the study of mediating effects failed to reveal a substantial involvement of O.C.B. in mediating this specific association. Although O.C.B. is commonly acknowledged as a crucial element in employee performance, the results of this analysis indicate that it does not operate as a mediator in the connection between the fulfillment of transactional psychological contracts and worker performance. Unexplored mediating processes or factors may be influencing this association.

The results highlight the significance of meeting the expectations outlined in the psychological contract to improve worker performance by encouraging corporate citizenship behavior. Organizations should aim to create and sustain positive psychological agreements with their employees, cultivating an atmosphere of trust, equity, and reciprocal responsibilities. By implementing this approach, organizations

https://doi.org/10.17993/3cemp.2024.130153.56-79

can enhance employees' involvement in organizational citizenship behaviors, which in turn can result in enhanced worker performance and overall organizational outcomes.

RECOMMENDATION

Based on the findings of this study, we may offer the following set of recommendations:

- Enhance awareness and understanding of psychological contracts: Saudi universities should educate managers and employees about the concept and importance of psychological contracts. This will help create a shared understanding of the expectations and obligations between the organization and its employees.

- Foster a supportive work environment: Saudi universities should strive to create a work environment that fosters trust, fairness, and open communication. This will contribute to a favorable psychological contract and increase the likelihood of fulfillment, improving worker performance.

- Strengthen employee engagement initiatives: Saudi universities should implement strategies to engage employees actively in their work and the organizational mission. This can be achieved through regular feedback, recognition programs, and employee involvement and participation opportunities.

- Encourage and reward organizational citizenship behaviors: Saudi universities should recognize and reward employees who engage in organizational citizenship behaviors. This can be done through performance evaluations, promotions, and incentives. By highlighting and appreciating such behaviors, organizations can reinforce their importance and encourage their continuation.

- Regularly assess and monitor psychological contract fulfillment: It is essential for organizations to periodically assess and monitor the level of psychological contract fulfillment among employees. This can be done through surveys, focus groups, or individual discussions. By staying attuned to the fulfillment levels, organizations can identify areas of improvement and take corrective actions if necessary.

- Conduct further research: While this study has provided valuable insights into the relationship between psychological contract forms fulfillment, worker performance, and organizational citizenship behavior, further research is needed. Future studies can explore the impact of different contextual factors, such as organizational culture and industry-specific dynamics, on this relationship.

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CULTURAL VISION OF DANCE EDUCATION: RESEARCH ON TEACHING AND PERFORMING CHINESE CLASSICAL DANCE IN CROSS-CULTURAL CONTEXTS

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ABSTRACT

This paper explores the teaching and performance of classical Chinese dance in a cross-cultural context, and proposes an innovative deep learning-based model for generating classical Chinese dance. The model effectively combines dance gestures and audio features, accurately extracts key features from dance and music data, and transforms these features into internal representations through an encoder, which in turn generates dance movements that match the music. The introduction of the attention mechanism allows the model to focus on the important parts of the music during the generation process, realizing a more harmonious fusion of classical Chinese dance and music. Finally, the model of teaching ability module, performance ability module and choreography ability module is carried out to comprehensively improve students' dance skills and humanistic literacy, and to develop cross-cultural communication ability and creativity. The results show that this model excels in dance innovativeness and ability to convey emotions, receiving high scores of 8.9 and 9.3, respectively. The research results can provide dancers from different cultural backgrounds with a new perspective for learning and appreciating classical Chinese dance, and promote the communication and dissemination of world culture.

KEYWORDS

Deep learning; classical Chinese dance; audio features; decoder; attention mechanism

https://doi.org/10.17993/3cemp.2024.130153.81-100

INDEX

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1. INTRODUCTION

With the deepening of globalization, cultural exchange and integration have become the theme of the times. In this context, dance, as one of the oldest art forms of mankind, its education and performance are naturally endowed with a broader cultural vision [1]. Chinese classical dance has a long history and rich movements, and is an important part of Chinese culture. With its unique rhythms, gestures and expressions, dance shows the charm of Chinese civilization to the world [2-3]. However, due to cultural differences and language barriers, the teaching and performance of classical Chinese dance in cross-cultural contexts often face many challenges. In terms of teaching, due to the differences in students' perception and understanding of body language in different cultures, how to enable students to accurately master the movement essentials and rhythmic characteristics of classical Chinese dance has become the primary problem that teachers need to solve [4]. In terms of performance, it is also a big challenge to make audiences from different cultural backgrounds understand and appreciate the beauty of classical Chinese dance. Teachers and performers are required to have not only superior dance skills, but also profound cultural literacy and cross-cultural communication skills [5].

Combined with the research data, it is found that a large number of scholars put forward targeted strategies for the development of classical Chinese dance and foreign dance teaching and performance. For example, Ma, L perfectly united training, creation and performance in the teaching of classical Chinese dance, analyzed the importance and artistic characteristics of body rhyme teaching, explored the comprehensive scoring system from four aspects, namely, the establishment of evaluation index dimensions, the analysis and treatment of evaluation indexes, the weight ratio of evaluation index dimensions, and the conversion and comprehensive calculation of evaluation indexes, and explored the new possibilities of choreographic creation [6]. Li, J et al. on the MOOCs platform, integrating high-quality teaching resources worldwide, including dance videos, teaching courseware, expert lectures and so on. And using the MOOCs platform's wide dissemination and sharing function, the customized teaching method can deliver the quality dance teaching resources to more people and promote the inheritance and development of the dance art [7]. Yang, X in the special performance prediction model for dance students, correlation analysis and clustering analysis were performed, and neural network was used to build the prediction model, and the model was analyzed for reliability and error. The test results showed that the model constructed by the neural network predicted the level of development of dance performance and physical fitness more accurately than the regression model [8]. Anderson, M presents the work of many of Australia's major dance companies and individual performers while spanning a wide range of genres, including modern, ballet, theater, contemporary, folk and social dance styles. This dance collection is part of the Australian Performing Arts Collection and encompasses five key areas of circus, dance, opera, music and theatre [9]. Zhang, D takes dance choreographers as the object of study and applies the music feature extraction technique in machine learning to analyze the choreographers, applying the extracted music feature information to the choreography process while synchronizing the audio

https://doi.org/10.17993/3cemp.2024.130153.81-100

and video to achieve better choreographic effect [10]. Daly, D. K adopted an artistic practice investigation approach that included designing, rehearsing, performing and recording two performance events. A departure from traditional classical music methods, drawing on Dalcroze's artistic rhythmic techniques and utilizing ethnography and other arts-based methods to develop and collect data. An overview of Dalcroze's artistic rhythms from the performer's perspective, i.e. the researcher's, is presented and the implications of this approach for the investigation of his artistic practice are discussed [11].

The above dance teaching methods are often limited to a particular cultural context, which is difficult to meet the growing demand for cross-cultural teaching. In order to break through this limitation, this paper starts from the cultural perspective of dance education, and the deep learning-based machine dance automatic generation technology brings new possibilities for cross-cultural dance teaching. Deep learning technology's has achieved remarkable results in the fields of image recognition, speech recognition and natural language processing. Deep learning has a powerful feature extraction and learning ability, which can automatically extract useful information from a large amount of data and simulate the complex thinking process of human beings. Therefore, applying deep learning technology to the generation and teaching of Chinese classical dance is expected to provide a new solution for cross-cultural dance communication and dissemination. Through deep learning algorithms, a classical Chinese dance generation model is constructed, which is able to combine dance gestures and audio features, improve the model's ability to capture the complex relationship between dance and music by improving the traditional encoder and decoder and introducing the attention mechanism, so as to make a perfect match between dance and music, realize a better fit between classical Chinese dance movements and music, and provide a new perspective for dancers of different cultural backgrounds to learn This will provide dancers from different cultural backgrounds with a new perspective on learning and appreciating classical Chinese dance. At the same time, by combining the teaching ability module, performance ability module and choreography ability module, we can comprehensively improve students' dance skills and humanistic qualities, and cultivate cross-cultural communication ability and creativity.

2. CHINESE CLASSICAL DANCE MUSIC FEATURE EXTRACTION

2.1. AUDIO FEATURE EXTRACTION

Audio feature extraction is a key technique for analyzing and understanding the intrinsic properties of music, especially for Chinese classical dance music, whose unique rhythmic and rhythmic characteristics need to be captured by precise audio analysis. This process not only involves the technical aspects of signal processing, but also requires an in-depth understanding of the cultural connotation and artistic

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expression of the music. In terms of rhythmic feature extraction, Mel Frequency Cepstrum Coefficient (MFCC) is a commonly used method. MFCC is able to simulate the human ear's perceptual characteristics of sound and effectively represent key information such as pitch, timbre, etc. of an audio signal. By extracting MFCC features, the melody of classical Chinese dance music can be analyzed in detail to capture its unique pitch changes and timbre characteristics. Rhythm feature extraction, on the other hand, is an important part of understanding classical Chinese dance music. Classical Chinese dance music often has a distinctive sense of rhythm, which is crucial to the coordination of dance movements. Rhythm feature extraction needs to accurately capture the beat information in the music, including the strength and speed of the beat. By analyzing these rhythmic features, the coordinated relationship between music and dance movements can be better understood. In conclusion, through the extraction of rhythmic and rhythmic features, the intrinsic properties of music can be understood more deeply, providing strong support for the subsequent generation and teaching of dance movements.

2.2. ACTION FEATURE EXTRACTION

Action feature extraction is a key link to deeply understand the connotation and style of dance movement, especially in the analysis of Chinese classical dance, which is famous for its rich body language, precise action positioning and smooth action transition, so extracting its action features is of great significance for subsequent dance generation, teaching and performance. OpenPose technology can detect and track multiple key points of the human body in real time. The OpenPose technology can detect and track multiple key points of the human body in real time, and Figure 1 shows the key points of human dance movement characteristics. Figure 1 shows the key points of human dance movements, such as wrists, ankles, knees, shoulders, etc., so as to accurately capture the position information, trajectory, speed and acceleration of the key points of dance movements. These features can not only describe the basic form of dance movements, but also reflect the dancer's performance style and emotional expression. In Chinese classical dance, the soft curves of the arms and wrists, the light jumps of the feet, and the coordinated rotation of the body are important parts of the dance flavor and style, and the 18 key points of the human body are obtained by extracting the human body movement features using OpenPose.

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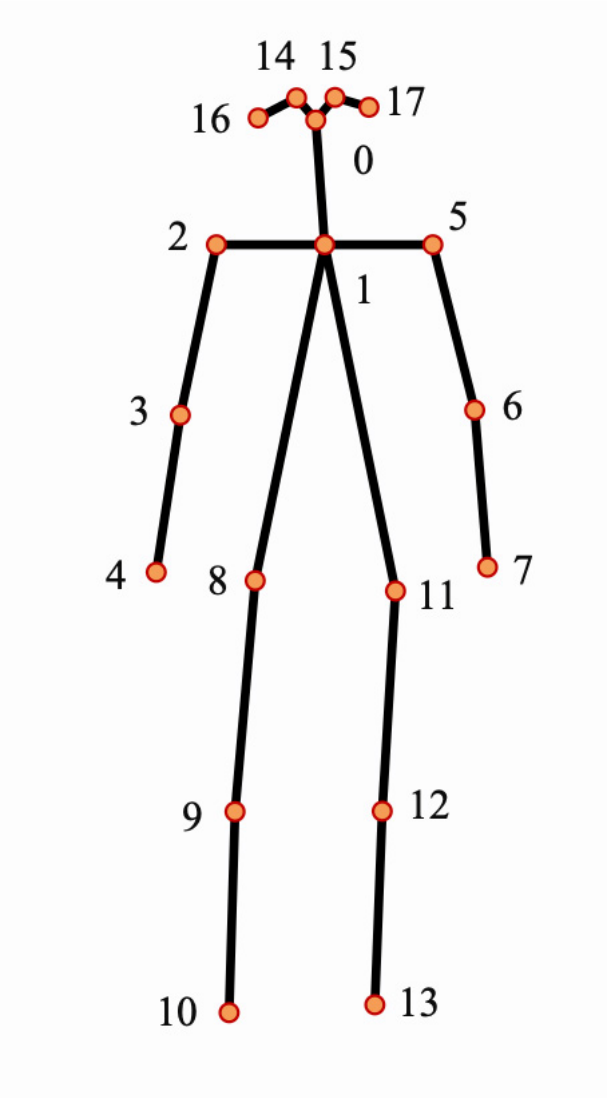

Figure 1. Key point detection of human dance motion features

By extracting audio features and action features, the following sets of feature data are obtained:

1. Audio feature $M_i = \left\langle m_i^1, m_i^2, \cdots, m_i^{32} \right\rangle$, i.e., the feature dimension of each audio is 32.

2. Beat feature $B_i = \left\langle b_i^1, b_i^2, \cdots, b_i^3 \right\rangle$, i.e., the beat dimension size of the video frame section is 3.

3. Pose feature $p_i = \left\langle p_i^1, p_i^2, \cdots, p_i^{36} \right\rangle$, i.e., the size of the pose dimension in a video frame is 36.

4. Audio data $M = \left\{ M_1, M_2, \cdots, M_n \right\}$, which means that the audio data is n frames in total, and each frame is represented as M.

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5. Dance Gesture Data $p = \{p_1, p_2, \cdots, p_n\}$, indicates that the dance gesture is n frames, and each frame is represented as P.

3. MODULE DESIGN OF GENERATIVE MODELING FOR CLASSICAL CHINESE DANCE

3.1. GENERATIVE MODEL NETWORK STRUCTURE

After feature extraction is completed, the classical Chinese dance generation model can be divided into three main parts, generator, self-encoder and discriminator. These parts work together to generate realistic dance movements. The network structure of the classical Chinese dance generation model is shown in Figure 2. The generator is the core part of the dance generation model, which is responsible for generating the corresponding dance action gestures based on the input audio features or other information. Self-encoder is a neural network model for data compression and reconstruction, which is used for audio reconstruction in the classical Chinese dance generation model. The self-encoder accepts the input audio signal and tries to recover the original audio signal through the process of encoding and decoding [12]. In the dance generation model, the role of the self-encoder is to compress and reconstruct the extracted audio features so that they can better guide the generator to output the corresponding dance movements. The discriminator is another important component used to evaluate the authenticity of the generated classical Chinese dance movements. The task of the discriminator is to determine whether the generated classical Chinese dance movements are similar to the real ones, so as to help the generator learn more realistic dance movements. By combining the three parts of generator, self-encoder and discriminator, a complete model of classical Chinese dance generation can be constructed. This model is able to generate realistic classical Chinese dance movement gestures based on input audio features or other information, which provides powerful support for classical Chinese dance creation and learning [13-14].

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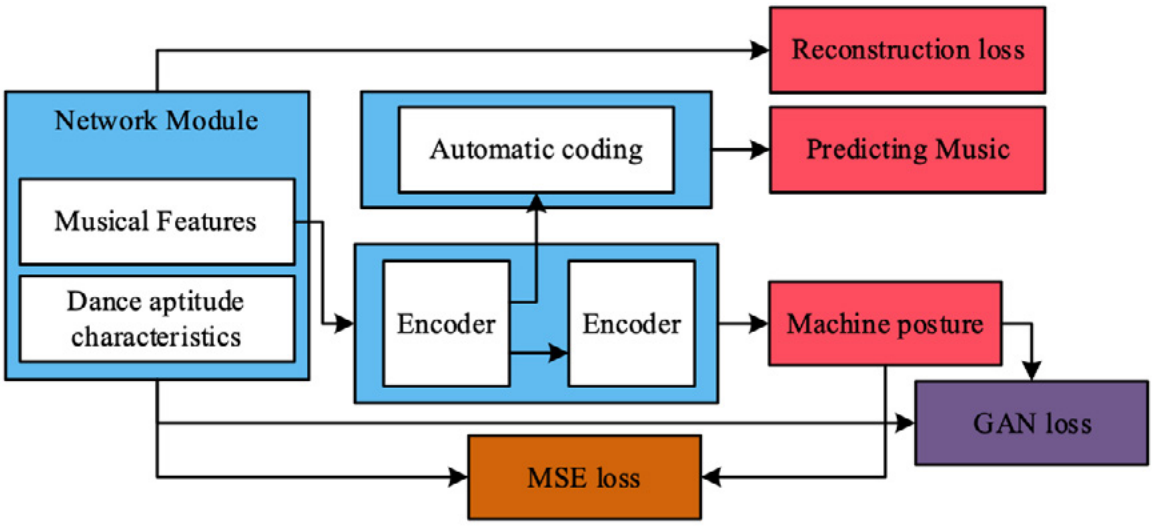

Figure 2. Network structure of Chinese classical dance generation model

3.2. CLASSICAL DANCE GENERATOR AND ENCODER DESIGN

In order to make the generation of Chinese classical dance more effective, the Seq2Seq model is chosen to design the generator, which specifically includes the encoder and decoder. However, the Seq2Seq model cannot represent all the semantic information, and the attention mechanism will be added on the basis of this model, so as to become a context vector that can summarize different semantic information at different moments. The dance generation sequence with the addition of the attention mechanism is shown in Figure 3.

In the encoder part, the attention mechanism is used to calculate the weight of each position in the input sequence so that all relevant information is taken into account when generating the context vector. This is achieved by assigning a weight to each position in the input sequence, which is calculated based on the importance of the semantic information at that position. In the decoder part, the same attention mechanism is used to compute the weight for each position in the output sequence. In this way, the model can take into account contextual information when generating each output step and emphasize or ignore certain parts as needed. By combining the Seq2Seq model and the attention mechanism, a flexible dance generation model can be created. The model can generate richer, more realistic and compliant dance movements based on input audio features and other information.

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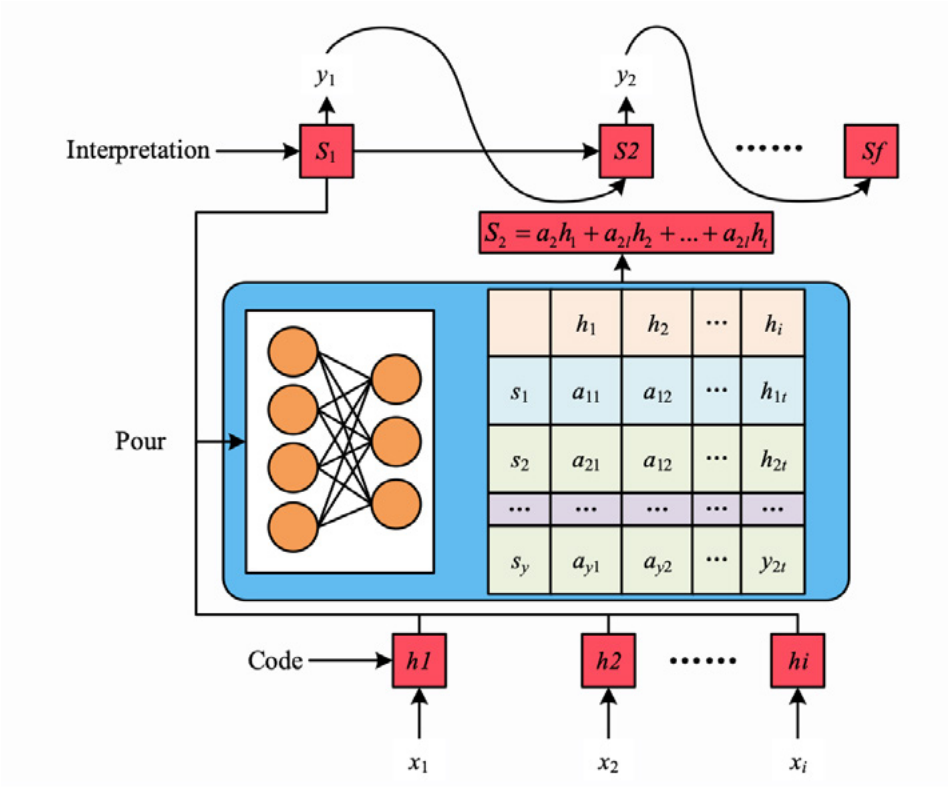

Figure 3. Attention mechanism

With the introduction of the attention mechanism, the generator network is able to focus on different semantic information at different moments to better understand and generate dance movements related to the input audio features [15]. This design approach can improve the flexibility and generation effect of the model, and better meet the needs of cross-cultural teaching and learning. The generator model of classical Chinese dance for the generator network after the introduction of the attention mechanism is shown in Figure 4.

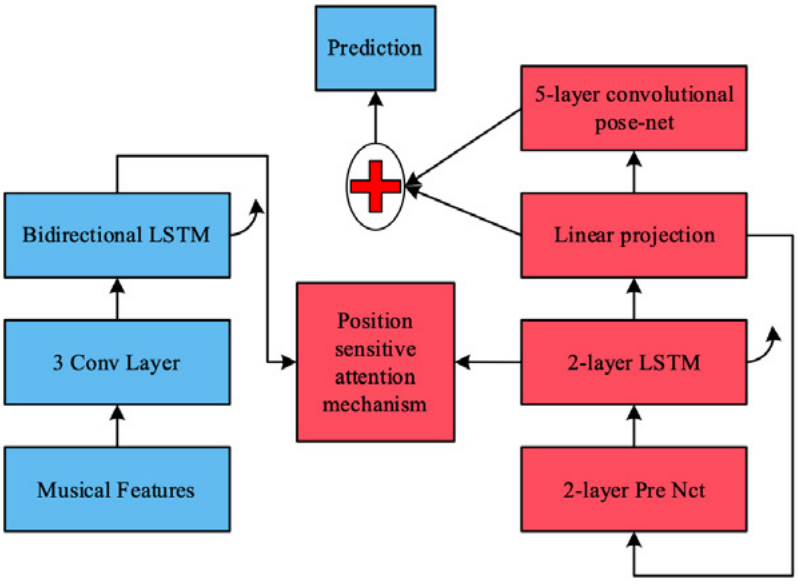

Figure 4. Schematic diagram of the Chinese classical dance generator model

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3.3. DISCRIMINATOR DESIGN FOR DANCE MOVEMENT EVALUATION

In order to make the matching of classical Chinese dance gestures and music more accurate, the matching results are evaluated by adding a discriminator. The discriminator is designed to evaluate how well the generated dance movements match the music. By adding the discriminator, the generated dance movements can be evaluated more accurately so that the generation process can be adjusted to improve the matching between the dance movements and the music. The discriminator receives the generated dance movement as input and outputs an evaluation result indicating how well the movement matches the music. This evaluation result may be a probability value, e.g., the discriminator outputs a probability value close to 1 if the generated dance movement is highly matched to the music, and a probability value close to 0 if the degree of matching is low. During the training process, the loss function of the discriminator can be designed according to practical needs. A common loss function is the binary cross-entropy loss, which is used to measure the difference between the generated movements and the real music match. By minimizing this loss function, the discriminator can gradually learn how to accurately assess the degree of match between dance movements and music. The specific way of discriminating is mainly through the loss function of the

$$L_{GAN}(G,D)=E_{(P,M)}[\log D(P,M)]+\frac{1}{2}[\log(1-D(P,M))+\log(1-D(W,M))] \quad (1)$$

Where, G denotes the generator, M denotes the music, $G(M)$ denotes the generation of the dance gesture, and $D(G,M)$ denotes the size of the probability that the dance matches the music, if the value is close to 1, it indicates that the two match more. If the value is in the range of 0, it indicates that the dance-music matching probability is small.

The classical Chinese dance gesture encoder network structure is shown in Figure 5, after generating the dance gesture, the discriminator is used to judge the match between the dance and the audio, so as to confirm whether the audio is consistent with the real gesture. If the gesture vector is denoted as $p=\{p_1,p_2,\cdots,p_n\}$, the difference between the front and back frames is denoted as $\{P_1-P_2,P_2-P_3,\cdots,P_{n-1}-P_n\}$, and the audio features are denoted as $M=\{M_1,M_2,\cdots,M_n\}$ [16]. All of them are input into the discriminator and then the discrimination is calculated by equation (1).

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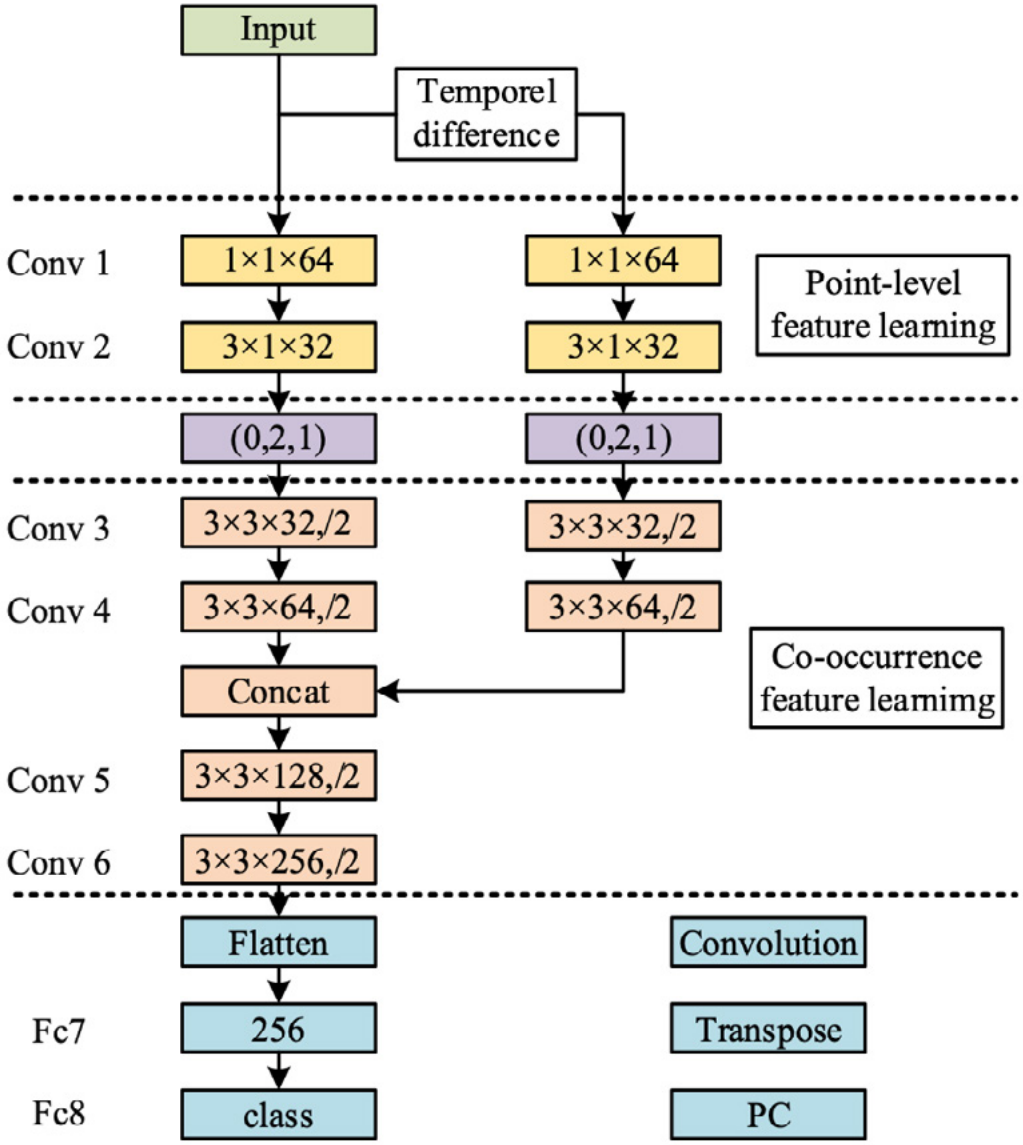

Figure 5. Network structure of Chinese classical dance pose encoder

The role of self encoder is to reconstruct the audio features. If M denotes an audio feature and B denotes a beat feature, the match between music and dance can be improved by inputting the two features into the encoder and then encoding and decoding them. The specific reconstruction is as follows:

$$f_i = Encoder(Concat(M_i, B_i)) \quad (2)$$

$$M_i^{\sim} = Decoder(f_i) \quad (3)$$

where $M_i^{\sim}$ denotes the reconstructed audio, f denotes the extracted low dimensional audio features. $Concat$ denotes the splicing process of the extracted parameters, and $Encoder$ and $Decoder$ denote the neural networks to be learned [17].

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3.4. REALISTIC CHINESE CLASSICAL DANCE DESIGN

In order to make the generated dance movements more realistic and in line with the style of Chinese classical dance, the improved Pix2Pix algorithm can be used to further process the generated dance movements. The training process of the improved Pix2Pix network for the dance movements is shown in Figure 6. The Pix2Pix algorithm is an image-to-image conversion algorithm that converts the sketches of the dance poses into real dance poses. During the training process, the Pix2Pix algorithm gradually improves its conversion ability by learning the mapping relationship from sketches to real dance poses. The algorithm continuously optimizes its parameters to minimize the difference between the real dance pose and the conversion result. By using the improved Pix2Pix algorithm, the generated dance movements can be converted into movements that are more realistic and in line with the Chinese classical dance style.

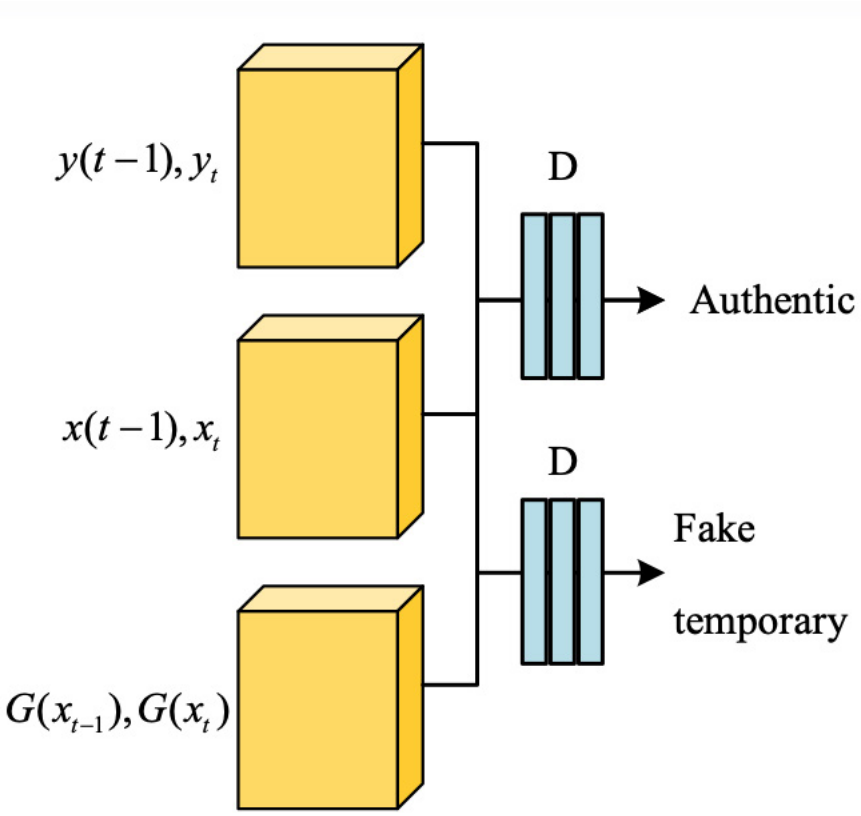

Figure 6. Dance Action Training Process of Improved Pix2Pix Network

Based on the above training process, the whole process of realizing the live-action dance can be divided into the following steps:

1. Video reading and single-frame extraction, using the OpenCV library to read the dance video file. Extract single frames in the video to form a collection of single frames as input for subsequent processing.

2. Dance movement pose extraction, use pose estimation tools such as OpenPose to analyze the extracted single frames for pose analysis. The pose

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information is converted into a heat map representation, where each pixel of the heat map represents the action pose of the corresponding part.

3. Establish the mapping relationship between the heat map and the real-life video, using the labeled training dataset, train the Pix2Pix model to establish the mapping relationship from the heat map to the real-life dance video. Let the model learn how to convert the pose information into real dance movements.

4. Dance movement coordinate conversion and video synthesis to convert the predicted dance gesture coordinates into corresponding heat maps. Using the trained Pix2Pix model, the newly generated heat maps are converted back to real dance movements. These real dance action frames are combined according to the chronological order to form a new real-life version of classical Chinese dance video, which further enriches and advances the teaching of classical Chinese dance.

4. TEACHING AND PERFORMING INTERCULTURAL CHINESE CLASSICAL DANCE

In order to further enrich and promote the teaching and dissemination of cross-cultural classical Chinese dance, the cultivation model of teaching ability module + performance ability module + choreography ability module can be implemented. This model aims to cultivate students' intercultural communication ability and dance ability through systematic teaching and practicing activities. The three levels of modules for the cultivation of classical Chinese dance ability are shown in Figure 7.

1. The basic skills training in the teaching ability module is the cornerstone of dance learning, including the training of body flexibility, strength and coordination. Body rhythm is the soul of dance, emphasizing the integration of the dancer's inner emotions and outer movements [18]. Understanding the development history of classical Chinese dance as well as teaching methods provides future dance teachers with the necessary knowledge base. By attending and observing various performances, students can cultivate creativity, stimulate vigor and passion, and better understand the charm of dance art.

2. The performance ability module includes repertoire rehearsals and international exchange activities. By rehearsing classical or modern Chinese classical dance repertoires, students can improve their performance skills and stage presence. Students are encouraged to participate in international dance festivals, cultural exchange activities, etc., to cultivate their international vision and cross-cultural communication skills [19-20].

3. The choreography ability module includes the fundamentals of dance choreography, multicultural integration, and international cooperation programs. Learning the basic principles and techniques of choreography

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enables students to create dance works with personal characteristics [21]. Students are guided to explore the possibility of combining classical Chinese dance with dance elements from other countries and regions to develop their cross-cultural choreographic ability. Encourage students to participate in international dance creation projects and collaborate with international dance artists to create dance works with international perspectives [22].

This cultivation mode of curriculum module + practical ability adds the element of cross-cultural exchange to the original foundation, provides students with a wider range of dance education opportunities, and cultivates their ability to perform, teach and create dance in the context of globalization. Through participation in international exchange activities and cross-cultural cooperation programs, students can better understand and disseminate Chinese classical dance culture, and at the same time learn from and absorb the outstanding dance elements of other countries and regions, thus laying a solid foundation for their future cross-cultural teaching and performing careers.

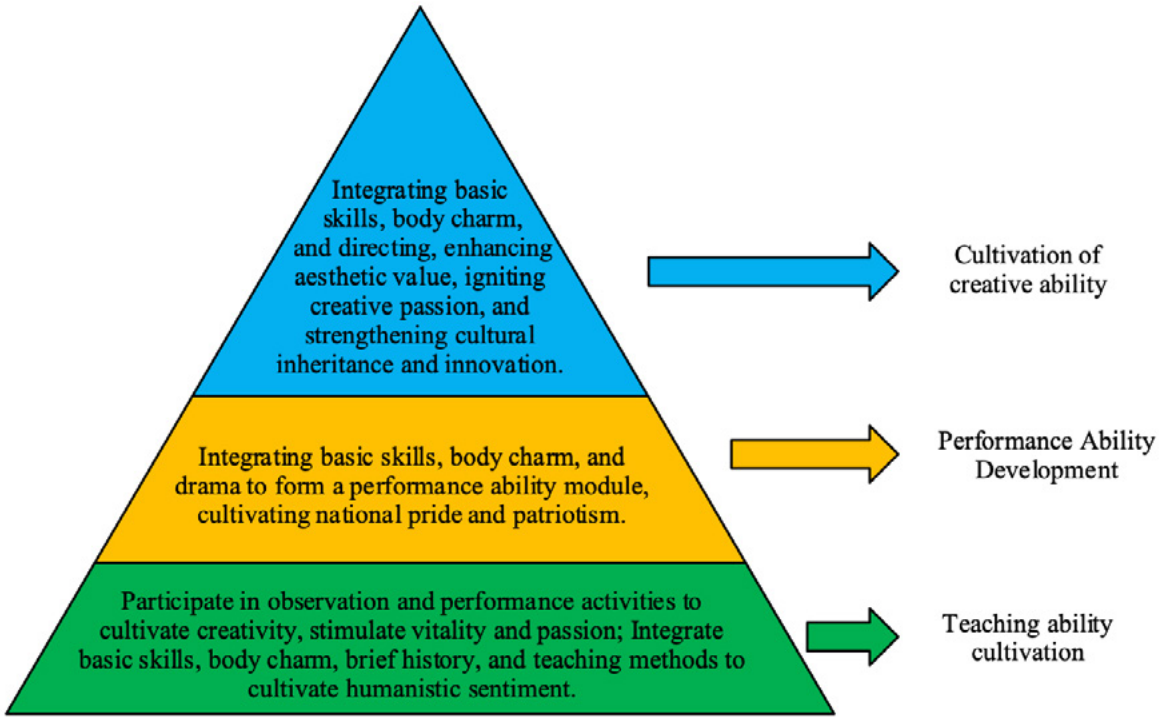

Figure 7. Three Levels of Cultivating the Ability of Chinese Classical Dance

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5. DISCUSSION OF EMPIRICAL EVIDENCE ON THE RESULTS OF TEACHING CLASSICAL CHINESE DANCE

5.1. ANALYSIS OF CHOREOGRAPHIC AUTHENTICITY AND COHERENCE

In order to objectively assess the authenticity and coherence performance of the system proposed in this paper on classical Chinese dance choreography, a user manual scoring method was adopted for the empirical study. Thirty-five postgraduate students were invited as experimental participants, 18 of whom had a background in dance, musical instruments or voice. This combination of participants ensured the professionalism of the scoring and also took into account the aesthetic viewpoints of the general audience. During the experiment, emphasis was placed on ensuring that the participants had sufficient musicality and aesthetic knowledge of music and dance to ensure the reliability and validity of their ratings. Participants were asked to watch two videos of classical Chinese dances, one was a classical Chinese dance choreographed through traditional teaching methods, and the other was a classical Chinese dance generated through the methodology of this paper. After viewing, participants were asked to rate the authenticity and coherence of the two dances on a five-point scale based on their subjective judgment. The scale was 1-5, where 1 indicated very poor and 5 indicated very good. This is designed to allow participants to express their evaluation clearly. The result scores for the authenticity and coherence of the choreography of classical Chinese dance are shown in Figure 8, and the authenticity scores of the dance movements generated by this paper's method are all significantly higher than the results of the control group.

Figure 8(a) shows the authenticity score, the final score of the authenticity of the choreography results of the control group is 1.61, and the proportion of users who scored 1 and 2 is more than 40%, i.e., most of the users think that the results of the choreography are very inauthentic and inauthentic, and the users who think that the results are barely authentic and authentic only account for 6% each. The final score for the authenticity of the results of this paper's method is 4.09, with more than 60% of users scoring 4 and considering the results to be authentic, and 24% of users considering the results to be very authentic. Figure 8(b) shows the coherence score, the coherence of the results of the control group choreography final score of 1.76, the highest score is only 3, the users who scored 1 and 2 almost accounted for 50% each, i.e., the users who think the results are very incoherent and incoherent almost accounted for half each. The final score for the coherence of the results of this paper's method was 4.1, with a minimum score of 3. More than 70% of users scored 4 and considered the results coherent, and almost 20% scored 5 and considered the results very coherent.

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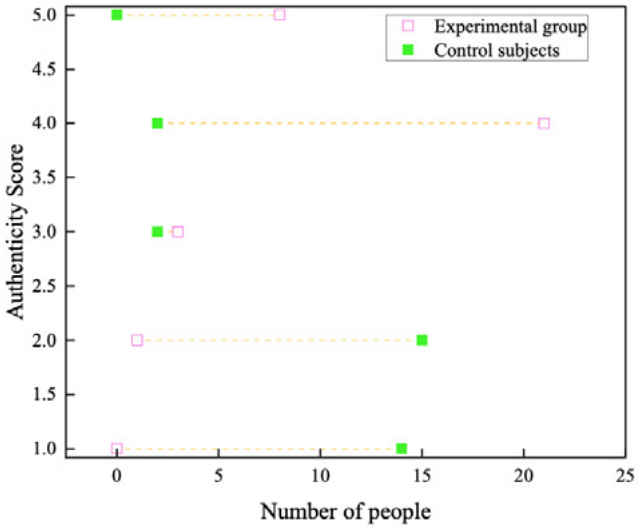
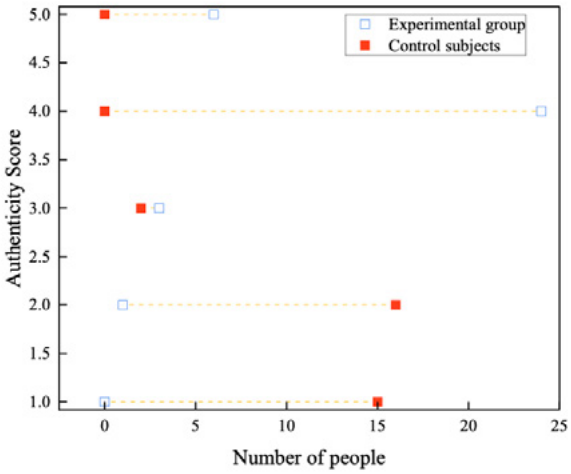


(a) Authenticity



(b) Coherence

Figure 8. The choreography results of Chinese classical dance

5.2. MULTIDIMENSIONAL ASSESSMENT OF DANCE PERFORMANCE

In order to comprehensively assess the effectiveness of the dance auto-generation method in teaching classical Chinese dance, an empirical study was designed for dance performance. Two groups of experimental subjects with different backgrounds5 were selected for this study, aiming to compare the differences between traditional teaching methods and supplementary teaching methods incorporating dance auto-generation in developing students' dance performance abilities. Two groups of experimental subjects were selected, one was students with a basic knowledge of classical Chinese dance, experimental group A, and the other was students without a basic knowledge of dance but with an interest in Chinese culture, experimental group B. A four-week cross-cultural classical Chinese dance teaching program was conducted for the two groups of students, in which experimental group A adopted the

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traditional teaching method, and experimental group B used the dance auto-generation system as the supplemental teaching method.

At the end of the teaching period, students in both groups were assessed on their performances, and the results of the multidimensional classical Chinese dance performance assessment are shown in Figure 9. In all three dance actions, the scores of experimental group B were higher than those of experimental group A. Experimental group A was good in the accuracy of dance actions, and scored 8.5 points in dance action 1. It scored relatively low on rhythm, expressiveness, creativity, and ability to convey emotion. Experimental group B scored higher on all assessment dimensions than experimental group A. It performed well in dance action 3 with a score of 9.6 for movement accuracy. There were also significant improvements in rhythm, expressiveness, innovativeness, and the ability to convey emotion, especially in innovativeness and the ability to convey emotion, which received high scores of 8.9 and 9.3, respectively. From the data, experimental group B combined with the dance automatic generation system teaching showed a trend of superiority over the traditional teaching method of experimental group A in all aspects of dance performance. This suggests that the use of the Dance Automated Generation System in teaching may help to improve students' dance performance abilities, especially in terms of creativity and ability to convey emotion. These enhancements may be attributed to the features of instant feedback, personalized instruction, and creative inspiration provided by the system.

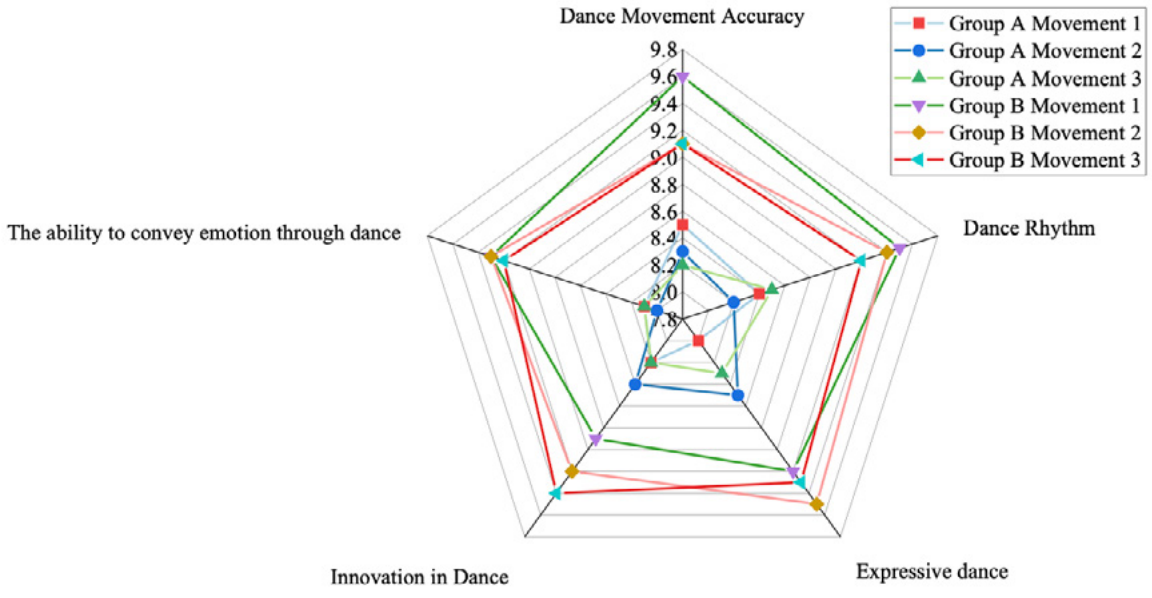

Figure 9. Evaluation Results of Multidimensional Chinese Classical Dance Performance

6. CONCLUSION

In order to promote the inheritance and promotion of Chinese classical dance, this paper successfully constructs a deep learning-based Chinese classical dance

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generation model, which realizes a better fit between dance movements and music by combining dance gestures and audio features. The results of the traditional teaching method and the teaching method combined with the automatic dance generation system on the assessment of students' performances were compared. The final score of the authenticity of the choreography results of the control group was 1.61, and most users considered the choreography results to be very inauthentic and unrealistic. The final score for the veracity of this paper's method was 4.09, with more than 60% of users considering the results to be veritable and 24% considering the results to be very veritable. The final score for the coherence of the choreography results for the control group was 1.76, and most of the users considered the results to be very disjointed and incoherent. The final score for the coherence of this paper's method was 4.1, with more than 70% of users considering the results to be coherent and nearly 20% considering the results to be very coherent. Experimental Group B, taught in conjunction with the Dance Automation Generation System, showed a tendency to outperform the traditional teaching methods of Experimental Group A in all aspects of dance performance. The cultural vision of dance education in the study of teaching and performing classical Chinese dance in a cross-cultural context has both deep cultural connotations and is able to promote cultural inheritance and innovation, as well as the coexistence and development of global cultural diversity.

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/05/

ART HISTORY THEORY IN DIGITAL VISUAL CULTURE

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ABSTRACT

In order to meet the diversified visual aesthetic needs of the public, this paper constructs a digital visual model based on art history theory. Firstly, the SIFT algorithm is used to extract the art scene feature points, and the convolution operation is carried out by Gaussian function to form a three-dimensional scale space. Then the system reconstruction technology is applied to realize the reconstruction of digital images, and the completeness of the reconstructed images is ensured by setting visual symbols. Finally, texture segmentation is performed by combining pixel difference features, and according to the dynamic distribution of the corner points of the art scene, the local binary fitting method is used for the information enhancement and restoration processing of the art image. The results show that the drawing time of the model in this paper is always kept within 4s, and the completeness of the images all reach more than 99%, and the highest clarity can reach 0.99. It is verified that under the guidance of the art history theory, the attributes of the digitized visual culture have been innovated, and the art space has been expanded.

KEYWORDS

Art history theory; digital vision; SIFT algorithm; Gaussian function; system reconstruction technology

https://doi.org/10.17993/3cemp.2024.130153.102-118

INDEX

https://doi.org/10.17993/3cemp.2024.130153.102-118

1. INTRODUCTION

With the rapid development of information technology, the diversification of art media provides a favorable environment for the operation of sensory association mechanism in public space. The continuous progress of media technology makes multi-sensory interaction as the characteristics of super design become the main way of art communication in the information society [1]. Sensory interaction and media integration also make public space become an art museum without walls, which is an aesthetic realm where the light of science and technology ignites artistic ideals. Holographic technology fully mobilizes all our senses, dynamically presenting human cultural genes and historical codes through the perspective of art, promoting contemporary art to break the traditional aesthetics and take a solid step towards the future of art history [2-3]. Behind a certain art history writing practice, there is always a certain art history theory. Because the scientific and ideological aspects of art history are different from the scientific aspects of natural sciences and the ideological aspects of other humanities and social sciences, art history theories will undoubtedly understand the scientific and ideological aspects of the artworks with variations and uncertainties at the same time, which will make the scientific aspects and ideological aspects realize the mutual intertwining in themselves [4]. The presentation of art and cultural information cannot be separated from the participation of visual technology. The continuous updating of visual technology promotes the constant change of cultural communication. Nowadays, digital technology is widely used in all aspects of people's life world, and cultural information is more often presented in the form of visual images, which has become the most powerful communication method in contemporary times [5-6]. In the new period, it is of great practical significance to study the innovation and development of visual communication design in the digital era.

Based on the theory of art history, this paper constructs a digital visual model and adopts the SIFT algorithm to adjust the transparency and grayscale value, which enhances the visual communication effect of art and culture packaging. The construction of a symbol library and material database with information and the development of technologies such as image retrieval can improve the efficiency of researchers and conservators in querying relevant data, and can expand the traditional visual art expression. On the basis of the texture information characteristics of digital images, the optimized design of digital simulation synthesis of art images is carried out. In the practical analysis, the feasibility of the method of this paper is verified by performance testing, image quality testing and creation cost. It is proved that art history theory shapes new ways of information acquisition and interpretation, contributes to new thinking and cognition, highlights the challenging nature of postmodernism, shapes art history into a visual visual trajectory, and realizes the breakthrough of art history from static research to dynamic research.

https://doi.org/10.17993/3cemp.2024.130153.102-118

2. LITERATURE REVIEW

Potashova, K The technique of attracting pictorial elements into textual poetics, outlining the special way in which vision is associated with the perception of the envisioned world as a picture, identifies the mechanism of linguistic color transfer. The vastness of the universe is represented by complex color nicknames in rich semantic shades, wild animals are considered as aesthetic objects, and the vastness of the universe is represented by a large number of colorful minute details [7]. He, L. aims to analyze the possibilities of mixing the modern image visualization with the emerging VR technologies, proposing a model of artistic image design based on the process of visual interaction, a rigorous sequence of assembly, and a suitable mode of equipment. The VR-based design achieved promising results, realizing three basic image manipulations: illumination change, occlusion change and color change, proving that the technology is feasible and suitable for combining with the visual design of artistic images [8]. Midak, L. et al. visualized the educational process of the chemical discipline based on augmented reality technology, whose 3D model appears to be manipulable in some way to better understand its structure, working principles, etc. The application of augmented reality objects gives the teacher the opportunity to explain a large amount of theory quickly and efficiently, while the student memorizes it effectively, fosters creativity and increases motivation to learn [9]. He, W proposed a further application based on the JTFA method to reconstruct the frequency 3D sliced image visualization to represent the distribution of the main frequency components in the measurement area. The frequency C-scan can be reconstructed after using the proposed signal processing process. By segmenting the frequency C-scan, the frequency distribution of the surface at a specific radar time/depth can be obtained [10].

Pintus, R through MLIC's latest integrated view as a means of gaining insight into objects through analysis and visualization of acquired data. By fusing all acquisitions into a single augmented image, the focus is on methods that produce relightable images through intermediate representations. This is achieved using various analytical forms of the fitted light transformation function, but also by locally estimating the parameters of physically plausible shape and reflectance models and using them for visualization and analysis [11]. Gultyaeva, G explores the phenomenon of Chinese realism and the premises and factors that influence the process of acceptance of modern art in China. Using a systematic and holistic approach to analyze the realism of Chinese painting, it reveals the diversity of forms and directions of Chinese painting and provides a basis for the evolution of Chinese painting in the context of Chinese art and culture in the twentieth century, and develops ideas about how artistic consciousness changed throughout the era [12]. Qi, B takes the subject of the Chinese and Western art history course in a school and first summarizes the teaching features and flaws, and explains the method of applying big data technology in it. Through actual statistics, students' views on the new education model are counted. Through data analysis, the help of the new education mode on students' learning outcomes is obtained [13]. Peng, Y proposed a visual communication design method for websites based on user experience. With the enhancement of website user

https://doi.org/10.17993/3cemp.2024.130153.102-118

experience as the main line of research, the elements that need to be considered in webpage design are summarized from the perspective of visual communication design. Design elements are extracted from several large commercial websites in China, and a website emotion evaluation scale is constructed and tested for its credibility and validity. Finally, taking the design process of a thematic website as an example, the specific realization method of visual communication elements in the process of website construction is given [14].

3. ART HISTORY THEORY VISUAL COMMUNICATION

The study of art history can not only explain the causes of artistic trends and styles through history and society, but also interpret and reveal the material and spiritual connotations of the development of human civilization through the themes and styles of artistic phenomena and works [15]. The study of art history is by no means only to examine the general laws of artistic development and stylistic evolution, and to provide theoretical and empirical guidance for artistic creation, but it should be a humanities discipline as a study of history and culture. Relative to the text, the research object of art history is visual culture dominated by images, which involves a wider scope than painting and sculpture in the general sense [16]. Therefore, in visual communication, in order to assist the meaning of the main sign, it is transformed into a visual symbol on the graphics to convey the meaning. Art graphics in visual design not only to express their own design intent, but also to play its visual beauty, that is, art graphics should be in line with its laws, but also to consider its special characteristics. Art graphics play a role in strengthening the main elements and emphasizing the overall atmosphere in the components. Through digital technology, the design process and design methods are constantly improved, gradually developing in the direction of diversification and multidimensionalization, digitizing all kinds of text, images and graphics, and bringing people a richer visual experience.

4. CONSTRUCTING A DIGITAL VISUAL MODEL

4.1. VISUAL REPRESENTATION PROCESS

The human sensory system, mainly visual and auditory, plays an important role in the art creation of the aesthetic subject and the art appreciation activities of the aesthetic object. The visual communication design in the digital era is the realization of interactive communication between human and machine, and the new medium of visual communication design can form a good interactive function and interactive interface to quickly convey important information content [17-18]. Through the continuous improvement of the design process and design methods, it gradually develops in the direction of diversification and multidimensionalization, and digitizes all kinds of text, images and graphics to bring people a richer visual experience [19]. Therefore. Based on the theory of art history, this paper uses limited digital media to realize swifter and more accurate communication and improve the quality and effect of

https://doi.org/10.17993/3cemp.2024.130153.102-118

visual communication. Figure 1 shows the digital visual embodiment process, through the pre-processing module to get the input data and initialized graphics required for structural analysis, the values obtained by the calculation module calculation are transferred to the post-processing module to output the relevant data and construct the three-dimensional visual model, based on which, the SIFT algorithm is used to regulate the transparency and grayscale value, to enhance the visual communication effect of the art and culture packaging. The construction of a symbolic library with information and material database and the development of technologies such as image retrieval can improve the efficiency of researchers and protectors to query the relevant data, can expand the protection ideas of the remains of traditional visual art expressions, promote innovative thinking, and improve the level of protection and research on the remains of traditional visual art expressions as a whole [20]. Through digital visualization. The information communication form presents diversification and multidimensionalization, and the deconstruction and reorganization of text, pictures, images and other graphic design elements, and the combination of two-dimensional and three-dimensional space can design more diversified, more vivid and more visually striking works, which can strongly stimulate people's vision and psychology.

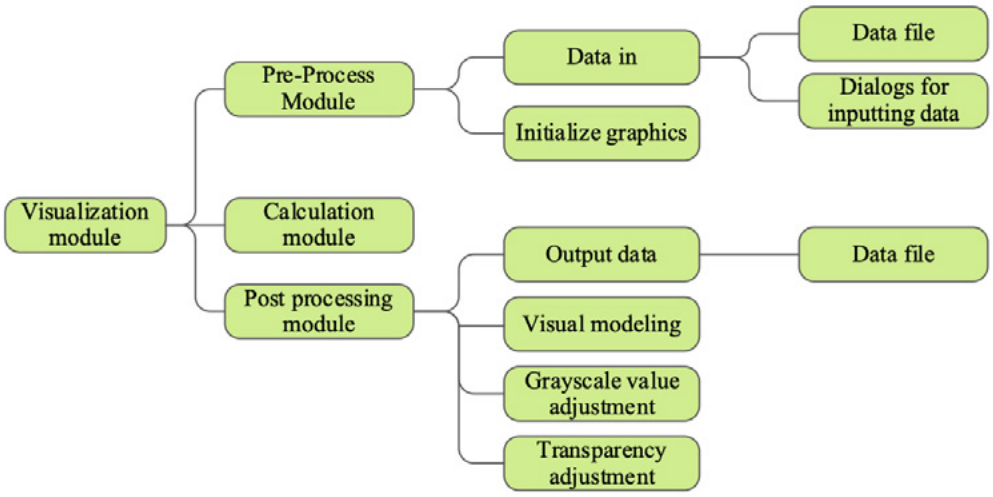

Figure 1. Digital visualization of the process

Based on the theory of art history in the visual language to express, can have a lot of space for activities, can be cross-linguistic and cross-script communication, there are tens of millions of languages in the world, not through the language of the text can become a kind of independent graphics, but also can become a kind of information dissemination of symbols. Through the integration of digital technology, visual communication design can integrate graphics, video, sound, text, animation and other media into one, and a variety of media synergies to achieve a combination of sight, sound, touch, and unity, making the information transfer more intuitive and convenient compared to the text. And visual communication from two-dimensional gradually shifted to three-dimensional, from static gradually shifted to dynamic, and gradually developed into dynamic three-dimensional image, which makes the traditional design of the expression of a more technological, digital, to achieve the desired effect, to meet the audience's multiple visual aesthetic needs.

https://doi.org/10.17993/3cemp.2024.130153.102-118

4.2. EXTRACT IMAGE FEATURE POINTS

In this design, visual communication technology is referred to the process of art scene processing, and a variety of visual symbols are set in the processed scene, and the processed scene is categorized and stored through the symbols, and a special file is set to improve the precision and speed of scene processing during reconstruction [21]. In the setting of visual symbols, attention is paid to the format of the scene to ensure that the symbols are used in the processed scene as a basis for feature point extraction.

Using the processed scene, the SIFT algorithm is used to extract the art scene feature points. First, the three-dimensional scale space is constructed, and the Gaussian function with different scale factors is convolved with the scene to form a series of images with different scales and image pixels, and the scale space is set to be $A(x, y, \partial)$, the original image to be $B(x, y)$, and the Gaussian function to be $C(x, y, \partial)$, then there are

$$A(x, y, \partial) = B(x, y) \otimes C(x, y, \partial) \tag{1}$$

where ∂ is the scale space factor. It is set to increase exponentially, and each value has a corresponding image, which is formed into a Gaussian pyramid for feature extraction of the art scene, and its extreme points are set to be the feature points of the image, i.e:

$$D(x, y, \partial) = (C(x, y, n\partial) - C(x, y, \partial)) \otimes B(x, y) \tag{2}$$

where n is the scale shrinkage factor. Find the extreme value point in the result of equation (2), which is the feature point of the image. The acquired feature points are matched and their consistency is calculated to derive the key points for image reconstruction and complete the 3D digital visual reconstruction.

4.3. DIGITAL IMAGE RECONSTRUCTION

Using the feature points obtained above, the original system reconstruction technology is used to realize the reconstruction of digital images. The image information after setting the visual symbols is used in the reconstruction to ensure the completeness of its reconstruction, and the digital image reconstruction process is shown in Figure 2. On the basis of the original digital image reconstruction system, the visual communication technology is quoted to ensure the feasibility of the application of this technology in the three-dimensional image reconstruction system, and the specific process is designed as the following steps:

1. After inputting the image, capture the original image and preprocess the image to make the picture more suitable for processing and operation than the original image.

https://doi.org/10.17993/3cemp.2024.130153.102-118

2. Supplement the missing parts of the spatial domain of the image to enhance the spatial domain of the original image and improve the appearance of the image.

3. Describe the image with different resolutions respectively, and cooperate with the image self to the resolution description after the image segmentation, adapted to the most suitable resolution.

4. Complete the image processing and output the new image.

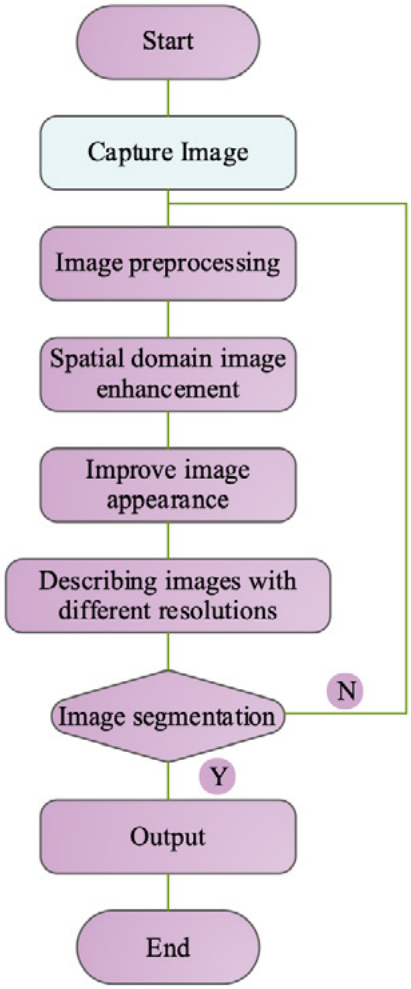

Figure 2. Digital image reconstruction process

Through the above process to realize the reconstruction of three-dimensional image, the reconstructed feature point set is set to u, S for the reconstructed three-dimensional image image vector, the original image feature point is p, in the reconstructed image has a point of overlap, the accuracy of its operation does not take into account the overlap part, then:

$$I(n) = (S(n) \cdot u + S(n) \cdot p)/n \tag{3}$$

Where, p is the 3D image section, after reconstruction, the 3D image error does not exceed 0.1% is qualified.

https://doi.org/10.17993/3cemp.2024.130153.102-118

4.4. ENHANCEMENT OF ARTISTIC MESSAGES

Initializing the model and combining the 3D data distribution synthesized from the digital simulation of the art scene, the following iterative equations for the contour curve evolution process are obtained:

$$v_{i,d}^{k+1} = \omega \cdot v_{i,d}^{k} + c_1 \cdot \text{rand}\Big(\Big) \cdot \Big(c_3 \cdot \text{rand}()) \cdot \ \text{pbest}_{i,d}^{k} - x_{i,d}^{k}\Big) + c_2 \cdot \text{rand}())\Big(c_4 \cdot \text{rand}()) \cdot \text{gbest}_{d}^{k} - x_{i,d}^{k}\Big) \quad (4)$$

where C_3 and C_4 are called the secondary matching templates of the 3D digitized image of the art scene. In the process of contour curve evolution, the texture segmentation is performed by combining the pixel difference features, and for the gray sample set $\{x_i, y_i, z_i\}$ of the art image, x_i is used to denote the input of the sparsity texture feature of the prints, y_i denotes the output of the corresponding edge pixel set, and z_i denotes the output of the pixel intensity feature, and the geometrical feature distribution function of the digitized simulated synthetic image of the art scene is obtained as:

$$f(x) = w^T \varphi(x) + b \quad (5)$$

where w is the gray scale inhomogeneous pixel feature component and b is the bias.

In this paper, the art history theory is used to optimize the art information of art scenes through digital technology. On the basis of the texture information characteristics of digital images, the optimization design of digital simulation synthesis of art images is carried out. In the gray scale pixel area, according to the dynamic distribution of the corner points of the art scene, the image digital simulation synthesis is carried out by the local binary fitting method to establish the Lagrangian function:

$$L(w, b, e, \alpha) = J(w, e) - \sum_{i=1}^{l} \alpha_i \Big(w^T \varphi\big(x_i\big) + b + e_i - y_i \Big) \quad (6)$$

where α_i is the Lagrange multiplier. In the whole visual communication process, information interpretation and visual symbol reception are a more complicated process. In this paper, the art history theory is used as the basis for dynamic feature segmentation of digital images of prints by combining edge contour segmentation and texture segmentation techniques. The local binary fitting method is used for information enhancement and restoration of art images, and the information fusion technology is used to realize the analog synthesis of digital images.

https://doi.org/10.17993/3cemp.2024.130153.102-118

5. ANALYSIS OF DIGITAL VISUAL MODELING PRACTICES IN ART HISTORY THEORY

5.1. PERFORMANCE TESTING

5.1.1. MAPPING TIME

In order to verify the performance of the system, an art image is taken as the research object, and the system is verified from the visualization point of view, and in order to compare the performance of the system, the model of this paper is compared with the sensor-based visual communication system and the visual system based on feature extraction, and in the process of the model drawing the image, the size of the image affects the time of drawing, and the time required by the system to draw the image in the case of different image sizes is shown in Table 1, and the time required by the system to draw the image is compared with the other two methods at the same time. The drawing time of the system in this paper is compared with the other two methods implemented. With the growth of the image size, the drawing time increases gradually, but the model in this paper always stays within 4s, the drawing time is faster, while the other two systems drawing time grows continuously, the longest drawing time has been more than 10s, indicating that the model constructed in this paper is more efficient in drawing, and it can improve the work efficiency in the process of practical use. Digital information acquisition and processing technology can better organize, collect and record the information of visible artistic expressions of national folklore, which can break through the display requirements and real effects that cannot be achieved by the protection methods in the traditional sense.

Table 1. System drawing time

The image is large Small /dpi	Theoretical models of art history/s	Visual communication systems for sensors/s	Visual systems for feature extraction/s
256×256	2.36	4.28	6.85
640×480	2.96	4.87	7.34
1024×768	3.18	5.19	8.64
1600×1 200	3.49	5.67	9.66
2048×1536	3.97	6.35	10.35

5.1.2. ENERGY CONSUMPTION

A delicate and beautiful image can attract people's attention and give them a good emotional experience. The visual environment conveys artistic and cultural connotations and aesthetic requirements in the form of image modeling. There are also differences in the energy consumed by the system in drawing images, for

https://doi.org/10.17993/3cemp.2024.130153.102-118

example, the size of the image of 1600 × 1200 dpi, the model of this paper and the other two systems in the drawing of the image of the energy consumed as shown in Figure 3. With the increase of the system use time of the system energy consumption of this paper does not change much, always keep below 0.45J, and the trend is relatively smooth. While the other two systems with the increase of the system use time energy consumption in general shows a rising trend, in which the sensor-based visual communication system fluctuates more during the working time, indicating that the stability of the system's energy consumption is poor. The theoretical model of art history consumes the least amount of energy in the design of the experimental object, and in the actual use of the process, it is able to preserve the digital information that meets the needs of the legacy of traditional visual art expressions, and it can exert its advantages of convenience and lower cost. It makes the modern visual communication design works richer in content, more diverse in form and more profound in connotation, forming a stronger visual impact and thus achieving a more desirable visual communication effect.

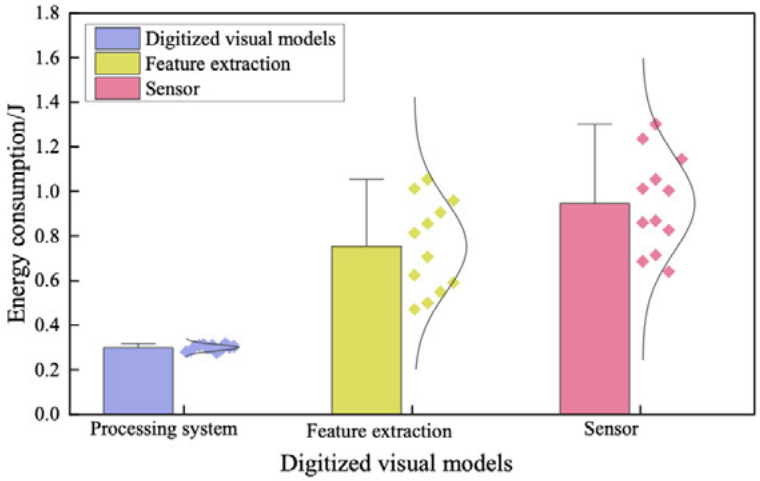

Figure 3. The amount of energy expended when drawing an image

5.2. IMAGE QUALITY DETECTION

5.2.1. IMAGE INTEGRITY

In order to verify the feasibility of the designed digital visual model based on art history theory, a test session is set to judge its feasibility by comparing the integrity of the reconstructed images. The test is based on the reconstruction results to build a 3D reconstruction platform, based on the image editing tools, 3D production equipment and professional engine, using C language as the platform development language, and adopting a multi-architecture network to transmit the image data to ensure its timeliness and completeness. The editor selects highly integrated equipment to improve the operation speed of reconstruction. Table 2 shows the results of the comparison of the integrity of the reconstructed image, using the art history theory model to reconstruct the image of the results of the integrity is significantly higher than

https://doi.org/10.17993/3cemp.2024.130153.102-118

the original image, and the degree of completeness of more than 99% of more stable, while the original image fluctuations are larger. Through the comparison, it can be seen that the original image texture and color matching and samples differ greatly, the reconstruction results of this paper and samples are more consistent. To ensure the integrity of the image edge structure, effectively combined with the characteristics of the depth image, to obtain a complete image after processing. Through the theory of art history, and the completion of the digital media, so that its artistic characteristics have undergone a great transformation.

Table 2. Comparison of image integrity after reconstruction

Sample serial number	Size	Original image		Reconstructed image	
		Resolution/dpi	Completeness/%	Resolution/ dpi	Completeness/%
1	50×50×50	112	98.9	170	99.01
2	100×120×10	215	93.5	300	99.3
3	20×35×40	306	97.26	360	99.0
4	55×60×90	118	94.5	211	99.89
5	20×180×9	198	90.81	246	99.67

5.2.2. IMAGE CLARITY

In order to test the feasibility of this proposed idea of creating a digital visual model based on art history theory, as well as to verify the adaptability in the field of digital media, certain digital media art scenes are selected as examples of digital media art creation using the sub-design method, and in order to make the experimental results and experimental data more illustrative, this experiment adopts numerical comparisons, selecting the sensor-based visual communication system and the feature extraction based visual system for comparison. Since clarity can reflect the clarity of digital media art images, the higher the clarity value, the clearer the digital media art image is viewed by the naked eye and the higher the image quality. The experiment randomly selects 10 images of different scenes and records the art image clarity. Table 3 shows the results of image clarity comparison, the application of digital visual model based on the theory of art history created by the art work image clarity is relatively high, the highest clarity can reach 0.99, the lowest clarity is 0.96. The average value of the image clarity of the art work image clarity is 0.97, which can be controlled at more than 0.95, which is a higher level, indicating that the use of this paper's design methods the quality of the art images created is relatively high and the picture quality is clear. On the other hand, the image clarity of art works created by sensor-based visual communication system and feature extraction-based visual system is relatively low, the maximum value of image clarity of sensor-based visual communication system and feature extraction-based visual system are 0.74 and 0.66 respectively, the minimum value is 0.51 and 0.52 respectively, and the average value

https://doi.org/10.17993/3cemp.2024.130153.102-118

is 0.55 and 0.57 respectively, which indicates that the visual cultural research objects often overlap with art history, which promotes the pace of exploration of digital media art on contemporary art, brings infinite possibilities for its development, and broadens the original boundaries.

Table 3. Comparison results of image clarity

Serial number	Theoretical models of art history/s	Visual communication systems for sensors/s	Visual systems for feature extraction/s
1	0.98	0.56	0.55
2	0.96	0.74	0.63
3	0.99	0.71	0.58
4	0.97	0.65	0.64
5	0.98	0.59	0.66
6	0.99	0.54	0.61
7	0.96	0.62	0.59
8	0.97	0.62	0.54
9	0.99	0.69	0.52
10	0.98	0.51	0.55

5.3. COSTS OF ARTISTIC CREATION

Since the cost of art creation directly affects the benefit of art design, this paper respectively applies the digital visual model based on the theory of art history, the visual communication system of sensors, and the visual system based on feature extraction to different scenes for art creation, and records all the cost data during the creation process, and Figure 4 shows the results of the comparison of the cost of art creation, in which the model constructed in this paper has a relatively low cost, all of which are less than 10000 yuan, and the cost of creation in urban greening is low, at about 2800 yuan. While the visual communication system of the sensor has the highest cost of creation in commercial land reaching 23895 yuan, the cost of creation in indoor landscape is lower, and the cost of visual system based on feature extraction in indoor art creation reaches 23465 yuan. It shows that the digital visual model of art history theory can not only ensure the quality of picture quality in practical application, the image clarity of art works is relatively high, but also the creation cost is relatively low, which meets the needs of digital media creation.

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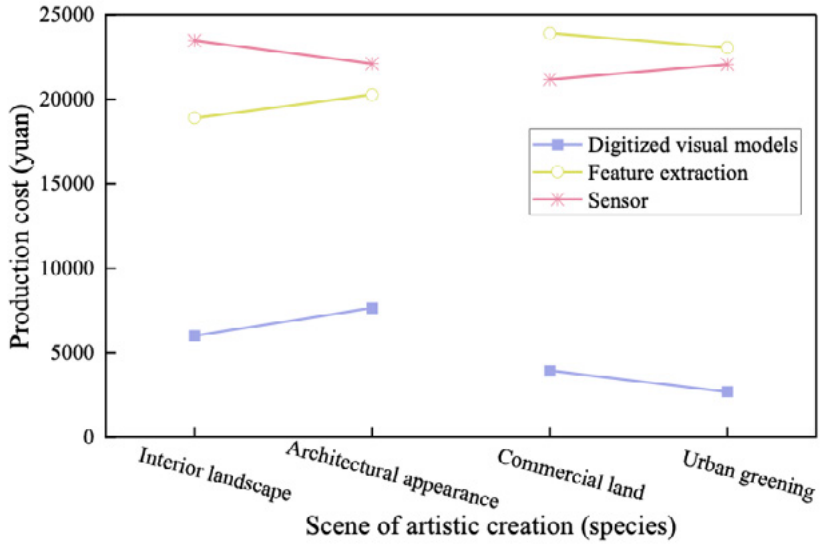

Figure 4. Comparison of the cost of art creation

6. CONCLUSION

This paper investigates the mention of art historical theories in visual communication by constructing a digital visual model. The conclusions are as follows.

1. In the performance test, with the growth of image size, the drawing time of the model in this paper always stays within 4s. The energy consumption situation always stays below 0.45J, and the trend is smoother. It shows that the model constructed in this paper can better collect the information of visible artistic expressions, ensure the integrity of the image edge structure, and effectively combine the features of the depth image.

2. In the image quality detection, the image integrity are more than 99% more stable, and the art work image clarity is relatively high, the highest clarity can reach 0.99, the lowest clarity is 0.96. It shows that the object of research of visual culture often overlaps with art history, to ensure the integrity of the image edge structure, and to promote the pace of exploration of digital media art to contemporary art.

3. In the analysis of the cost of creation, the model constructed in this paper want more low cost, are more than 10,000 yuan, in the urban greening in the creation of low cost, in about 2800 yuan. It shows that the digital visual model of art history theory in the practical application can not only ensure the quality of the picture quality, the image clarity of the art work is relatively high, and the cost of creation is also relatively low, to meet the needs of digital media creation

https://doi.org/10.17993/3cemp.2024.130153.102-118

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https://doi.org/10.17993/3cemp.2024.130153.102-118

/06/

PHYSICAL EXERCISE AND EMOTIONAL MANAGEMENT COLLEGE STUDENTS

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ABSTRACT

In order to study the correlation between emotion management ability and physical activity, and the role of physical activity on emotion management ability, this paper used gray correlation analysis to establish a correlation model. The sequence of features is represented by the degree of association between the factors in the gray system, and the similarity of the spatial and temporal evolution of the data is measured by using the horizontal distance, incremental distance, and variance distance. The correlation coefficient between physical exercise and emotion management ability was calculated according to the integrated correlation distance, and the correlation degree was realized according to the coefficient matrix. The results showed that the correlation coefficient between college students' emotion management ability and physical exercise was 0.378, the number of people who used psychological adjustment as the motivation for exercise occupied 52.0%, and the difference between different amounts of exercise in emotion management ability was relatively significant with P-value <0.01. It shows that through physical exercise can escape from the low mood and regain positive emotions, is conducive to improve the emotion management ability of contemporary college students.

KEYWORDS

Emotion management ability; physical exercise; gray correlation analysis; correlation coefficient; exercise motivation

https://doi.org/10.17993/3cemp.2024.130153.120-136

INDEX

https://doi.org/10.17993/3cemp.2024.130153.120-136

1. INTRODUCTION

College students are the backbone and cornerstone of the future development of Chinese society, and they bear the great responsibility of promoting the development of society and building the great motherland, and they are a social group that attracts much attention [1]. In modern society, the pressure of competition is becoming more and more intense, rich knowledge and advanced theories are necessary for contemporary college students to master, in addition to having a healthy body and good mental quality. Research on the emotional management of college students shows that there are certain hidden dangers in the emotional management of college students, which hinders the establishment of good interpersonal relationships and the ability to communicate with others [2]. Emotion is a comprehensive physiological and psychological state that exists as a special factor in various cognitions, sensations and behaviors of human beings, and it is the corresponding psychological and physiological special reaction produced in response to external stimuli, and emotion has an important driving effect on human behavior, and it is an important factor that influences the formation and development of human behavior, cognition, and psychology [3-4]. The youthfulness of juvenile delinquency and the suicides of a few college students call for people to pay attention to emotion management, in short, the various emotional problems presented call for us to pay close attention to the emotional needs of college students at different stages, and to control and regulate the emotional mechanism of students [5]. Therefore, the current situation of physical exercise and emotional management ability of contemporary college students can be improved through the study of the relevant aspects of physical exercise and emotional management ability of contemporary college students [6]. It serves to improve the quality of life for the majority of students, serves for the future college students to better adapt to the social status quo and rapid employment, provides a reference for the development of more reasonable theories on cultivating college students' mental health and moral education, and provides some theoretical references for enriching the psychology of college students' exercise and the development of college students' mental health education programs.

This paper constructs an association model based on gray correlation analysis, in order to analyze the relationship between physical exercise and emotion management. Firstly, the sequence of features was established to indicate the degree of association between individual factors, and then in order to accurately portray the spatial and temporal characteristics of the data, the horizontal distance, incremental distance, and variation distance between columns were utilized to portray the trend differences in the changes in the value added of each index between the evaluation objects. And the stem correlation coefficient was calculated according to the comprehensive distance, which was used to construct the body of indicators of the psychological effect of physical exercise. Finally, in the correlation analysis, the reasonableness of this paper's model is verified through validity test, basic situation analysis, significance analysis and regression analysis, which illustrates that there is an interaction between physical exercise and emotion management ability, i.e., the emotion management ability can improve the level of physical exercise, and physical

https://doi.org/10.17993/3cemp.2024.130153.120-136

exercise in turn can improve the emotion management ability. Exercise emotional benefit has a better prediction effect on college students' emotional management ability, and college students' good experience of exercise emotion will be more helpful to the cultivation of emotional management ability, which in turn will enhance the overall psychological quality of college students.

2. LITERATURE REVIEW

Long, Z et al. designed a 20-minute moderate-intensity cycling experiment and an EEG data acquisition experiment based on an image-evoked mood assessment protocol. The experimental procedure included two mood assessment sessions, each containing 24 images. It was shown that moderate-intensity physical activity can reduce negative emotional experiences and support the hypothesis that moderate-intensity physical activity is beneficial for improving emotional responses to negative stimuli [7]. Liu, Y. W et al. were exploring the effects of self-representation and psychological needs on exercise dependence to provide necessary references for preventing and inhibiting the emergence of exercise dependence in overweight college students. They also conducted physical fitness tests on freshmen of two comprehensive universities and analyzed the related data by using multiple regression, exploratory factor and validation factor analysis, and found that self-representation of overweight male and female college students had a significant positive effect on psychological needs and exercise dependence [8]. Meidut, V took elderly people over 60 years old as the research subjects. Subjects were assessed before and after the physical activity intervention using the Hospital Anxiety and Depression Scale method, and the percentage change in physical functioning after the exercise intervention was better in those who were in poorer physical health before exercise. Subjects who rated their mental health better prior to the physical activity intervention showed better percentage changes in anxiety and overall psychoemotional state than those who rated it worse [9]. Khan, M investigated whether these social changes in Western college students were consistent with changes in trait emotional intelligence. The methodology used was a meta-analysis across time. The results were that there were no significant changes in the overall trait emotional intelligence but that the domains of trait emotional intelligence of well-being, self-control, and emotionality declined significantly over time after controlling for differences in gender composition and between countries [10].

Ji, C. explored the effects of exercise intensity and frequency on anxiety, depression, and sleep quality in college students. Participants' exercise intensity was monitored using a Polar H10 HR sensor and the Borg RPE scale. The experiment was conducted for a total of 6 weeks. Exercise intensity was found to improve anxiety and depression symptoms better than exercise frequency, and sleep quality was more closely related to exercise intensity [11]. Yu, Y. et al. used artificial intelligence recognition algorithms to identify college students' extracurricular physical activity behaviors, and UHF RFID technology was used to design a student information collection system. The collected information and data were processed to get the

https://doi.org/10.17993/3cemp.2024.130153.120-136

individual positioning of students, and combined with student behavior identification for student positioning and behavior identification management, which can help teachers to improve the efficiency of extracurricular management, student safety and physical exercise efficiency [12]. Lacount, P. A. et al. elucidated the acute effects of high-intensity interval training on college students with and without attention deficit hyperactivity disorder. High-intensity interval training was found to be a useful adjunct to psychosocial or pharmacological treatments for college students with ADHD, as it can produce immediate immediate and acute improvements in executive functioning and promote improved physical and mental health [13]. Song, C conducted a survey on the current status of physical activity among primary and secondary school students to analyze the factors affecting the physical activity of primary and secondary school students with the aim of assisting primary and secondary school students to develop a good habit of physical activity. The results found that most of the primary and secondary school students' awareness of physical exercise is correct. Most students are able to participate in physical exercise, but few of them are able to participate regularly. Parental support, parents' exercise habits, and family expenditures on physical activity have a significant impact on developing students' exercise habits [14].

3. CONSTRUCTING A GRAY CORRELATION ANALYSIS MODEL OF PHYSICAL EXERCISE AND EMOTION MANAGEMENT

3.1. CONSTRUCTION OF THE MODEL

Emotion management refers to the ability of an individual to actively search for emotional strategies to resolve emotional discomfort in an effective way when encountering emotions that are unfavorable to the development of the individual [15]. It has become an indisputable fact that physical exercise will have a certain impact on the physical and mental state of a person, and as one of the psychological indicators, emotion will naturally have a certain connection with physical exercise [16]. This paper establishes the relationship model between physical exercise and emotion management based on gray correlation analysis.

Gray correlation analysis method is an important part of gray system theory, which is an effective means of information system analysis [17]. Gray correlation is a scale that characterizes the degree of association between factors within a gray system, let the sample feature sequence is $X_0 = (x_0(1), x_0(2), \cdots, x_0(n)$ and $x_i(k) > 0, i = 1, 2 \cdots m; k = 1, 2 \cdots n,$ then the related factor feature sequence can be expressed as:

https://doi.org/10.17993/3cemp.2024.130153.120-136

$$\begin{aligned} X_1 &= \left(x_1(1), x_1(2), \cdots, x_1(n)\right) \\ &\cdots \\ X_i &= \left(x_i(1), x_i(2), \cdots, x_i(n)\right) \\ &\cdots \\ X_m &= \left(x_m(1), x_m(2), \cdots, x_m(n)\right) \end{aligned} \tag{1}$$

Given the real number $\gamma\left(x_0, x_i\right)$, thus the gray correlation calculation model is obtained as:

$$\gamma^*\left(X_0 X_i\right) = \frac{\gamma\left(X_0, X_i\right)}{1 + S\left(\gamma_{0,j}\right)} \tag{2}$$

The gray correlation of X_i with X_0 is represented by $.\gamma\left(X_0, X_i\right)$ The stability of the sequence of point correlation coefficients of sequence X_i with X_0 is represented by $S\left(\gamma_{0_i}\right)$. A larger value of $S\left(\gamma_{0_i}\right)$ indicates a less stable sequence of point correlation coefficients.

3.2. CORRELATION DISTANCE

In the gray correlation analysis model to reflect the spatio-temporal characteristics of the sequence, in order to be able to accurately portray the spatio-temporal characteristics of the data, the similarity of the spatio-temporal evolution of the data can be measured by using the horizontal distance, incremental distance, and variance distance [18]. Let the horizontal distance between evaluation object k' and evaluation object k be:

$$d_1^i = \| X_{k'}^i - X_k^i \|_2 \tag{3}$$

where $\| X_{k^i}^i - X_k^i \|_2$ denotes the Euclidean paradigm of the sequence $X_{k'}^i - X_k^i$, and d^1 can reflect the absolute distance between the evaluating object k' and the evaluating object k at the i moment, which is called the horizontal distance between the sequences.

Notation $\nabla x_k^i(j) = \begin{cases} x_k^i(j) - x_k^{i-1}(j), i = 2, 3, \cdots, m \\ 0, i = 1 \end{cases}$, denotes the increment of the jrd indicator of evaluation object k on $[i-1, i]$. The sequence of increments of indicators of evaluation object k at the moment of i is $\nabla X_k^i = \left(\nabla x_k^i(1), \nabla x_k^i(2), \cdots, \nabla x_k^i(n)\right), i = 1, 2, \cdots, m$, and the incremental distance between evaluation object k' and evaluation object k is:

$$d_2^i = \| \nabla X_{k'}^i - \nabla X_k^i \|_2 \tag{4}$$

https://doi.org/10.17993/3cemp.2024.130153.120-136

Where $\| \nabla X_{k'}^i - \nabla X_k^i \|_2$ represents the Euclidean parameter of vector $\nabla X_{k'}^i - \nabla X_k^i$, and d_2^idepicts the difference in the trend of the change in the value added of each indicator between the evaluation objects. If the indicators of the two evaluation objects are changing in the same direction, the more coordinated the change is, the more similar is the trend of the change in the two evaluation objects, and the distance is also smaller. If they change in the opposite direction, the distance is generally larger and the similarity between them is less. The variation distance between evaluation object k' and evaluation object k is:

$$d_3^i = \left[\sum_{t=1}^{n} \left(\frac{\bar{x}_{k'}^i}{\sigma_{k'}^i} - \frac{\bar{x}_k^i}{\sigma_k^i} \right)^2 \right]^{\frac{1}{2}} \tag{5}$$

Where $\bar{x}_k^i = \frac{1}{n} \sum_{j=1}^{n} x_k^j(j)$, $\sigma_k^{i2} = \frac{1}{n-1} \sum_{j=1}^{n} \left(x_k^i(j) - \bar{x}_k^i \right)^2$, $\bar{x}_k^i$ represents the mean value of the variable standardized for n indicators of the k th evaluation object at the moment of i, and i represents the standard deviation standardized for n indicators of the k th evaluation object at the moment of i. d_3^i characterizes the similarity of the degree of fluctuation of the indicator values of the evaluation objects, if the degree of fluctuation of the indicators between the evaluation objects is close, the distance is smaller, and vice versa, the distance is larger.

3.3. CORRELATION COEFFICIENTS

Using the correlation distance, calculate the horizontal distance d_1^i, incremental distance d_2^i, and variation distance d_3^i between each object and the ideal object and negative ideal object at time i. Then, determine the comprehensive distance d_3^i between each evaluation object and the ideal object and negative ideal object based on factors d_1^i, d_2^i, and d_3^i. Next, calculate the gray correlation coefficient of each evaluation object and the ideal object and negative ideal object at time i using the comprehensive distance $\gamma\left(X_+^i, X_k^i\right), \gamma\left(X_-^i, X_k^i\right)$. Finally, calculate the weight of each time point $\lambda_i (i = 1, 2, \cdots, m)$ based on the matrix of decision-making coefficients. Use these weights to calculate the comprehensive correlation degree.

$$\gamma\left(X_+, X_k\right) = \sum_{i=1}^{m} \lambda_i \gamma\left(X_+^i, X_k^i\right) \tag{6}$$

$$\gamma\left(X_+, X_k\right) = \sum_{i=1}^{m} \lambda_i \gamma\left(X_+^i, X_k^i\right) \tag{7}$$

https://doi.org/10.17993/3cemp.2024.130153.120-136

4. ESTABLISHMENT OF INDICATOR DATA

Individual emotional states mark the individual's response to the environment and to the biologically motivated state when adapting to changes in the environment [19]. The emotion behind the behavior is not only an expression of the outcome of the behavior, but also represents some kind of adaptive motivational factors [20]. Whether adolescents can achieve healthy psychological benefits after participating in physical exercise and whether physical exercise can promote adolescents to achieve psychological health can be constructed as a reasonable index system for the psychological effects of physical exercise. This paper proposes the gray correlation degree and tries to construct the physical exercise psychological effect index system through it. Figure 1 shows the index relationship structure between physical exercise and emotion management. Adolescents are in the transition period of physical and mental development, and have their own psychological characteristics, such as the rapid development of self-consciousness, emotionally rich but easy to be impulsive and so on. The indicator system is based on the psychological needs of adolescents' independent physical exercise, self-determination motivation, exercise satisfaction, happiness and pleasure and other four variables to construct a structural relationship, in order to effectively promote adolescents to actively participate in sports and develop independent exercise habits to provide reference. Exercise satisfaction is the positive perception or feeling that adolescents have when engaging in physical exercise, and both exercise satisfaction and motivation are based on psychological needs as a starting point.

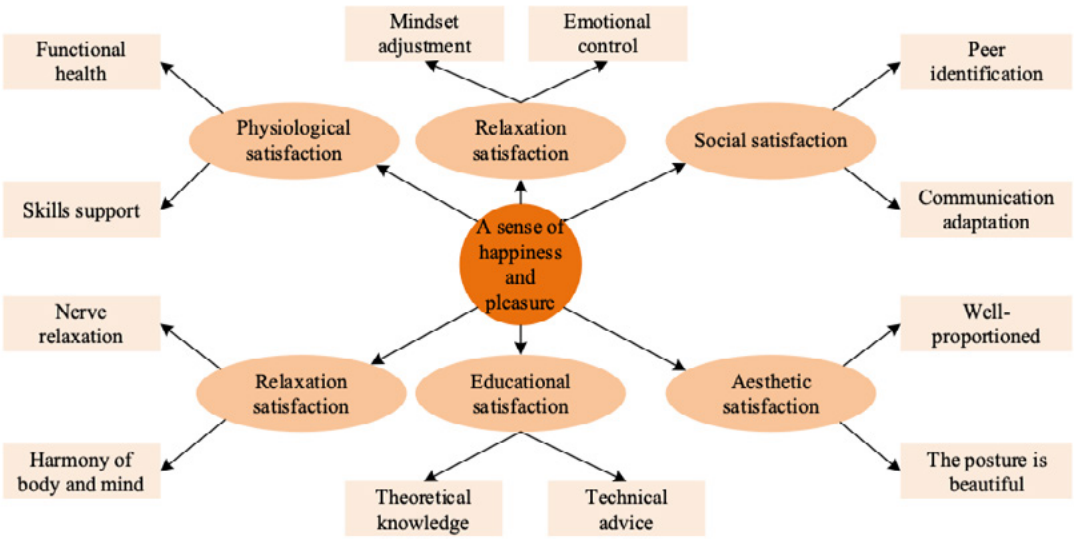

Figure 1. Structure of indicator relationship

Let the time sample point of the dynamic multi-indicator evaluation problem be $T_i(i=1,2,\cdots,m)$, and its corresponding weight be $\lambda_i(i=1,2,\cdots,m)$. The indicator be $P_j(j=1,2,\cdots,n)$, and its corresponding weight be $\omega_j(j=1,2,\cdots,n)$, and the object of evaluation be $S_k(k=1,2,\cdots,q)$. Let the sequence of indicators of the object of evaluation at the moment i be:

https://doi.org/10.17993/3cemp.2024.130153.120-136

$$\begin{aligned} X_1^i &= \left(x_1^i(1), x_1^i(2), \ldots, x_1^i(n)\right) \\ X_2^i &= \left(x_2^i(1), x_2^i(2), \ldots, x_2^i(n)\right); i = 1, 2, \cdots, m \\ &\cdots\cdots\cdots\cdots\cdots\cdots \\ X_q^i &= \left(x_q^i(1), x_q^i(2), \ldots, x_q^i(n)\right) \end{aligned} \tag{8}$$

Where $x_k^i(j)$ denotes the jth indicator value of the krd object at the i nd moment, it is said that $X_k^i(j)$ denotes the sequence of characteristic behaviors consisting of each indicator value of the th object at the i moment.

Since different evaluation objects are meaningful only when compared at the same point in time and on the same indicator, and different magnitudes of the indicators will have an impact on the quality of the modeling and the results of the systematic analysis, it is necessary to carry out a dimensionless processing of the evaluation matrix in order to eliminate the influence of the magnitude.

Let the observed value of the j nd indicator of the k st object in the evaluation matrix at the moment of i be $.X_k^i(j)$ If $X_k^i(j)$ is a benefit indicator, i.e., the larger the value of the indicator, the better, then the following transformation is applied:

$$x_k^i(j)D_1 = \frac{x_k^i(j) - \min_k x_k^i(j)}{\max_k x_k^i(j) - \min_k x_k^i(j)} \tag{9}$$

5. ANALYSIS OF THE CORRELATION BETWEEN PHYSICAL EXERCISE AND EMOTIONAL MANAGEMENT

5.1. VALIDITY TESTS

The basic factors of physical health, one is the physical aspect of physical exercise, such as external sports and fitness, etc.; the other psychological aspect of emotional management, such as the regulation and control of bad emotions. Combining the two organically for research will be a better help to the physical and mental health of contemporary college students. For this reason, this paper selects a college to collect data information on college students' physical exercise, emotional management, mental health and psychology. In order to verify the reliability of the relevant scales studied in this paper, the test is carried out through the correlation coefficient. The test results are shown in Table 1, which provides an overall scientific analysis of the validity of the scales to be studied in this thesis; the correlation coefficient between physical exercise and physical activity level is 0.235, the correlation coefficient between college students' emotional management ability and physical exercise is 0.378, and the correlation coefficient between college students' emotional management ability and physical activity level is 0.183, which is in conformity with the

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test standard. It indicates that when the interaction between emotion management ability and physical exercise is included in the equation, it has the same significant effect on the exercise emotion, which means that there is an interaction between physical exercise and emotion management ability, i.e., the emotion management ability can improve the level of physical exercise, and physical exercise in turn can improve the emotion management ability. Therefore, there is a positive mediating effect of physical exercise in emotion management ability.

Table 1. Results of validity test

Option	Physical exercise	Level of physical activity	Ability to manage emotions
Physical exercise	1.000	0.235***	0.378***
Level of physical activity	0.235***	1.000	0.183***
Ability to manage emotions	0.378***	0.183***	1.000

5.2. BASIC SITUATION ANALYSIS

In order to understand the basic situation of contemporary college students' physical exercise and emotion management, this paper takes the second-year college students in this higher education school as the main survey sample, randomly selects 1,000 of them for physical training, and analyzes them from two aspects. Table 2 shows the analysis table of college students' motivation for physical exercise. The personal motivation of college students to participate in physical exercise mainly focuses on the main purposes of physical fitness, recreation and psychological adjustment. In addition to the above three, the motives for choosing to exercise also include improving socialization, feeling insufficient for sports, being fit, mastering skills and taking part in competitions. A comprehensive analysis shows that in addition to the purpose of physical exercise, recreation and psychological adjustment are also important motives for young college students at the turning point of their lives and psychological age transition, with the proportion of 55.9% and 52.0% respectively. Physical exercise for college students has been gradually accepted and recognized by the society, and the fitness and recreation way of enhancing communication as physical exercise has become the mainstream way of physical exercise for contemporary college students, and has become an essential fitness demand in the daily fitness life of college students.

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Table 2. Analysis of physical exercise motivation

Exercise motivation	General situation		Boys		Girls	
	N	%	N	%	N	%
Increase communication	309	39.2	233	50.0	76	23.7
Keep fit	661	83.7	419	89.3	242	75.4
Psychological adjustment	411	52.0	232	50.0	179	55.8
Feel under-exercised	150	19.0	98	21.0	52	16.2
Recreation	442	55.9	230	49.0	212	66.0
Body Building	265	33.5	115	24.5	150	46.7
Acquire skills	160	20.3	111	23.7	49	15.3
Enter the contest	85	10.8	73	15.6	12	3.7

Table 3 shows the results of the analysis of the overall situation of emotion management ability, in the dimension of the ability to control negative venting, the highest mean score of T is 4.21, which shows that the university students have a strong ability to control the negative venting of emotion management, but in the dimension of the ability to positively remediate the lowest mean score of the questions, which shows that the university students have a poor ability to positively remediate the problem, which requires teachers and parents to give the necessary attention to the various dimensions The order of mean scores in descending order of magnitude is the ability to control emotional outbursts, the ability to rationally regulate, the ability to control negative cues, the ability to seek external support, and the ability to positively remedy. The data can be used to analyze the psychological factors of college students. With the rapid development of modern society, some contemporary college students, under the pressure of academics, employment, feelings and other pressures, the psychological condition of the development of the adverse direction, prone to loneliness, bitterness, anxiety, confusion and other bad emotions. Therefore, for school sports, in the design of curriculum content and teaching methods, firstly, we should pay attention to the auxiliary improvement and enhancement of the mental health level of adolescents by physical exercise, and fully integrate the game and fun into the sports program. Secondly, we should pay attention to the development of adolescents' social interaction ability through teamwork sports activities. Finally, based on the natural laws of physical development for adolescents, the intensity, frequency and duration of exercise are scientifically and reasonably arranged in sports activities.

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Table 3. The results of general situation analysis of emotion management ability

Project	Valid	Missing	Variance
Ability of rational control	790	0	4.92
Control negative venting	790	0	7.31
Ability to seek outside support	790	0	3.78
Control negative suggestibility	790	0	4.96
Ability to actively remedy	790	0	4.53
Overall analysis	790	0	17.20

5.3. SIGNIFICANCE ANALYSIS

After moderate physical exercise, it tends to eliminate the psychological state brought about by various negative emotions, making it physically and mentally comfortable, energized, and with an enhanced sense of meaning in life, which is just enough to make up for the spiritual emptiness of college students, and to alleviate all kinds of negative influences through physical exercise. By participating in physical exercise, each dimension of college students' emotion management ability is analyzed in terms of the control of emotion management. In order to understand the problems related to college students' participation in physical exercise and emotion management ability, the author conducted a correlation analysis of the differences, and the T-test of independent samples for different exercise amounts of college students' physical exercise and emotion management ability, and the results of the test are shown in Table 4. $p=0.002<0.01$, which means that overall, the differences between different amounts of exercise are more significant in terms of the ability to manage their emotions. On the ability to control negative emotional outbursts and the ability to control negative cues $P=0.000<0.001$ indicates that the difference is significant and that exercise intensity is one of the factors that make up the amount of exercise. On the ability to regulate reasoning $P=0.001<0.01$ indicates that the difference between different amount of exercise and the ability to regulate reasoning is more significant. The highest scores were obtained when exercising at moderate intensity, indicating that emotional sanity regulation ability is best with moderate exercise volume, and that too much or too little reduces college students' ability to manage their emotions. Therefore, it is possible to determine and choose the moderate amount of physical exercise according to the differences in individual physical fitness and exercise ability, which is conducive to improving the emotion management ability of contemporary college students.

https://doi.org/10.17993/3cemp.2024.130153.120-136

Table 4. Analysis of differences in emotion management ability

Variable dimension	Small amount of exercise	A lot of exercise	F value	P
Ability of rational control	27.09±4.914	26.75±4.725	5.645	1
Control negative venting	46.20±7.295	49.01±7.138	7.894	0
Ability to seek outside support	17.07±4.251	17.21±4.111	2.154	9
Control negative suggestibility	19.29±4.692	20.10±4.595	7.742	0
Ability to actively remedy	21.53±4.324	21.63±4.318	1.071	361
Ability to manage emotions	131.1±15.233	134.70±15.801	3.725	2

Table 5 shows the results of the significance analysis of the correlation between physical exercise and emotion management ability, from the perspective of exercise time, college students' emotion management ability in general has a significant correlation with exercise time, with a correlation coefficient of 0.880. In particular, college students' emotion management ability to seek external support ability, the ability to control the negative implication ability, and the ability to rationally regulate the emotion has a significant correlation with exercise time. There is a very significant correlation between students' emotional ability and exercise intensity in general, with a correlation coefficient of 0.880.

The correlation coefficient is 0.165, and there is a very significant correlation between college students' emotion management ability and exercise intensity in all dimensions except for the ability to seek external support and the ability to control negative suggestion. From the perspective of exercise frequency, there is a very significant correlation between college students' emotion management ability and exercise frequency in general, with a correlation coefficient of 0.193, and there is a very significant correlation between the dimensions of emotion management ability and exercise frequency. Suggesting that escaping from such depressed emotions and regaining positive emotions through physical exercise, which is the process of emotion management that

It is an instinctive directional tendency, a psychological tendency to react instinctively, and a value reference system that exists in people's own relationship with the treatment and understanding of external things. Even if an individual participates in exercise without caring about the exercise itself and its results or is constrained by external factors, along with the accumulation of opportunities and frequency of such exercise, even though external motivation and lack of motivation are not as high as internal motivation in triggering exercise satisfaction, exercisers can still experience a portion of the health benefits from exercise from physical activity without negatively affecting exercise satisfaction.

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Table 5. Results of correlation significance analysis

Variable dimension	Exercise time	Exercise intensity	Exercise frequency
Ability of rational control	0.087*	0.104*	0.108*
Control negative venting	2	0.118**	0.195***
Ability to seek outside support	0.115**	15	1
Control negative suggestibility	0.082*	23	0.125**
Ability to actively remedy	3	0.094*	0.081*
Ability to manage emotions	0.880*	0.165*	0.193***

5.4. REGRESSION ANALYSIS

The results of physical activity mood scores were used as the dependent variable in the stratified multiple regression analysis, and the physical activity mood scores and emotion management ability scores were centered and transformed into standard scores before being included in the analysis. Table 6 shows the results of the regression analysis, and the regression results show that gender has a negative regression relationship with exercise mood scores, and the regression coefficient changes from -0.089 to 0.464 after the inclusion of the emotion management ability scores, which changes the regression relationship from negative to positive, suggesting that the emotion management ability can regulate the influence of gender on exercise mood to a certain extent. The positive regression relationship between grade and exercise mood and the small change in the regression equation results may be related to the influence of family, social, and school environments, the concern for physical fitness and health, and the more in-depth knowledge of the benefits of exercise as age increases. Emotional management ability included in the regression analysis showed a positive regression relationship with exercise mood scores, with the smallest P value, indicating that physical activity has a significant positive effect on emotional management ability, showing that there is a significant moderating effect of physical activity in emotional management ability.

Table 6. Results of regression analysis

Variable	Ability to manage emotions		Physical Activity Score	
	(1)	(2)	(3)	(4)
Gender	-3.174	-89	464	13
Grade	2.446	65	2.225	95
Ability to manage emotions			3.791	516
Physical Activity Score	6.588	375		

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6. CONCLUSION

This paper takes the relationship between physical exercise and emotion management as the research direction, and uses gray correlation analysis method to construct the relevant model, and analyzes the rationality of the model. The conclusions are as follows.

1. In the validity test, the correlation coefficient between college students' emotion management ability and physical exercise is 0.378, and the correlation coefficient between college students' emotion management ability and physical activity level is 0.183. It indicates that when the interaction between emotion management ability and physical exercise is included in the equation, it has the same significant effect on the emotion of exercise, which means that there is an interaction between physical exercise and emotion management ability.

2. In the significance analysis, P=0.000<0.001 on the ability to control negative emotional outbursts and the ability to control negative cues indicate significant differences. The overall correlation coefficient between students' emotional ability and exercise intensity is 0.165, which is a very significant correlation. It indicates that can college students can determine and choose the moderate exercise intensity of physical exercise according to the differences in individual physical fitness and exercise ability, which is conducive to improving the emotional management ability of contemporary college students.

3. After the inclusion of emotion management ability score, the regression coefficient changed from -0.089 to 0.464, the regression relationship changed from negative to positive, indicating that the emotion management ability can regulate the influence of gender on the exercise emotion to a certain extent.

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Research Project (Humanities and Social Sciences), Jiaying College, The Effects of Physical Exercise on Emotion Management of College Students: A Longitudinal Study

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/07/

EXPLORATION OF THE MULTIPLE INTEGRATION MODE OF MODERN INTELLECTUALISED MUSIC TEACHING AND TRADITIONAL MUSIC CULTURE

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ABSTRACT

In this paper, the elite TLBO algorithm is utilized to integrate modern vocal music teaching with traditional music culture, and a feedback phase is introduced to improve the algorithm's optimization accuracy and stability. An intelligent teaching framework is constructed to integrate the integration of different forms and repertoire of traditional music, as well as the integration of phonetics and phonological systems. Artificial intelligence is integrated with modern sound teaching through traditional music culture, and an experimental test and satisfaction survey is conducted in a university as an example. The results show that the percentage of students' time spent on independent learning outside the classroom rises rapidly from 51% to 77%, while on the contrary the percentage of time invested in entertainment decreases from 26.6% to 11.5%. Satisfaction surveys of teachers using the application as well as students were conducted, with all six evaluation components scoring above 9.0. The study shows that the teaching mode of integrating traditional music culture in modern intelligent teaching can enhance the students' vocal skill ability, which in turn improves the students' vocal art quality and improves the overall level of vocal music teaching.

KEYWORDS

Elite TLBO algorithm; feedback stage; phonological system; artificial intelligence; intelligentized teaching

https://doi.org/10.17993/3cemp.2024.130153.138-155

INDEX

https://doi.org/10.17993/3cemp.2024.130153.138-155

1. INTRODUCTION

At this stage, has fully entered the information society, education and teaching, should also be fully integrated with intelligent related technology to improve the quality of music classroom teaching [1]. Therefore, music teachers should be aimed at the characteristics of students who are full of curiosity about new things, actively develop and utilize information technology, explore the integration strategy of music teaching and intelligent technology, and then help students fall in love with music and develop good learning habits [2]. Creating an intelligent teaching environment on the one hand changes the teaching method of the teacher-led classroom and provides students with rich database resources [3]. Students use network resources to understand the major teaching platforms and learn the relevant knowledge of the music curriculum, and at the same time, they can make personalized choices according to their own learning characteristics in terms of teaching materials, content, exams, forms of expression, etc., to achieve personalized learning [4-5]. On the other hand, to improve students' learning conditions, students, with the support of diversified and modernized technologies, can quickly stimulate learning motivation, enter the world of music, experience the creator's emotions, and form music literacy in an image and vivid environment [6-7].

In this paper, artificial intelligence is firstly used to enhance learning efficiency by personalized learning experience and intelligent content recommendation. Secondly, elite algorithms are used to optimize teaching plans and content to ensure more efficient and goal-oriented teaching activities. In the teacher phase, it helps teachers to adjust teaching methods and materials based on students' progress and feedback. In addition, an intelligent teaching framework was established to combine traditional music and cultural elements with modern teaching techniques. Integration of different forms and repertoire of traditional music, as well as the integration of tonal and phonetic systems, thus utilizing the advantages of modern teaching methods while maintaining the authenticity and depth of traditional music education. Through these methods, not only can traditional music be taught and passed on more effectively, but intelligent technology can also be utilized to improve the teaching effect and create a modern music teaching environment that is multifaceted and integrated.

2. LITERATURE REVIEW

Jiandong Cai used neural networks for audio time domain and frequency domain feature extraction to construct a music pattern library, a synthesis algorithm to generate a music training model, and a GRU model for music training and model prediction. The experimental results show the conclusion that adopting the teaching mode of traditional music and culture integration can improve students' music skills and artistic literacy, which in turn improves the accomplishment of students' learning objectives and improves the level of music teaching [8]. Yan Bai constructed a variety of music integration teaching methods by analyzing the development characteristics of music teaching, and used adaptive sampling and BP network-based Markov chain

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Monte Carlo methods to conduct teaching evaluation. The prediction accuracy of the model constructed in this thesis reaches more than 94%, and the relative error is controlled within 1.5%. It shows the feasibility of teaching the integration of modern popular music and traditional music culture through the BP neural network model and provides a meaningful teaching quality evaluation system [9]. Gegen bilige used the association rule algorithm to establish a computational model for the integration of university music teaching and traditional music culture, and used the indexes of the integration degree, the value, and the acceptance degree to the degree of integration and the effect of integration are analyzed. The results of the study show that the combination of college music teaching and traditional music culture is a feasible and effective teaching strategy with popularization value [10]. Yingxue Zhang et al. develop a recursive neural network music-based automatic synthesis technology for melody teaching. First, a strategy for extracting acoustic features from musical melodies was proposed. Secondly, a sequence model was used to synthesize general music melodies. After that, a synthesized musical RNN melody is set up to combine with a singing melody, e.g., to find a suitable singing clip for a musical melody in a teaching scenario. The RNN can synthesize a musical melody with a short delay based on static acoustic features only, thus eliminating the need for dynamic features. Experiments have proved the effectiveness of the model [11]. Jun Hao analyzed the degree of information diffusion of traditional music culture in music teaching in colleges and universities by combining the information diffusion model, and the results show that the integration of different types of traditional music cultures has different impacts on music teaching; traditional music is mainly integrated into music teaching through musical emotions and tunes. Therefore, integrating the emotion of traditional music culture into music teaching can enhance students' understanding of music and improve their perception of music emotion to a certain extent [12]. Jun Hao believes that the co-development of music teaching in colleges and universities and the inheritance of national music culture is an important topic. In music teaching in colleges and universities, it is necessary to strengthen the attention to and inheritance of national music culture, so that students can understand and experience the essence of national music culture while learning music [13]. Li Sun puts forward positive and effective specific paths for the integration of traditional music culture into the teaching of vocal music in universities to strengthen the traditional music culture literacy of vocal music teachers, further innovate the teaching methods of vocal music, utilize the advanced teaching technology for teaching, enriching students' emotional experience in the teaching process, as well as choosing suitable music works to cultivate students' perceptual ability [14]. Yuan,Y. proposed that multimedia can improve students' thinking ability and cultivate students' thinking quality, which, combined with the vivid function of Cal courses, greatly stimulates students' interest in learning, and put forward that computer-assisted teaching will be the direction of the future reform of education [15]. He,J. used multimedia digital technology to build a rich and independent online learning learning environment. Teachers can present music teaching content through Internet teaching resources, and students learn music through online platforms to realize interactive learning [16].

https://doi.org/10.17993/3cemp.2024.130153.138-155

3. APPLICATION OF INTELLECTUALIZATION TECHNOLOGY IN MUSIC TEACHING

3.1. ARTIFICIAL INTELLIGENCE EMPOWERS MUSIC TEACHING

The value of technology in education is not determined by technology, but by people. Therefore, AI-enabled teacher education should first follow the law of human understanding of things [17]. At the same time, it should also make scientific decisions about the main contradiction and the main contradictory aspects of AI-enabled teaching and teaching research, that is, how to accurately empower for different contents and different periods of time, so as to construct an intelligent and precise boosting matrix [18]. Based on the above ideas, the realization path of AI-enabled teacher education is constructed as shown in Figure 1. First, it should follow the law of scientific understanding, and the law of teachers' and students' understanding of things is the foundation and premise of AI-enabled teacher education. For example, in the case of practical training on music lesson preparation ability, teachers or teacher trainees should first have practical experience through studying excellent teaching design, trying to prepare lessons for a specific music course, etc., to form a perceptual understanding of lesson preparation. Secondly, it should be facilitated based on the precision matrix, and the use of the precision teaching matrix can make teaching more precise, and promote students' efficient learning by constructing precise teaching strategies that match the music teaching stage and different lesson types [19].

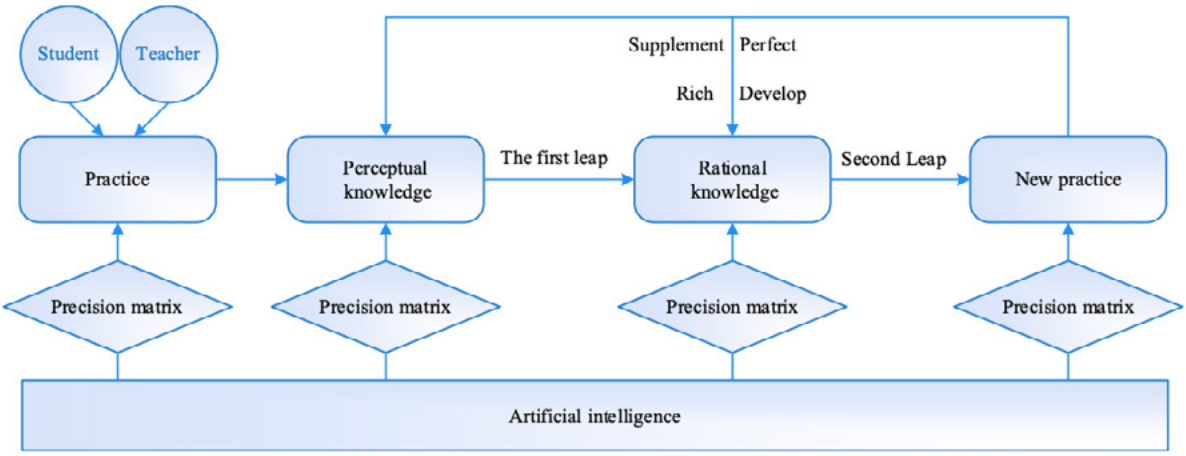

Figure 1. Ai-enabled teacher education path

3.2. INSTRUCTIONAL OPTIMIZATION ALGORITHM

3.2.1. ELITE ALGORITHM

Suppose there are two different teachers T_1 and T_2, teaching the same music subject in different classes, and the students in both classes have the same initial

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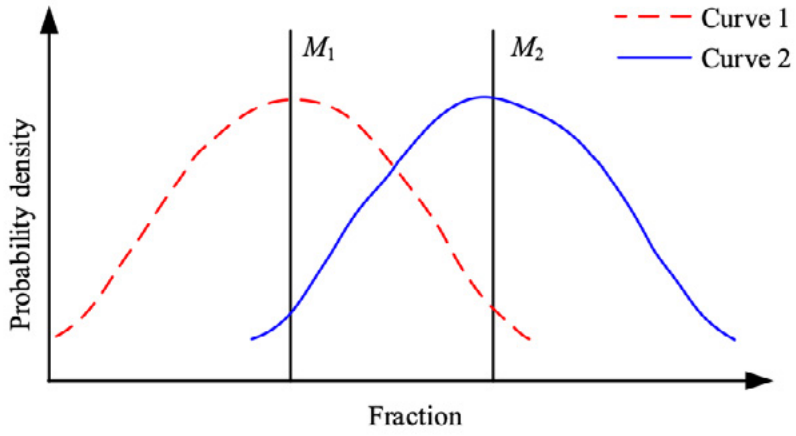
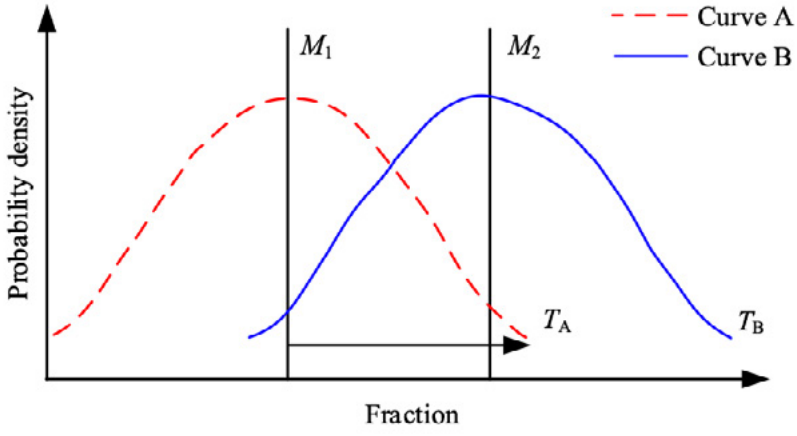
level [20]. Figure 2 shows the teacher and student distribution curves, Figure 2(a) shows the distribution of student scores in the two classes under the teaching of the teachers, Curve 1 and Curve 2 are the distributions of scores under the teaching of Teachers T_1 and T_2, respectively, and M_1 and M_2 are the mean values of Curve 1 and Curve 2, respectively. Assuming that the scores follow a normal distribution, curve 2 has a higher mean than curve 1, and it can be said that teacher T_2 is better in teaching than T_1. Besides the help of the teacher, the students improve their scores by communicating with each other. Figure 2(b) shows the curve of students' obtained scores and curve A represents the model of distribution of scores obtained by students in a class. Teachers are the most knowledgeable people in the society, so the students who get the highest scores act as teachers, and teachers T_A impart knowledge to the students, which increases the average score of the whole class. Teacher T_A endeavors to bring the class mean score from M_A closer to the new mean score M_B by teaching the students knowledge, so that the students in turn need new teachers with more knowledge than the students, i.e., new teachers T_B on the new curve B.



(a) The distribution of students' scores under different teachers' instruction



(b) Students get a grade curve

Figure 2. Distribution curve of teachers and students

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$$f(x) = \frac{1}{\sqrt{2\pi}\sigma}\exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right) \quad (1)$$

where σ^2 is the variance, μ is the mean, and x is a normally distributed random variable. Like other algorithms inspired by natural phenomena, the TLBO algorithm is a population-based algorithm. In TLBO algorithm, the number of students is the population number of the algorithm, the music learned by the students is the independent variable, the result of the students' learning is the fitness value, and the teacher is the current best solution. The TLBO algorithm is divided into a teacher phase and a student phase, the teacher phase is for the students to learn the knowledge from the teacher, the student phase is for the students to learn the knowledge by communicating with each other, and the outputs of the teacher phase are used as inputs for the student phase.

3.2.2. TEACHER PHASE

At any number of iterations i, M_i is the mean, T_i is the teacher, and the teacher T_i tries his best to keep the mean T_i close to his level so that the new mean M_{new} is close to T_i. The difference between the current mean and the new mean is given by equation (2):

$$\text{DifferenceMean}_i = r_i\left(M_{\text{new}} - T_F M_i\right) \quad (2)$$

where r_i is a random number from 0 to 1, T_F is the teaching factor, which determines the extent to which the mean value is changed, and T_F is randomly determined to be 1 or 2 by equation (3), i.e:

$$T_F = \text{round}[1 + \text{rand}(0,1)] \quad (3)$$

The teacher phase updates the current solution according to equation (4):

$$x_{\text{new},i} = x_{\text{old},i} + \text{Difference Mean}_i \quad (4)$$

Accept x_{new} if x_{new} is better than x_{old}.

Determine the average level of the student population for any number of iterations. The goal of the teacher, as an expert or best practitioner in the field, is to bring the average level of the student population as close as possible to his or her own level. This approach is similar to mentorship in modern teaching, in which the teacher helps students progressively reach higher skill levels by providing expert guidance and feedback. This is achieved through a specific mathematical formula. Here, a decisive role is played by the teaching factor, which controls the extent to which the mean value changes, and this factor itself is determined by the rule of randomly determining it as 1 or 2. This element of randomization increases the flexibility and adaptability of the teaching process, allowing the teaching method to be adjusted to different

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situations and student needs. Further, another task of the teacher phase is to update the current pedagogical solution according to a specific update formula. This updating is based on comparing the effects of the current solution with the new one, thus ensuring that the teaching process is always moving towards the optimal outcome. If the new solution is superior to the current one, then it will be accepted and applied in the teaching practice.

3.2.3. STUDENT PHASE

The student phase is for students to randomly interact with each other, where students are able to acquire new knowledge from students who have more knowledge than they do. Is the independent variable of the optimization problem and $f(x)$ is the objective function of the optimization problem. After the teacher phase, two students x_i and x_h are randomly selected, where $i \neq h$. Firstly, the values of the objective function corresponding to the two students are compared, and if $f(x_i) < f(x_h)$, it means that student x_i is better than student x_h, then x_{new} is closer to x_i, as shown in equation (5):

$$x_{\text{new},i} = x_{\text{old},i} + \text{rand}_i(x_i - x_h), \quad f(x_i) < f(x_h) \tag{5}$$

Conversely, student x_h is superior to student x_i, then x_{new} moves closer to x_h as shown in equation (6):

$$x_{\text{new},i} = x_{\text{old},i} + \text{rand}_i(x_h - x_i), \quad f(x_h) < f(x_i) \tag{6}$$

After the student stage process, compare new solution x_{new} with current solution x_{old} and accept x_{new} if x_{new} is better than x_{old}.

3.2.4. ALGORITHM FLOW

In the elite TLBO algorithm, students improve their scores only through teachers' teaching or communication with students, which is a single learning method [21-22]. However, in the actual student learning process, students often also with the teacher active and purposeful feedback exchanges, through the feedback for their own learning knowledge to check the gaps and fill in the gaps can get more knowledge, which can further improve the students' scores. Therefore, this paper introduces a feedback phase based on the elite TLBO algorithm to improve the algorithm's optimization accuracy and stability.

The feedback phase is added after the student phase so that students improve their scores not only through the teacher's teaching and students' communication with each other, but also through students' direct feedback communication with the teacher. After the student stage, two students x_i and x_d are randomly selected, where $i \neq d$. Compares the corresponding objective function values of the two students, and

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if $f(x_i) < f(x_d)$, it means that student x_i is better than x_d, then student x_d is selected to have a feedback exchange with the teacher, as shown in equation (7):

$$x_{\text{new},i} = x_{\text{old},i} + \text{rand}_i(M_{\text{new}} - x_d), f(x_i) < f(x_d) \quad (7)$$

Instead, students were selected for a feedback exchange with the teacher, as shown in equation (8):

$$x_{\text{new},i} = x_{\text{old},i} + \text{rand}_i(M_{\text{new}} - x_i), f(x_d) < f(x_i) \quad (8)$$

After the feedback stage process, compare the new solution x_{new} with the current solution x_{old} and accept x_{new} if x_{new} is better than Student satisfaction.

The addition of the above feedback process increases the learning mode of students, ensures the diversity of students and improves the global search performance of the algorithm. At the same time, the feedback stage enables poorer students to quickly approach the current optimal individual teacher, and the search range is quickly converged to the vicinity of the optimal solution, and in the algorithm's termination conditions iterative number of generations must be certain, the algorithm carries out the local fine search in the later stage of the number of generations of the relative increase, so that the algorithm's optimization search accuracy and stability will be improved.

Feedback elite teaching algorithm for optimization problems, the algorithm flow is shown in Figure 3, the steps are as follows:

1. Define the optimization problem and initialize the parameters of the optimization problem, initialize the number of group members, the number of iteration generations, the number of independent variables and the constraints of the optimization problem.

2. According to the number of group members and the number of independent variables, randomly generate the initial population.

3. Evaluate the population and retain the elite solution.

4. Teacher stage, teaching process in teacher stage according to equation (4).

5. Student phase, according to Eqs. (5) and (6) students are randomized to communicate with each other to improve their performance.

6. Feedback phase, according to Eqs. (7) and (8) students engage in feedback exchanges with the teacher to improve student performance.

7. Elite solutions replace poorer solutions.

8. Randomize the variation operation on the elite solution.

9. Repeat steps 3 to 8 until the end condition is satisfied.

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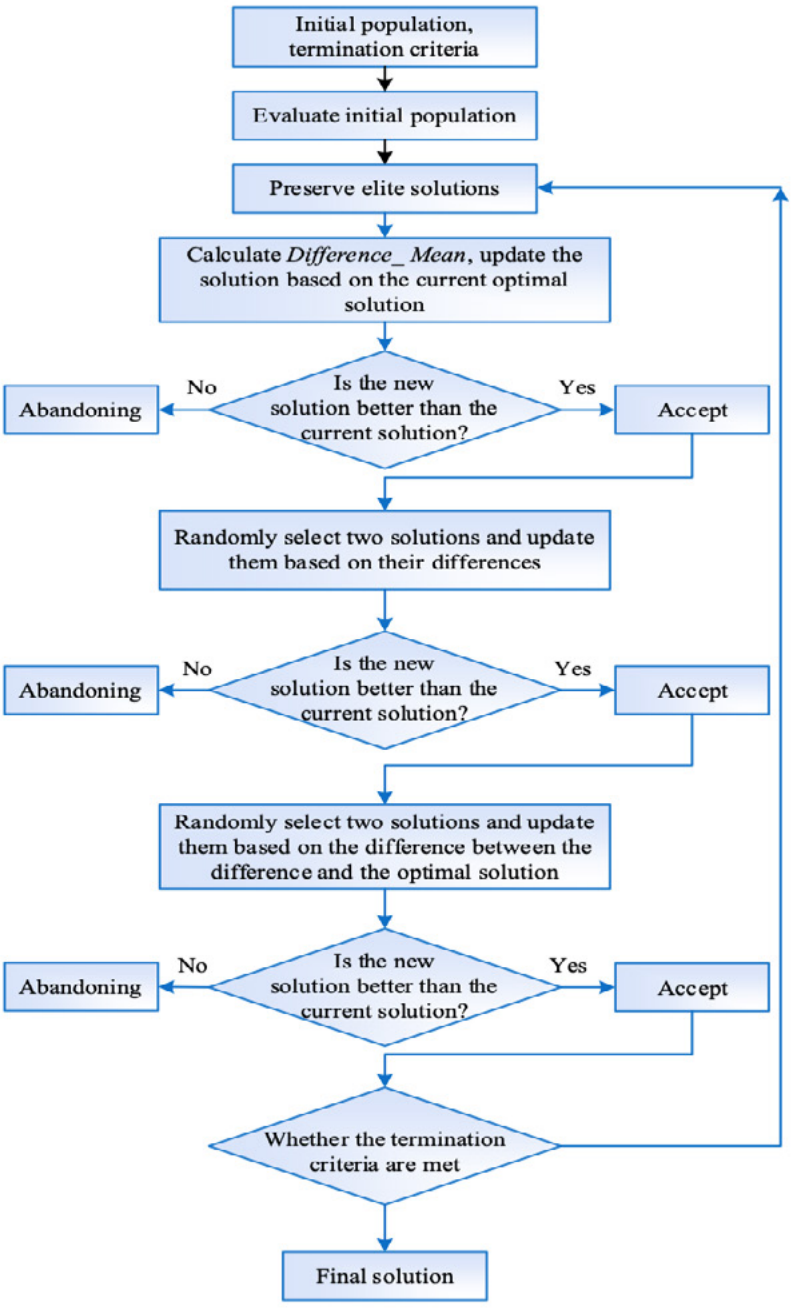

Figure 3. Algorithm flow

4. CONSTRUCTION OF A MODERN INTELLIGENTIZED MULTI-INTEGRATION MODEL

4.1. INTELLIGENT TEACHING AND LEARNING FRAMEWORK

Intelligent teaching is therefore intelligent because the agent has a thinking state, which is generally categorized into three parts: belief-knowledge, desire and intention for education, which in turn can be integrated with the Agent's perception and reasoning as well as planning and action [23]. The intelligent teaching conceptual

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model is shown in Figure 4, where the agent's belief-awareness state is used to portray the user's learning needs and cognitive abilities in the teaching conceptual model. The agent's information is stored in the knowledge base, the learning module accepts the user's feedback and the KQML messages transmitted by other teaching agents, and then converts these feedbacks and messages into the agent's information about the user's learning needs and cognitive abilities according to certain inference rules, and then utilizes this information to update the agent's information stored in the knowledge base. Based on the agent's information, the matching module filters out the learning resources from the resource base that are suitable for the user's needs and abilities.

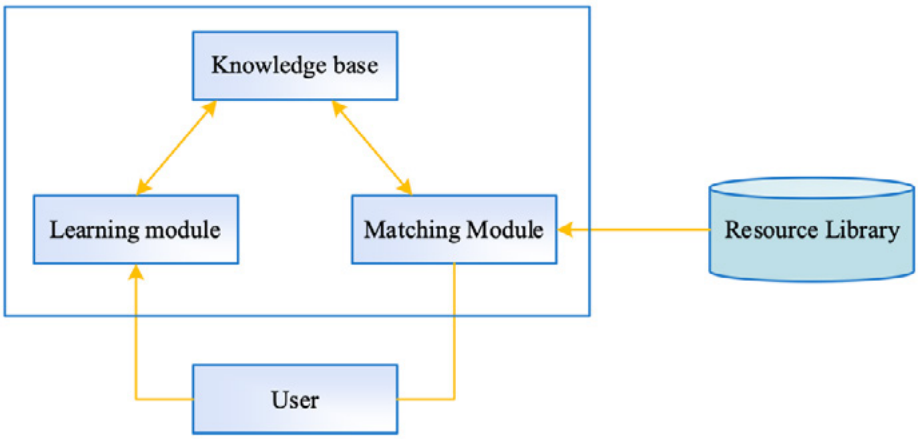

Figure 4. Intelligent teaching model

Suppose that in the teaching activity, the agent adopts a certain behavior a, and the representation of the credence on which behavior a is based is $S(a)$. The agent updates the credence based on the following formula:

$$S(a) \leftarrow S(a) + \lambda(r - S(a)) \tag{9}$$

where r is the feedback signal resulting from the agent's behavior a, and $\lambda(0 < \lambda < 1)$ denotes the learning efficiency, i.e., the extent to which the new credence replaces the current credence.

4.2. INTEGRATION OF TRADITIONAL MUSIC AND CULTURAL ELEMENTS

4.2.1. TRADITIONAL MUSIC FORMS AND REPERTOIRE

In modern intelligentized music teaching, the integration of traditional music forms and repertoire is a key part of realizing multicultural inheritance. First of all, it is necessary to clarify the traditional music forms to be fused, which include, but are not limited to, classical music, ethnic music and so on [24]. These forms represent the music culture of different historical periods and regions, and are the vivid expression of traditional music. When choosing traditional repertoire, emphasis should be placed

https://doi.org/10.17993/3cemp.2024.130153.138-155

on representativeness to cover different styles and regions. This not only helps students to fully understand the diversity of traditional music, but also provides them with a broader learning horizon. By selecting representative repertoire, students can deeply feel the essence of traditional music, experience the musical language of different cultures, and promote their understanding and love of traditional music.

4.2.2. METRICAL AND PHONETIC SYSTEMS

Traditional rhythms often carry unique cultural connotations and have certain differences from modern rhythms. In the process of integration, these differences need to be studied in depth and a suitable way of integration determined. Adjustments involving tonality, scales, intervals, etc., are involved to ensure that the integrated music can inherit the traditional tonal characteristics while conforming to the context of modern music. Focusing on the preservation of the unique tonal system of traditional music is an important means of maintaining cultural heritage, including the protection and inheritance of traditional timbres, performance techniques, and sonorities [25]. In the integration mode, the traditional phonological system is integrated into modern music teaching through the use of traditional instruments and the preservation of traditional performance methods. Such integration not only allows students to feel the uniqueness of traditional music, but also provides them with a more comprehensive musical experience.

5. ANALYSIS OF THE EFFECTIVENESS OF THE INTEGRATION OF MODERN INTELLECTUALIZATION AND TRADITIONAL MUSIC CULTURE

5.1. COMPARISON OF LEARNING OUTCOMES

For the structural change of students' music assignment participation in the two teaching contexts before and after the smart application, students' time investment indicators are usually used to carry out observational analyses, and the difference in students' time investment in learning leads to significant differences in their perceptions of the effectiveness of teaching and learning before and after the smart application. For this reason, this paper first utilizes the time investment of students' participation and their time allocation structure to explore the changes in students' academic participation paradigms in different teaching contexts.

Table 1 shows the study and recreation time before and after the smart application, and the study shows that the total total time investment in students' weekly activities increased during the online learning period, and that there was a slight increase in the time spent on independent learning outside the classroom. However, it is of great concern that the total weekly time investment of students' recreational time during post-application teaching amounted to 23 hours, which is 1.8 times of the time

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investment in recreational time in traditional offline teaching contexts. Meanwhile, this paper's investigation also found that students in online teaching situations spent an average of 11 hours per week utilizing online social networking platforms such as WeChat, QQ, and Weibo. When the students' learning field is changed from traditional offline classroom to intelligent multiple integration mode, the proportion of independent learning time outside the classroom rises rapidly from 51% to 77%, while the proportion of entertainment investment time decreases from 26.6% to 11.5%.

Table 1. Study and recreation time before and after intelligent application

	Before intelligent application	After intelligent application
After-school study time	11.3	10.5
Fun time	23.0	12.2
Class time	18.6	23.9
Proportion of study time	51	77
Percentage of recreation time	26.6	11.5

5.2. ANALYSIS OF LEARNING INTERESTS

The data obtained from the overall sample of subjects in the pre-test and post-test were applied to the t-test to see the differences in the interest in music learning before and after the integration of the multiple modes and their significance, Table 2 shows the analysis of the results of the t-test of the samples, which shows a significance at the 0.01 level of significance between the pre-music affective experience and the post-music affective experience with t=-6.7 and p=0.000, and comparing the differences it can be concluded that the pre-music affective experience mean of 2.6 would be significantly lower than the mean of 3.1 for the post-Musical Emotional Experience. pre-Musical Perceived Focusing Ability and post-Musical Perceived Focusing Ability showed a significance at the 0.01 level of t=-8.1, p=0.000, and a comparative difference can be made to conclude that the mean of 2.7 for the pre-Musical Perceived Focusing Ability would be significantly lower than the mean of 3.1 for the post-Musical Perceived Focusing Ability. music Novelty Associations pre and Music Novelty Associations post show a significance at the 0.01 level t=-3.9, p=0.000, and a comparative difference can be made to conclude that the mean of Music Novelty Associations pre, 2.9, would be significantly lower than the mean of Music Novelty Associations post, 3.1. Music Cognitive Explorations pre and Music Cognitive Explorations post show a significance at the 0.01 level t=-9.6, p=0.000, and a comparative difference can be made to conclude that Music Perceived Concentration ability pre mean 2.7, would be significantly lower than the mean of Music Perceived Concentration ability post, 3.1. 0.000, and a comparative difference can be made to conclude that a mean of 2.8 for the pre-musical cognitive inquiry would be significantly lower than a mean of 3.44 for the post-musical cognitive inquiry. The pre-musical

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creativity challenge level and the post-musical creativity challenge level show a significance at the 0.01 level, t=-9.2, p=0.000, and a comparative difference can be made to conclude that a mean of 2.89, which is significantly lower than the mean value of 3.3 after the music creation challenge level. 0.01 level of significance was found between the pre-feeling of the music classroom as a whole and the post-feeling of the music classroom as a whole, t=-10.1, p=0.000, and the difference in comparison can be concluded that the mean value of 2.75 for the pre-feeling of the music classroom as a whole is significantly lower than the mean value of 3.3 for the post-feeling of the music classroom as a whole. Reflecting the modern wisdom of music teaching and traditional music culture fusion, music teaching enhances the students' learning interest.

Table 2. Analysis of sample T-test results

Pair number	item	Mean value	Standard deviation	Mean difference	t	p
1	Music before emotional experience	2.6	0.6	-0.3	-6.7	0.000**
	Music after emotional experience	3.1	0.7			
2	Music perception before focus	2.7	0.6	-0.3	-8.1	0.000**
	Music perception after focus	3.1	0.6			
3	Music before new associations	2.9	0.5	-0.2	-3.9	0.000**
	Music after new associations	3.1	0.7			
4	Before music cognitive inquiry	2.8	0.6	-0.5	-9.6	0.000**
	After music cognitive inquiry	3.44	0.5			
5	Before the music creation challenge	2.89	0.6	-0.4	-9.2	0.000**
	After the music creation challenge	3.3	0.5			
6	Music class before the overall feeling	2.7	0.5	-0.6	-10.1	0.000**
	Music class after the overall feeling	3.3	0.6			

5.3. TEACHER AND STUDENT EXPERIENCE OF USE

To further validate the effectiveness of the Modern Intelligent Multi-Music Integration Model, a scale of 1-10 was used to indicate the satisfaction of teachers and students, with higher scores indicating higher levels of satisfaction. The results of the teachers' and students' experience of using the program are shown in Table 3, with all six evaluation components scoring above 9.0. Among them, the integrated traditional music form was highly recognized by teachers and students, with a teacher satisfaction score of 9.1 and a student satisfaction score of 9, providing strong support

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for teaching. For the question of whether the integrated music retained the characteristics of traditional meters, the teacher satisfaction was 9.2 and the student satisfaction was 9.5, indicating that the integrated music performed well in retaining the characteristics of traditional meters, and successfully inherited the unique charm of traditional music.

Table 3. Results of teachers' and students' experience

Evaluation item	Teacher satisfaction	Student satisfaction
Whether the integrated traditional music forms meet the teaching needs	9.1	9.2
Representativeness and coverage of traditional repertoire	9.2	9.4
The rationality of integrating traditional music elements into teaching content	9.0	9.0
Whether the integrated model can stimulate students' interest in traditional music	9.5	9.4
Whether the integrated music retains the characteristics of the traditional rhythm	9.2	9.5
Ease of use of the teaching platform using intelligent technology	9.4	9.6

6. CONCLUSION

For the long-term development of music teaching in colleges and universities, it is necessary to integrate traditional music culture into music teaching. This study utilizes the elite TLBO algorithm to integrate traditional music culture with modern music, introduces a feedback phase to improve the algorithm's optimization accuracy and stability, and gives a strategy for the integration of modern music teaching and traditional music culture information. The classroom application is analyzed with the students and teachers of a university as the research object. In terms of study and entertainment time before and after the intelligent application, after the students' learning field was changed from the traditional offline classroom to the intelligent multivariate fusion mode, the percentage of independent study time outside the classroom increased rapidly from 51% to 77%, and on the contrary, the percentage of time invested in entertainment decreased from 26.6% to 11.5%. T-algorithm was used to test the data to see the difference in music learning interest and its significance before and after the fusion of multiple modes, and the results showed that music teaching enhanced students' learning interest after the fusion of modern intelligentized music teaching and traditional music culture. To further validate the effectiveness of the modern intelligentized multivariate music integration model, a satisfaction survey was conducted on the teachers who used the application as well as the students, and the six evaluation components were all above 9.0 points. This indicates that the integrated music performed well in retaining the characteristics of traditional sound and successfully inherited the unique charm of traditional music. The above data

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indicate that students recognized the strategy of informational integration of music teaching and traditional music culture proposed in this study, and believed that the integration of traditional music culture into the modern music teaching mode could create a good learning atmosphere and improve learning efficiency. It can develop students' musical skill ability and increase their interest in traditional music culture.

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/08/

RESEARCH ON IMMERSIVE DIGITAL CULTURAL COMMUNICATION SYSTEM FOR LOCAL LANGUAGE AND CULTURE

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ABSTRACT

This paper presents an innovative immersive digital cultural communication system focusing on local language and culture. Utilizing virtual reality technology, the artistic, historical and linguistic elements of local culture are transformed into a digital format, which breaks through the limitations of traditional linear information dissemination and realizes two-way interaction. Users were involved in the creation and dissemination of information, and a comprehensive immersive technology platform was also constructed through a multi-stage planning, design, implementation and feedback loop. The results show that the Mongolian language user engagement was 70%, the lowest of all the regions studied. The Hmong language system demonstrated good stability with an operational stability score of 4.4. The Tibetan language users' satisfaction with the system was as high as 42 points, showing a high level of overall satisfaction with the system. It not only confirms the current effectiveness of the system, but also is of great significance in promoting immersive digital communication of local languages and cultures.

KEYWORDS

Immersive communication; virtual reality technology; two-way interaction; 3D modeling; digital formats

https://doi.org/10.17993/3cemp.2024.130153.157-174

INDEX

https://doi.org/10.17993/3cemp.2024.130153.157-174

1. INTRODUCTION

Under the impact of globalization and the wave of digitization, local languages and cultures are facing increasingly prominent challenges [1-2]. Traditional cultural communication methods have gradually lost their inclusiveness towards multiculturalism, while mainstream digital communication platforms focus more on globally common linguistic and cultural elements, leading to the predicament of the inheritance of local languages and cultures in the digital era [3-4]. Many local languages and cultures have not been effectively inherited and promoted due to the lack of communication systems adapted to the digital environment. The digital communication of local language and culture is no longer limited to words and images, but through virtual reality, augmented reality and other technologies, users are placed in immersive cultural scenes, so that the audience can feel, understand and experience the unique charm of local language and culture more intuitively [5].

N.E. Merkish discusses the problem of modeling cultural and linguistic environments in the process of training professionals in intercultural communication. Criteria for selecting media materials, determining the functioning of the multimedia environment and identifying the advantages and controversial aspects of its creation are identified. In the course of the research scientific methods of analysis of theoretical sources, empirical-empirical analysis and systematization were used [6]. Muthusamy, V proposed that each language is a replica of its culture and value system, and since each language is rooted in its native culture, faces the challenge of conquest of a foreign language [7]. Shevchenko, B. In the context of language training for military translators in the professional context, the study of linguistic and cultural realities of translation of the characteristics of the educational profession of military language discourse also includes linguistic and cultural realities related to the designation of weapons systems and military equipment of the armed forces of the country's foreign language is being studied [8]. Shan, L focuses on the role of informational technology foreign language teaching in the promotion of education technology culture in China. The introduction of information technology in foreign language teaching and the implementation of informationalized teaching methods in the foreign language classroom are conducive to the establishment of a multimodal corpus in the course website, the realization of a multidimensional interactive teaching model inside and outside the classroom, and the improvement of the diversity of the evaluation system [9].

Yuxiangt, Xi. suggests that the core and purpose of teaching Chinese as a foreign language is to cultivate students' Chinese communicative competence. For students whose mother tongue is not Chinese, this Chinese communicative competence is an intercultural dialogic competence [10]. Arifin, F uses qualitative analysis and applies the method of language planning to explore the role of language preservation when it is in the industrial revolution. The results of the study showed that the government suggested Indonesian language preservation to fill in the lyrics using local language songs in order to raise awareness of local language use among the Indonesian people [11]. Nersesyan, G explored the characteristics of the verbalization of values in

https://doi.org/10.17993/3cemp.2024.130153.157-174

the discourse of English science teaching. A comprehensive analysis of chapter fragmentation in the process of teaching a foreign language from the perspective of linguistic value theory and pragmatic-discursive discourse is presented and a definition of this type of discourse, which is a set of communicative practices that serve the learning process, is proposed [12]. Wahyuningtyas, D. used a virtual ethnography approach to collect offline and online data on the broadcasting content of four cultural radio stations, and the results showed that each of the radio station has excellent cultural programs with a solid appeal to maintain the loyalty of listeners, and the love of local culture is a strengthening of national identity, which is the richness of Indonesian culture [13].

This paper utilizes the core concept of immersive experience to model an immersive digital cultural communication system based on VR. Immersive technology is utilized to preserve, disseminate and promote unique local cultural heritage by converting local cultural elements into digital format. And the language recognition function is introduced, the system can automatically detect the user's preferred language, and can provide recommendations and personalized suggestions for relevant content. The cultural communication model is utilized to determine the state of the communication information. In the practical analysis, the effectiveness of the immersive digital cultural communication system is judged through multi-scenario validation, adaptation and stability validation, which proves that the digital cultural communication system is more effective in local language and culture communication, reflecting the diversity and complexity of the local culture. Through immersive experience and digital technology, it provides an innovative method for local language and culture communication.

2. IMMERSION COMMUNICATION PATHWAY OPTIONS

2.1. IMMERSION COMMUNICATION THEORY

Immersion is a psychological state in which people achieve an optimal experience when participating in an activity [14-15]. Users in immersion can better enjoy the experience process, and immersion refers to the immersion of objective existences in the physical space on the one hand, and the immersion of the subject's cognition in the consciousness space on the other. Immersion experience is also known as immersive experience, which refers to a state in which a person is completely devoted to the activity process and forgets about himself. The core concept of immersive experience focuses on the needs and feelings of the audience throughout the process, breaking the traditional linear information dissemination model and realizing two-way interaction, so that the experiencer becomes the creator and disseminator of information. Immersive communication, on the other hand, refers to communication that is immersed in the media and emphasizes that the audience is surrounded by the new technology of the media [16]. Immersive communication is a breakthrough to the

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traditional information dissemination methods, so that the information in the interaction with people to produce emotional resonance, focusing on shaping a strong sense of participation and immersion in the process of information dissemination.

2.2. VR-BASED CULTURAL COMMUNICATION

The VR-based cultural communication model is shown in Figure 1, which firstly requires the conversion of local cultural elements, such as art, history, and language, into digital format [17]. This includes 3D scanning of local artwork, digitizing historical documents, etc. Use VR technology to create an immersive experience by creating virtual environments in which users can interact with cultural content. Design how users will interact with the VR environment and how it will provide an educational and entertaining experience. Ensure that the system is open and accessible to users of different skill levels, including those of different ages, cultural backgrounds, and technical proficiency, and that cultural content is appropriately presented and interpreted in the VR environment in a way that respects and reflects the diversity and complexity of local cultures [18-19].

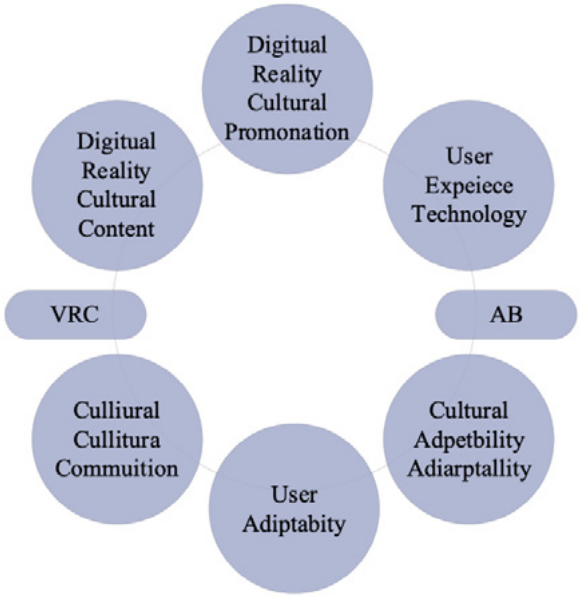

Figure 1. VR propagation model

VR technology is utilized to create an immersive virtual environment in which users can freely explore and interact with cultural content. This type of interaction goes far beyond traditional methods of learning and experiencing, allowing users to gain a deeper understanding and experience of local culture in a whole new light. For example, users can step into historic buildings in virtual reality, experience the process of making traditional crafts for themselves, or experience different local languages and dialects in virtual reality. Such immersive experiences make cultural learning more vivid and intuitive.

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When designing VR environments for interactivity, it is vital to consider both educational and entertaining aspects. Designers need to balance these two aspects to ensure that users can gain knowledge and understanding while enjoying entertainment. To this end, VR environments can integrate a variety of interactive elements, such as gamified learning, task challenges, and interactive guided tours, aimed at increasing user engagement and learning. In addition, ensuring that the VR system is open and accessible to users of different skill levels is also an important point of consideration. The system should be designed to be simple and intuitive, making it easy to use for users of all ages and technical proficiency levels. This may involve simplified design of the user interface, multilingual support, and customization of content to accommodate users from different cultural backgrounds. For example, for older users, more intuitive and simple operating instructions could be provided. For users from different cultural backgrounds, appropriate language options and cultural explanations could be provided. Finally, ensuring that cultural content is appropriately presented and interpreted in VR environments is crucial and needs to respect and reflect the diversity and complexity of local cultures. Cultural communication is not only about presenting cultural elements, but also about conveying the meaning and values behind them. Therefore, VR content needs to be developed in close collaboration with local cultural experts, historians and community members to ensure cultural authenticity and depth. In addition, VR experiences should include detailed explanations and background information on cultural elements to help users gain a deeper understanding of their cultural and historical significance.

2.3. SAMPLE SELECTION

In local language and culture communication, feature selection is an important task of the maximum entropy model, assuming that the categorical attribute values of feature selection constitute all output values Y of a stochastic process P. For each $y \in Y$, its occurrence is influenced by the decision attribute values X associated with it. Knowing that the set consisting of all decision attribute values associated with Y is X, the goal of the model is to compute the conditional probability that the output is $\{y \in Y\}$, i.e., to estimate $P(y \mid x)$, for all decision attributes $\{x \in X\}$ given where $y \in Y$ and $x \in X$.

Which linguistic information serves as predictive information i.e., it is a matter of feature selection. Therefore, the criterion for judging whether the features are effective or not is to see whether the model succeeds in selecting from the many decision attributes the features that have obvious characterization effects on the categorical attributes, and thus play an obvious role in determining the entropy value. The feature selection process is based on sampled data, so the accuracy of the sampled data is critical. The sampling data comes from a reliable sampling database and for the feature space also contains spatial data information, which can be represented as $(x1, y1), (x2, y2), \ldots, (xi, yi), \ldots, (xn, yn)$.

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where xi denotes a decision attribute, either spatial or non-spatial data, and yi is a categorical attribute, a class labeling number provided by an expert. The lexical properties of the word to be labeled are related to the language and culture in which the word is found, and the contextual environment information is described by features.

3. IMMERSIVE DIGITAL CULTURAL COMMUNICATION SYSTEM CONSTRUCTION

3.1. BUILDING AN IMMERSIVE TECHNOLOGY PLATFORM

The aim of this paper is to preserve, disseminate and promote unique local cultural heritage through the use of immersive technologies such as virtual reality, augmented reality and mixed reality. In this research, building an immersive technology platform is a central aspect that involves multiple stages of planning, design, realization and feedback loops. The structure of the technology platform is shown in Figure 2 and includes the following modules:

1. Detailed research is needed on local cultural characteristics, language usage habits, and the needs of the target audience. For example, if the research object is the folktales of a certain place, it is necessary to understand the traditional narrative style of these stories, the characteristics of the characters, and the connection with the local society and culture. It is also necessary to determine the ultimate goal of the technology platform, such as whether it is for educational popularization, cultural preservation, tourism promotion or other purposes.

2. The technology selection and design phase determines the technical infrastructure framework of the platform, including the selection of appropriate immersive technologies, hardware devices, and software tools. In addition, a data architecture needs to be designed to store and process cultural data to ensure that the platform can operate efficiently.

3. The content development and interface design phases are the core of creating an immersive experience, which requires digitizing cultural elements, creating 3D models, and writing interactive scripts. The interface design, on the other hand, needs to focus on the user experience to ensure that the interface is intuitive and easy to understand, and can guide users to naturally explore the culture.

4. The system development phase involves transforming the designed content and interface into an actual operable platform. This includes coding, integrating various media elements, and testing interactive performance. During this phase, the development team needs to work closely together to ensure that the technical implementation is consistent with the creative design.

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5. Testing is a critical step to ensure platform stability and quality of user experience. Through internal testing, small-scale user testing and multiple rounds of iteration, the platform performance is continuously optimized. After confirming that there are no major technical problems, the platform can be officially released for public use.

6. The released platform also requires regular maintenance and updates. Collecting user feedback is an important way for continuous improvement, which includes user's usage data analysis, direct user evaluation, and so on. Necessary content updates and functional iterations are made based on the feedback so that the platform can continue to adapt to changes in user needs.

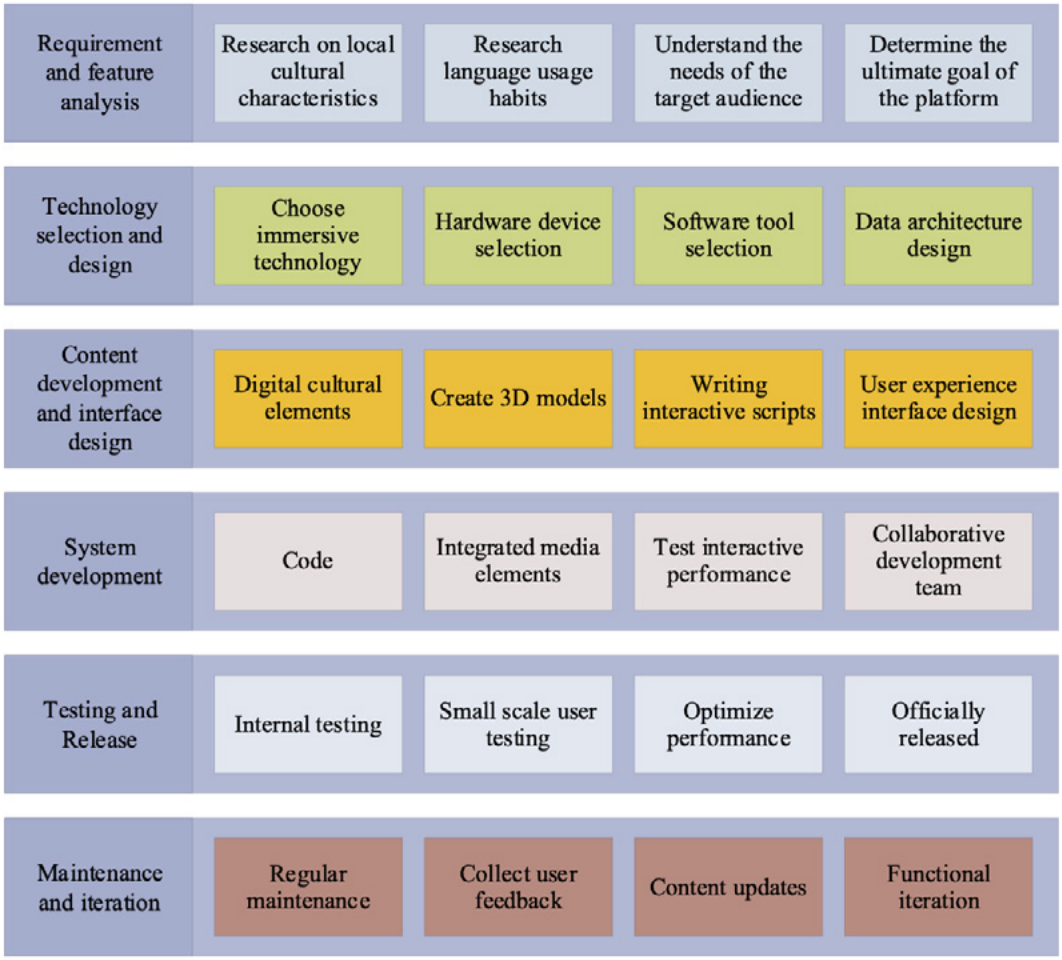

Figure 2 Technology platform architecture

3.2. DEVELOPMENT OF COMMUNICATION SYSTEMS TO SUPPORT LOCAL LANGUAGES AND CULTURES

Local languages and cultures are the unique cultural heritage of a country or region; they carry specific histories, values, and traditions that are essential to community identity and cultural diversity [20]. Therefore, the aim of this paper is to study and design a digital cultural dissemination system that supports the

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dissemination of local language and culture. The design of the dissemination system is shown in Figure 3. Before starting the design of the system, it is first necessary to clarify the goal of the system to create an immersive digital cultural dissemination system to support and promote local language and culture. The system should be able to effectively disseminate and present local language and culture content, including articles, videos, and music. The system should support multiple local languages, including full localization from user interface to content. Provide a powerful content management system so that content creators can easily upload, edit and manage works of language and culture.

In addition the user interface is the face of the system and the design is critical. The interface should be kept simple and intuitive so that users can easily navigate and interact with it, using clear navigation bars and menus so that users can easily find the content they need. Provide an intuitive search function so that users can quickly find content of interest. In addition to this, the interface should support multiple local languages so that users can choose the interface language according to their language preference. Provide language switching options so that users can change the interface language at any time. The user help documentation should also be fully localized to ensure that the user understands the instructions for using the system.

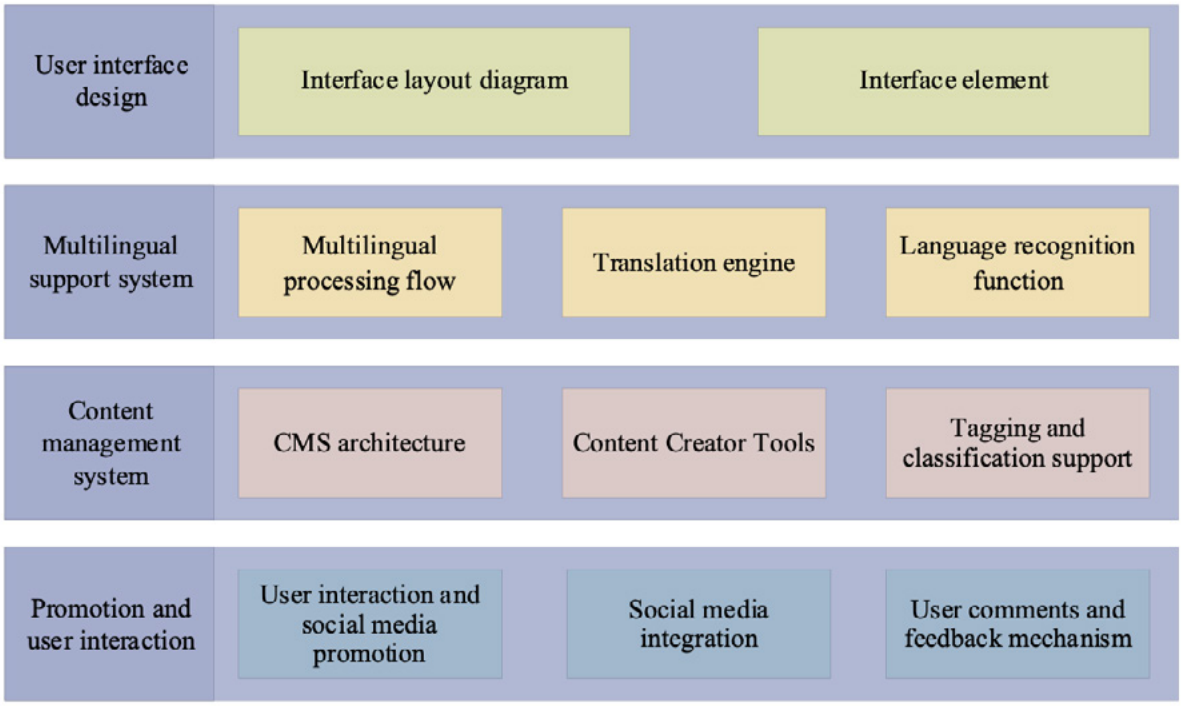

Figure 3. Dissemination system design

The multilingual support system is the core component that ensures that the system is able to showcase and disseminate local language and culture [21]. A powerful translation engine is introduced that can support instant translation of user uploaded content. The engine should have high-quality translation capabilities to ensure the accuracy and fluency of the content. User uploaded content should be able to automatically recognize the language and provide translation options. With the

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introduction of language recognition, the system can automatically detect the user's preferred language. Based on the user's preferred language, the system can provide recommendations and personalized suggestions for relevant content, and the user should also be able to manually select language settings [22].

Content Management System is a workbench for content creators, providing a convenient content upload interface that supports various types of media, including articles, videos, audios and more. Content creators can easily edit and format their work and upload related multimedia files. At the same time, content creators are allowed to add tags and categories to their works so that users can easily search and discover related content. The system can automatically suggest tags and categorizations to improve content discoverability.

3.3. PROPAGATION CALCULATIONS

Let the following variables N be the total number of people, $s(t)$ be the proportion of people who have not heard the local language at that moment t and $i(t)$: be the proportion of people who have transmitted the local language at that moment t. λ is the daily contact rate between each person who transmits the local language and those who have not heard the local language, assuming that the number of people infected per unit of time by each local language transmitter is proportional to the number of people who are not infected at that moment, and according to the assumption, each transmitter can turn $\lambda s(t)$ ignorant people into local language transmitters per day, because the number of local language transmitters is $i(t)$ so that there are $\lambda Ns(t)i(t)$ ignorant people who are being transmitted per day, and so λNsi is the rate of increase of the number of local language The rate of increase in the number t of propagators i.e:

$$\frac{di}{dt} = \lambda si \tag{1}$$

When $i = \frac{1}{2}$, $\frac{di}{dt}$ reaches its maximum value of $\left(\frac{di}{dt}\right)_m$, and this moment is $t_m = \lambda^{-1}\ln\left(\frac{1}{i_0} - 1\right)$. This is the moment when the number of dialect speakers increases the fastest, signaling the arrival of the dialect transmission period, which is a moment of concern for the officials. Obviously the increase of daily contact rate and the innovation of dialect transmission media, the dialect transmission period will come earlier. However, when the time increases infinitely, eventually all the people become dialect transmitters, which is obviously not realistic.

The reason for this is that it does not take into account the fact that there is a clear and essential difference between the transmission of information and the transmission of dialects. For example, information communication is memorized, while dialect communication is not. Information dissemination is socially reinforcing, whereas

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dialect dissemination is not. For a message, each link of communication is generally used only once, while dialect communication can be used several times. Based on these three considerations, this paper proposes a new model of cultural communication. For each time step, each body is in one of four states, namely, the unaware information state, the known information state, the confirmed information state, and the exhausted state. There are seven differences between information communication and dialect communication:

1. Information propagation activity decays rapidly over time, whereas dialects generally do not.

2. The different types of information communication differ not only in their propagation power, but also in their mode of propagation, whereas the intensity of contact in dialect communication only causes differences in the probability of propagation.

3. Information dissemination is significantly influenced by the content of the information, and the effective network activated by each dissemination is different.

4. There are qualitative differences in the roles of different communicators in information dissemination.

5. Information dissemination has a memory effect, which is influenced by previous exposure to information.

6. Information dissemination has a social reinforcement effect, for example, if a local language is heard from two places at the same time, its persuasive power is twice as high as if it is heard from one place.

7. A link in information dissemination is generally used only once.

4. PERFORMANCE AND USER EXPERIENCE EVALUATION

4.1. MULTI-SCENARIO VERIFICATION

4.1.1. VALIDATION OF MULTILINGUAL SUPPORT

In order to test whether the system correctly supports various local languages, tests were conducted using Tibetan, Uyghur and Mongolian from 2012 to 2022. Figure 4 shows the analysis of minority language usage frequency. Before the construction of the immersive digital cultural communication system, the usage frequency of the three languages fluctuates a lot, showing high and low fluctuations, but not more than 100%. And after the application, the usage frequency of the three languages shows a

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linear growth trend, up to 140%. It shows that the immersion constructed in this paper can support multiple minority languages and has made long-term progress.

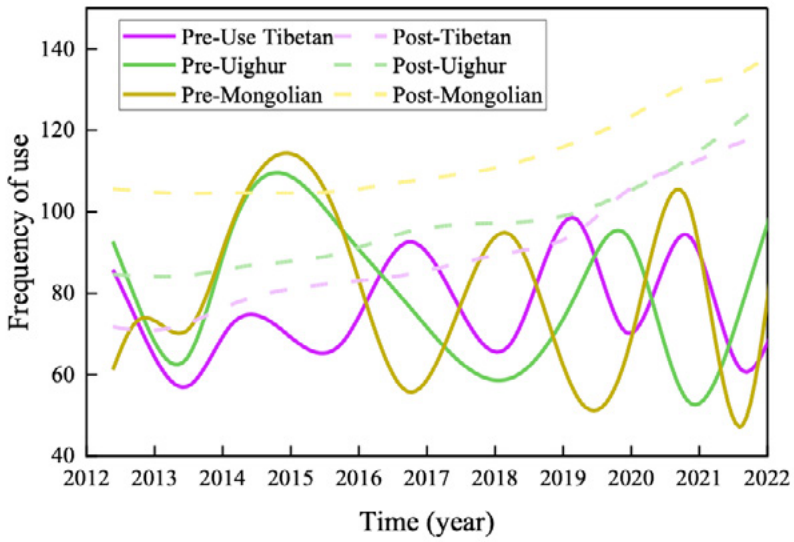

Figure 4. Frequency of use of minority languages

Meanwhile, the accuracy rate of immersive digital cultural communication is compared with machine learning methods for the three languages, and the accuracy results are shown in Table 1. The immersive communication method shows a high accuracy rate in digital cultural communication in these three languages, with accuracy rates above 95%, and the machine learning method has a lower accuracy rate in these languages, which is only 66% for Manchu translation, and the work performance still needs to be improved. Multimedia dissemination methods also achieved good results, but there is still some room for improvement, with accuracy rates ranging from 81-86%. Overall, immersion communication methods seem to be more effective in local language and culture communication.

Table 1. Minority language translation accuracy results

LANGUAGE	Immersive Communication	Machine Learning	Multimedia
Tibetan	99 %	80 %	86 %
Uyghur	98 %	76 %	84 %
Mongolian	95 %	75 %	83 %
Hmong	98 %	72 %	83 %
Korean	96 %	78 %	85 %
Manchurian	97 %	66 %	84 %
Hani	96 %	86 %	81 %

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4.1.2. CONTENT MANAGEMENT SYSTEM VALIDATION

In order to assess the performance of the immersive digital culture dissemination system for local language and culture, the leakage rate of the immersive system is shown in Table 2, which shows that the immersive dissemination system shows a decreasing trend in the leakage rate from 5% to 0.5% with the continuous increase of feature vectors of the language text. It shows that the immersive dissemination system is able to better capture and disseminate local language and culture, and the performance improves with the increase of feature vectors. Machine learning and multimedia methods have relatively high miss rates, especially at smaller feature vectors. As the feature vector increases, the underreporting rate of the machine learning approach gradually decreases, but at a minimum of 6% and 4%, it is still higher than that of the immersive communication system. The advantages of immersive digital cultural communication system in disseminating local language and culture are emphasized. With the increase of feature vectors, the performance of the system continues to improve and the underreporting rate decreases significantly. Compared to traditional machine learning and multimedia approaches, the immersive communication system performs better in keeping the underreporting rate low, which is crucial for effectively communicating local language and culture. These results provide strong support and evidence for the application of immersive digital cultural communication systems in promoting cultural diversity and communication.

Table 2. Linguistic textual feature underreporting rate

Linguistic Text Feature Vector	Immersion communication underreporting rate/%	Machine learning underreporting rate/%	Multimedia underreporting rate/ %
0	5	15	10
200	3	12	8
300	2	10	6
400	1	8	5
500	0.5	6	4

4.1.3. PROMOTION OF VALIDATION

In order to understand the impact of immersive digital cultural communication on the effect of local language and culture dissemination, the role and importance of immersive digital cultural communication in local language and culture dissemination is emphasized for the 18-50 year olds in a province. Figure 5 shows the comparison of the number of people before and after the dissemination, the number of people who mastered Hmong before the dissemination was 1,200, and after the dissemination there were 1,800 people, an increase of 600 people. There was also an increase from 1,100 to 1,600 in the gerund language and from 800 to 1,200 in Tibetan.

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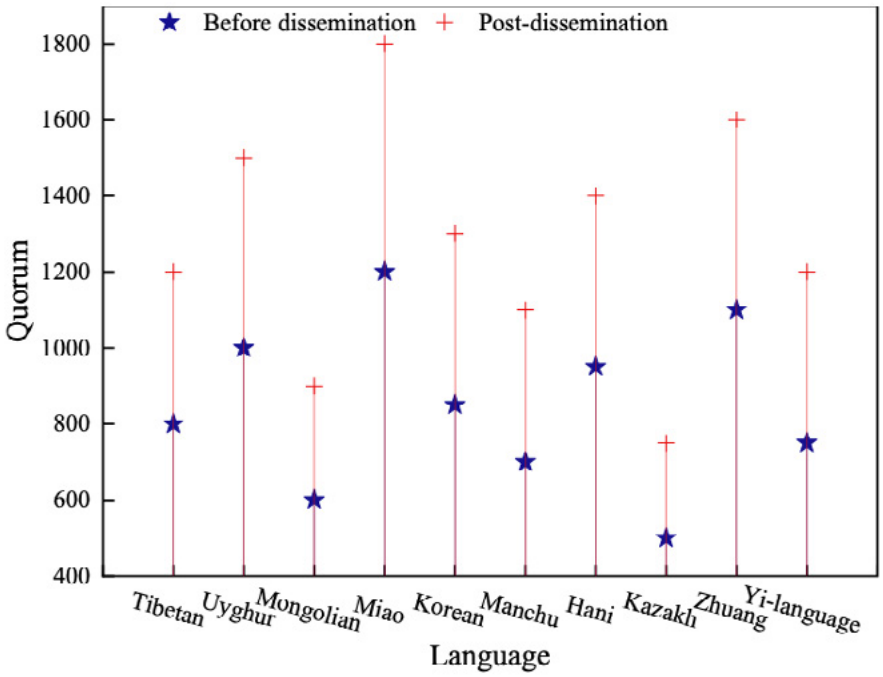

Figure 5. Comparison of numbers before and after dissemination

4.2. ADAPTATION AND STABILITY VALIDATION

In order to assess the adaptability and stability of the immersive digital cultural communication system, in different local language and culture contexts. Several regions with different local languages and cultures were selected for the study, and the immersive digital cultural communication system was implemented in each region to collect data on usage experience, user feedback, and system performance, and the results of the adaptability and stability analysis are shown in Table 3. The Mongolian language user participation rate of 70% is the lowest among all regions, indicating that the system has relatively low attractiveness in Region C. The Mongolian language user participation rate of 70% is the lowest among all regions. The Hmong language unity operation stability is 4.4 points, showing good stability. The Hmong Unity operational stability is 4.4 points, showing a high overall satisfaction with the system. The summary not only proves the current performance of the system, but also provides valuable data support for future optimization.

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Table 3. Adaptation and stability analysis results

Area	Local Language	User engagement (%)	User satisfaction (1-5 points)	System operational stability (1-5 points)	Adaptability score (1-5)
A	Tibetan	75 %	4.2	4.5	4.3
B	Uyghur	80 %	3.8	4.7	4.1
C	Mongolian	70 %	4.5	4.3	4.6
D	Hmong	85 %	3.9	4.4	4.2

5. CONCLUSION

This paper studies the stability of immersive digital cultural communication systems around local language and culture, and concludes that increasing the linguistic text feature vector decreases from 5% to 0.5%. It shows that the immersive communication system can better capture and disseminate local language and culture. As the feature vector increases, the machine omission rate gradually decreases, but the lowest is 6% and 4%, which is still higher than the immersive communication system. Adaptability and stability analysis Mongolian user participation is 70%, Hmong unity operation stability is 4.4 points, and Hmong unity operation stability is 4.4 points, in summary the overall satisfaction of the system is high. However immersive technologies such as virtual reality or augmented reality may require expensive equipment and advanced technical support, limiting the popularity and accessibility of the study. Technology implementation may be more challenging in areas with limited resources.

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RESEARCH ON PRAGMATIC CHARACTERISTICS AND COMMUNICATION STRATEGIES OF CHINESE LANGUAGE PHILOLOGY

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ABSTRACT

In this paper, we first analyze the discourse features in social and cultural contexts, and from the perspective of discourse output, we establish a model of maximizing the expectation of context and discourse choice by estimating the parameters of context, and explore the problem of contextual formalization as well as the influence of the time factor on the discourse features. Then the Hidden Markov Chain was adopted to consider the time factor and establish the corpus derivation relationship. The communication subject, communication content, technique and communication object are taken as the main factors, and the Chinese language communication strategy is constructed by combining the theory of pragmatics. In the final analysis, it is found that the cumulative number of learners is the largest in the US region, and the model only needs about 25 rounds of iterative training at the optimal running time. In the factor analysis, webpage has the highest factor loading value of 0.846 in Factor 4, indicating that it plays an important role in Chinese language text dissemination. The proposed model develops a more targeted and effective communication strategy, which can improve the communication effect of Chinese language and promote cultural exchange and understanding.

KEYWORDS

Context parameters; Markov chain; pragmatics theory; iterative training; factor loadings

https://doi.org/10.17993/3cemp.2024.130153.176-194

INDEX

https://doi.org/10.17993/3cemp.2024.130153.176-194

1. INTRODUCTION

The Chinese language and script is one of the ancient languages and scripts, and it is constantly revitalized following the past [1]. With the continuous promotion of the Belt and Road Initiative, China's discourse in the international community has been enhanced, and international trade and exchanges are increasing. In this context, the dissemination of Chinese language and script is particularly important [2]. Through the use of Internet platforms and new media and other channels, the dissemination of Chinese language and literature is expanded, so that more groups can understand Chinese culture and the connotation of Chinese language and writing, etc., and enhance the national cultural soft power [3]. With the continuous development and improvement of information technology, people's lifestyles and language habits are gradually changing, and the dissemination of Chinese language and literature is in a fragmented and fast-food environment [4]. The dissemination of Chinese language text with the help of network information carries a certain degree of fragmentation, and it is difficult to achieve a lasting effect in a relatively short period of time [5]. At the same time, as the dissemination of text is mostly replaced by the Internet, computer and cell phone input methods have brought writing convenience to people, and people's awareness of the writing standard of Chinese characters is relatively weak, and they often have the dilemma of forgetting the characters when they put pen to paper, or make frequent mistakes when writing [6].

Since existing studies have not proposed specific strategies for Chinese language text communication, this paper starts from the dimensions of social context and cultural context to reveal the pragmatic laws of Chinese language in social and cultural contexts. A theoretical framework for the computation of Chinese language communication is constructed, which includes the establishment of a model for maximizing the expectation of context and discourse choice, an in-depth discussion of the contextual formalization problem and the time factor, and an analysis of the computational pragmatics model of the corpus. In the establishment of the context and discourse choice expectation maximization model, the mathematical model of expectation maximization choice is derived by combining a large amount of corpus analysis. Meanwhile, when considering the issue of contextual formalization and the time factor, the formalization method and the time series analysis are adopted to comprehensively grasp the changes of discourse features in different contexts and time, providing a systematic research framework for the development of more specific and effective communication strategies.

2. LITERATURE REVIEW

Boal-San Miguel, I et al. examined the siting patterns of the Spanish CCI sector through a spatio-temporal perspective using micro-geographic data in the context of the increasing spatial distribution of the cultural and creative industries, emphasizing the impact of policy in terms of resource accountability and institutional coordination [7]. Harsch, S et al. suggested that due to language barriers, differences in cultural

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preferences, and differences in health literacy levels that providing healthcare to migrants and refugees faces difficulties. In order to improve this situation, the role of health literacy in second language programs was explored in depth in the CURA project, funded by the German Federal Ministry of Education and Research, which proposed interventions to facilitate its implementation [8]. Kessler, M et al. conducted a pre-writing discussion through verbal and text chats followed by a timed writing task with 10 university Chinese language learners. Students engaged in discussions for longer durations and rounds during the face-to-face program, and the FTF program led to an increase in lexical complexity and syntactic richness [9]. Wei, L et al. analyzed how multilingual Chinese language users incorporate new digital communication platforms through a long-term, ongoing digital ethnographic study of online communication and creative Chinese characters in the global Chinese diaspora. Utilizing the functionality of Chinese character writing systems to challenge dominant linguistic ideologies and policies and to express new transnational consciousnesses can facilitate cultural mobility and social participation on a global scale [10]. Wang, D identifies discrepancies between prescribed monolingual principles and perceived linguistic realities of translation from a socio-cultural perspective in the context of the gradual decline of language learning. It is recommended that foreign language programs in higher education revisit their monolingual ideology and consider adopting a translanguaging pedagogy to better attract and retain students [11].

Guo, Q et al. identified research trajectories targeting language learners and their language development across a variety of topics such as reading, pronunciation, task motivation and engagement, story retelling, group cohesion, and classroom management, affirming the scholarship of communication language teachers [12]. Pinto, R. D et al. explored whether the use of gaming strategies in virtual reality facilitates the acquisition of a second, i.e. foreign, language. The study found that learning was the most assessed dependent variable in the selected recordings, and augmented reality was the most used technology, suggesting that these technologies should be used to support second language learning rather than replacing traditional methods altogether [13]. Machwate, S et al. emphasized the benefits of student mobility in terms of enhancing communication skills, with a particular focus on foreign language learning and behavioral attitude development. The benefits of integrating virtual experiences from a mobility perspective are explored by using some elements of 21st century knowledge as a tool for developing intercultural, linguistic and digital competence [14]. Canals, L suggests the role of multimodality and translanguaging as underpinnings of spoken interactions, with the identification and transcription of language-related events, and quantitative and qualitative analyses of the data, including all translanguaging and the the use of multiple modes of meaning generation, revealing the interaction between multimodality and learners' multilingual replicas [15]. Kubota, R et al. explored the main goal of foreign language education, which is to develop learners' ability to communicate in a foreign language. The meaning of communicative competence becomes complex in the current neoliberal context of the importance of communication in the knowledge economy. The analysis

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reveals the paradoxical nature of neoliberal communicative competence, which both conflates global communication with the use of four measurable English language skills to convey information and challenges linguistic norms by emphasizing multilingualism and co-constructed interactional competence [16].

3. PRAGMATIC FEATURES OF CHINESE LANGUAGE AND LITERATURE

3.1. PRAGMATIC FEATURES IN SOCIAL CONTEXTS

Language activities are inseparable from the context, any kind of language activities are carried out in a specific context, and thus this language activity will be engraved with the color of a specific language, and influenced and constrained by this context [17]. The concept of context is very broad and covers a wide range. Context in a narrow sense refers to the context of language, and context in a broad sense refers to the communicative situation, objective conditions and background of language. Speech activities are always in a certain space and time, unfolding in a specific situation and between specific people [18]. The features of pragmatics in social context are shown in Fig. 1, context and language activity are inseparable, and context is the basis and prerequisite for understanding language activity. Social context involves the psychology, cognition and specific social and cultural environments of the communicating parties, and is also affected by factors such as age, social distance, social status and value orientation of the parties [19]. The Chinese language is also situated in its own social context, and is subject to the constraints and limitations of cultural, historical, religious, and socio-psychological factors in the social context.

Figure 1. Characterization of discourse in social contexts

3.2. PRAGMATIC FEATURES IN CULTURAL CONTEXTS

Chinese is a high-context language that is highly dependent on the environment, and the cultural context is summarized as the environment in which the discourse is produced, which can also be said to be the verbal and non-verbal contexts [20]. Figure 2 shows the features of discourse in cultural context, the former refers to the front and back of the written language or the front and back of the oral

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communication, while the latter refers to the specific environment when the language is expressed, such as the time, place, weather, body movements or the social environment such as the cultural background involved in the written expression [21]. It can be seen that the extension of the concept of context is relatively broad, then, from the point of view of literalism, the cultural context is more by virtue of the literary text in the textbook, that is, the written language. Therefore, it only includes contextual context and socio-cultural context, which are summarized as intra-linguistic context and extra-linguistic context. Intra-linguistic context refers to the linguistic environment that can be directly understood through the language in the text, and extra-linguistic context is the cultural environment of the times that influences the author's thoughts at the time of creation outside the language [22].

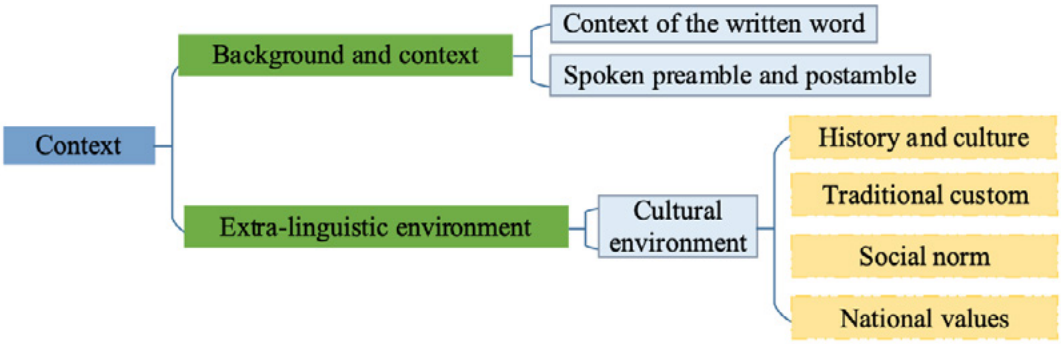

Figure 2. Characteristics of discourse in cultural contexts

4. CONSTRUCTING CHINESE LANGUAGE COMMUNICATION CALCULATIONS BASED ON PRAGMATICS THEORY

4.1. CONTEXT AND DISCOURSE CHOICE EXPECTATION MAXIMIZATION MODELING

From the perspective of discourse output, it is believed that using language is choosing language, and the task of discourse depiction and discourse interpretation lies mainly in the study of contextual conformity, structural conformity, dynamic conformity, and the degree of awareness of conformity [23]. The entry point chosen for modeling is dynamic conformity, i.e., discourse is accomplished in the dynamic process of specific contexts. Since contextual changes affect the linguistic forms chosen by the communicating parties, and the linguistic choices of the parties generate new contexts, context and discourse influence and interact with each other in a dynamic process.

Let the context x obey $N(\mu_x, \sigma_x^2)$, and the model parameters θ are vectors, including each statistic constructed according to the influencing factors of the context. It builds an expectation-maximizing context estimation model for the dynamic compliance process based on linguistic compliance theory and expectation-maximization

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algorithm: the input of the whole model includes four parts: the selected discourse *D*, the context *C*, the joint distribution of discourse and context under the given parameter conditions $P(D,C \mid \theta)$, and the conditional distribution of context under the given parameter and discourse conditions $P(D,C \mid \theta)$, and the output is the model parameters θ. The model first chooses an initial value of θ_0 for the parameter and starts iterating, producing an estimate for θ at each iteration, denoted θ_i, where i is the number of rounds of iteration. At the $i+1$th iteration, the expectation is computed:

$$Q\left(\theta,\theta_i\right)=E_C\left[\log P(D,C \mid \theta) \mid D',\theta_i\right]=\sum_C \log P(D,C \mid \theta)P\left(C \mid D,\theta_i\right) \quad (1)$$

Then the parameter θ, which makes Eq. (1) maximized, determines the estimate of the parameter for the $i+1$ nd iteration θ_{i+1}:

$$\theta_{i+1}=\arg\max_{\theta} Q\left(\theta,\theta_i\right) \quad (2)$$

The process of Eq. (1) and Eq. (2) is repeated continuously until convergence, so that the context parameters can be approximated and thus the discourse can be judged to belong to which context distribution [24].

4.2. DISCUSSION OF CONTEXTUAL FORMALIZATION ISSUES AND TIME FACTORS

In order to reflect the dynamics of the model, it is also necessary to take the time factor into account, adding the stochastic process model that fits the nature of compliance is an effective method.

1. The complexity of the context and the formalization of ideas, the current difficulties in the application of the model lies in the formal description of the discourse and the context, here you can refer to the relevant theories in formal pragmatics. In addition, two ideas about the description of context and discourse can be referred to here. First, consider the factors affecting the context as variables, and because of too many influencing factors you can set the number of variables to be infinite, and build the model through limit theory or infinite series. The second is not to consider each factor affecting the context, but to abstract the common characteristics of each factor and build the model in the way of structure and variety, similar to the construction of group, ring and domain in abstract algebra.

2. If we consider the time factor in the interaction process between the two parties using the discourse, the model can be constructed by using the Hidden Markov Chain. In this case, the state sequence of the potential Markov chain is the context state $C_1, C_2, \ldots$, which is unobservable, while the observation value is the discourse $D_1, D_2, \ldots$ obtained after selection, and its transfer probability at the *n* rd state is:

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$$P\{D_n = d \mid C_1, D_1, \cdots, C_{n-1}, D_{n-1}, C_n = C\} = p(d \mid c) \qquad (3)$$

The choice of discourse at a given moment is only relevant to the current context, and the effects of the previous moment's state on the present can all be regarded as part of the context in the current state, so that the memorylessness of the Hidden Markov Chain can be satisfied.

4.3. COMPUTATIONAL PRAGMATICS MODELING ANALYSIS OF THE CORPUS

The initial context of the whole corpus is C_1, C_2, C_3, in which, in order to fully indicate the learner's identity, the customer chooses the questioning mode with markers in the alternatives to convey the implicit meaning. To make context $C = [C_1, C_2, C_3]^T$, Chinese communication needs to consider the current context that can maximize the indication of one's own identity and generate the corresponding discourse, generating discourse $S1$, and the corpus derivation is shown in Fig. 3. In receiving $S1$, a cognitive model is formed to analyze the concepts and their more fixed connections with each other, which is then integrated into an abstract, unified and idealized perfect structure. Intrinsic cognition of the discourse $S1$ is formed through the intermediate process of organizing concepts to understanding the expressed meaning. At the same time, according to the external context C_1, C_2, C_3 and other social and cultural influences. The antecedent nodes of nodes such as C_1, C_2, C_3 are omitted here, and the antecedent can be understood as the possible values set by each node, whose conditional probability table reflects the size of the probability of taking each value. In this example C_1, C_2, C_3 is fixed, thus omitting its antecedent nodes.

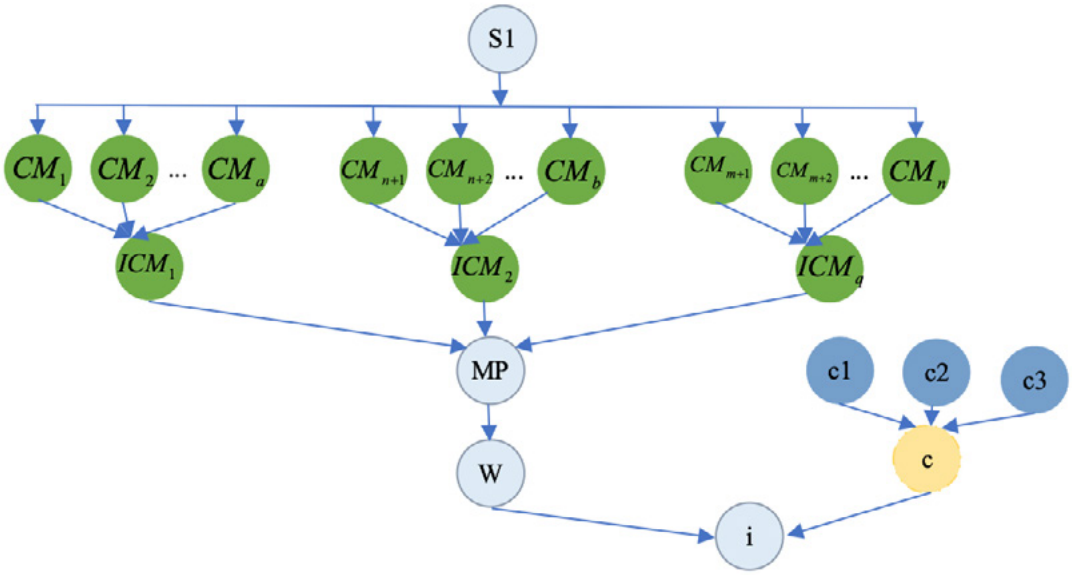

Figure 3. Relationships inferred from the corpus

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In the propagation process of Chinese characters, node i is obtained and merged into the new propagation strategy, at which time some parameters in the model vector need to be adjusted, viz:

$$\theta_{i+1} = \arg\max_{\theta} E_C\left[\log P(S1 \mid C \mid \theta) \mid S1', \theta_i\right] \quad (4)$$

The process of Eq. (4) is illustrated in Fig. 4, where the updated propagation parameters dynamically add the literal and implied meanings of $S1$ to the corresponding positions, or adjust the original strategy parameters. When the propagation strategy is updated, the implicit meaning that the Chinese language text wants to indicate has been clarified.

5. CHINESE LANGUAGE COMMUNICATION MODELING

Chinese language and text audiences are complex and varied, and are affected by a variety of factors, which are the result of a combination of factors. Audiences in different fields are affected by different factors. Communication subject, communication content and skills and communication object are the main factors affecting the communication effect, but the quantification of these factors is affected by many other complex and small factors, which work together to affect the communication effect. Chinese language communication influencing factors are shown in Figure 4, specifically including:

1. Activity is one of the influencing factors of Chinese language communication, indicating the importance of the communication object to this event. Therefore, in the first-level factor communication effectiveness, the audience's attention to the Chinese language text active degree becomes one of its second-level factors, including attention, participation and attention time of the three third-level factors.

2. Site contribution is the degree of influence of the Chinese language communication platform on the effectiveness of communication, Chinese language and literature through the network platform to disseminate information, in the first level of communication effectiveness, the communication platform that the site contribution to become one of the second level of influence of the Chinese language communication, including microblogging platforms, community platforms, web page news platforms, WeChat platforms and search engine platforms of the five third-level elements.

3. Communication mode, i.e., the communication skill or strategy of Chinese language and script, is divided into two kinds, namely, borrowing momentum and creating momentum. The momentum for the combination of the current hot topics to plan the language text, to attract the attention of the audience. The momentum building is to attract the audience's attention through creative ideas

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or influential opinions in Chinese language text. Momentum is the spontaneous dissemination of screen names, and momentum building is the promotion of human beings. Therefore, in the first level of communication effectiveness, the communication strategy adopted by Chinese language text in communication also becomes one of the second level factors, including two third level factors of borrowing momentum and creating momentum.

4. The communication trend factor can also be regarded as a risk control factor. There are many uncontrollable factors in the communication process, so we should be well prepared to control the communication trend of the Chinese language, and once negative voices appear, they should be dissolved in time, so as not to aggravate the situation. Therefore, in the first-level elements of communication effectiveness, communication trends on the Chinese language and script to become one of the second-level factors, including the control of word-of-mouth towards and control of word-of-mouth continuation of the two third-level elements [25].

5. The cost of communication is one of the most important factors considered at the beginning of the enterprise planning activities, so the cost is an important factor affecting the effectiveness of investment.

6. Nowadays, communication media are blossoming, and traditional media include newspapers, magazines, radio and television. New media include online new media, mobile new media, digital new media. If Chinese language and script want to expand their influence, penetration into other media is an effective communication method. In addition, free media coverage saves a lot of investment costs for dissemination. Therefore, whether or not Chinese language text causes media penetration is also an influencing factor of communication effectiveness.

7. Whether or not the Chinese language text is effective in communication is best evidenced by the sales of neighboring products or the rate of language usage.

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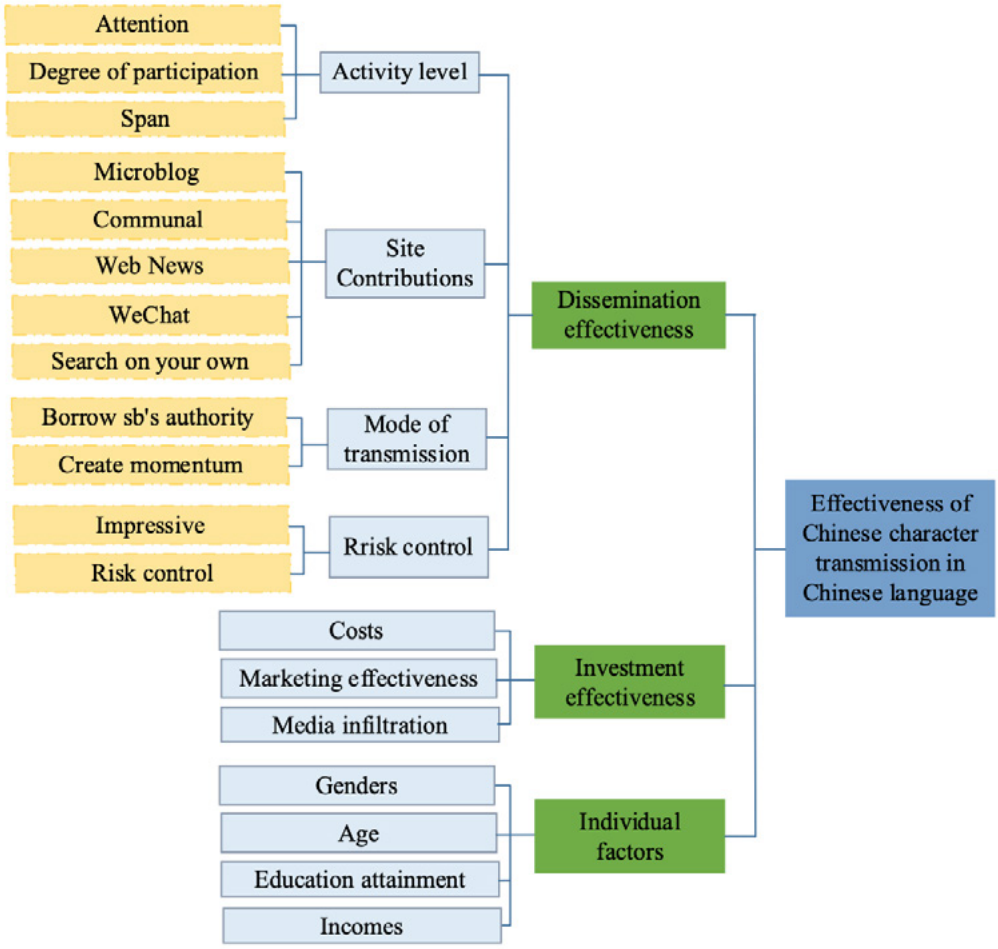

Figure 4. Factors affecting the effectiveness of Chinese language communication

6. EMPIRICAL ANALYSIS OF PRAGMATIC FEATURES AND COMMUNICATION STRATEGIES OF TEXTUAL STUDIES

6.1. BACKGROUND CONDITIONS

This section is based on the pragmatic features of Chinese language literature and the designed communication model based on pragmatics theory for validation, including three aspects:

1. The main consideration of this empirical evidence is that real-life Chinese language text usually fails to resonate at first when it is disseminated, and it needs to reach a certain level of dissemination before it may be noticed and learned. Therefore, the later the time in the communication strategy, the easier it is to realize. And the activity level is usually the earlier the intervention, the better, will explore the reasonable time to put the strategy.

2. The estimation of the number of dissemination nodes is mainly to explore what percentage of the minimum placement can get relatively good results. In reality,

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if we want to carry out Chinese language and text communication strategy placement, the larger the audience will inevitably invest more, so the number of communication nodes is a very important aspect of communication strategy.

3. On the basis of determining the time of strategy placement and the proportion of the number of communication nodes, the effects of different strategies are examined through batch validation to illustrate the advantages of communication based on the theory of pragmatics.

6.2. EFFECTIVENESS OF DISSEMINATION

Under the same communication strategy, Figure 5 shows the number of new Chinese learners and the cumulative number of learners in different regions. Figure 5(a) shows the new Chinese learning tasks in different regions, and the number of new learners peaks between 900-1500 hours, with the largest peak of new learners in the Iranian region and the smallest in the Korean region. Figure 5(b) shows the cumulative number of learners in different regions, and the number of learners peaked between 3300-4400 hours, with the earliest peak time reached in the Italian region and the latest peak time in the Korean region. The largest cumulative number of learners is in the U.S. region, and the smallest is in the Korean region. The earliest maximum number of learners is in the Italian region and the latest is in the US region.

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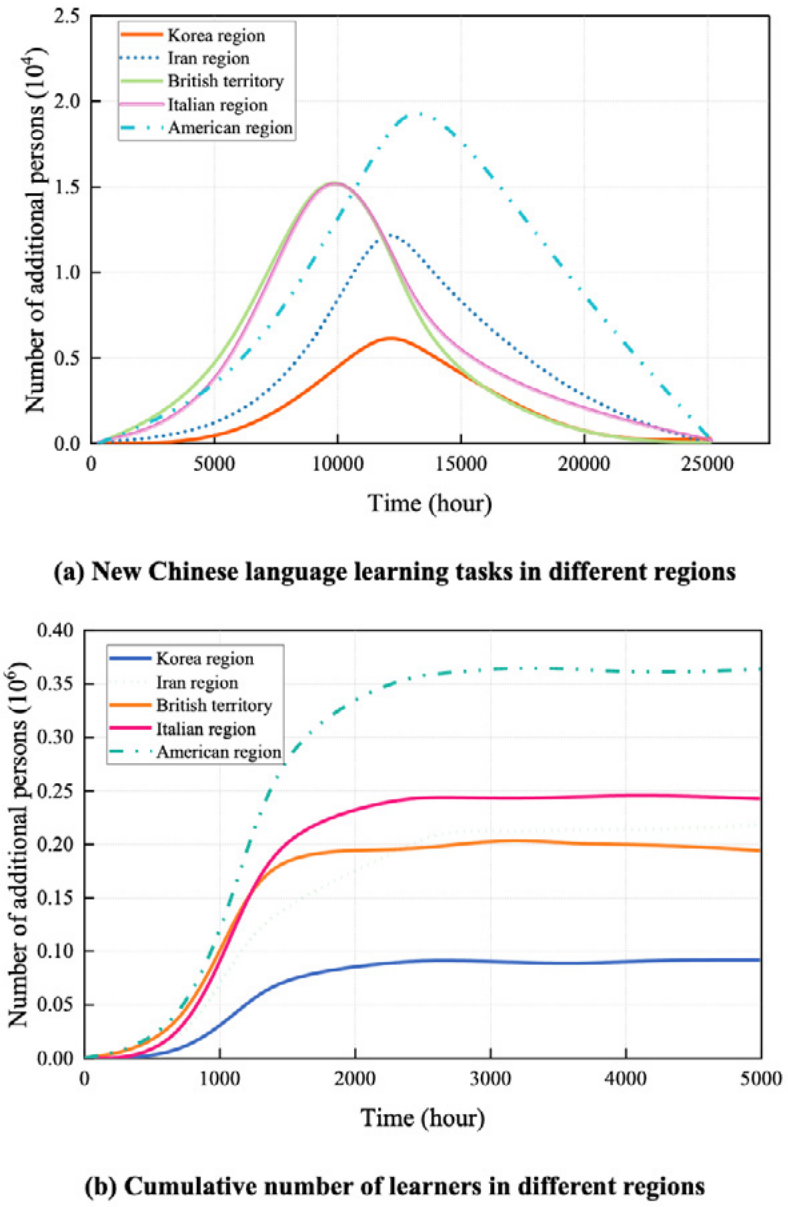

Figure 5. New and Cumulative Number of Chinese Language Learners in Different Regions

6.3. PROPAGATION ALGORITHM PERFORMANCE ANALYSIS

In order to prove that the Chinese language communication strategies constructed based on pragmatics theory have better performance, this paper conducts four groups of comparison experiments. The first two groups adopt the pragmatics theory and no theory approach respectively, randomly initialize the model parameters and train the strategy network from the initial state. The latter two groups adopt pragmatics theory and theory-free approach respectively, but first iteratively train 40 rounds of pre-training on a small-scale two-layer network, and then migrate the model to a large-scale four-layer network for training, corresponding to the Pre-Pragmatics theory and theory-free approach in the figure, respectively, and the results of the comparison of pre-training convergence rate are shown in Fig. 6. It is found that the pragmatics theory can better support pre-training, and the pre-training effect and model migration

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ability are better than the no-theory method, and the migrated -pragmatics theory has a better training starting point, and convergence to the optimal running time only requires about 25 rounds of iterative training, but the no-theory method still requires about 35 rounds of selective generation training. Meanwhile, in terms of convergence rate, the pragmatics theory is also slightly higher than the no-theory approach.

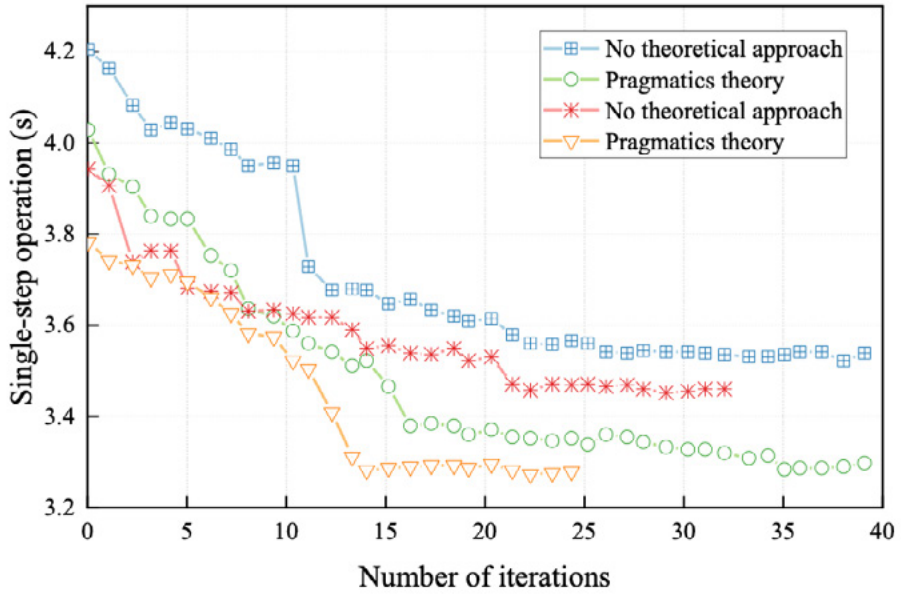

Figure 6. Convergence rate of pre-training with and without the theory of pragmatics

In order to prove the rationality and effectiveness of the proposed method, this paper compares the designed discourse-based model, the multimedia model and the web-based communication model respectively. Table 1 shows the results of comparing the average performance of propagation. For the average value of coverage obtained from 10 operations of the three propagation models, the multimedia model is 85.4%, which is 1.2% lower than the average value of the network propagation model, and 14.06% lower than the average coverage value of the discourse-based theory, which can be seen that the multimedia model has the highest coverage rate. For the running time, the multimedia and network propagation models have a certain arithmetic complexity, so their average arithmetic time is longer than that of the pragmatics theory by 75 s and 22.34 s. For the number of iterations, the average number of iterations of the pragmatics theory is the lowest, which is only 13.6, and the speed of convergence is significantly improved compared with the other two models. In conclusion, the communication model based on pragmatics theory constructed in this paper can improve the performance of Chinese language text communication.

https://doi.org/10.17993/3cemp.2024.130153.176-194

Table 1. Comparison of average propagation performance

Number of promotions	Multimedia model			Network communication			Pragmatics theory		
	Site covera ge	Running time/s	Number of iterations	Site covera ge	Running time/s	Number of iterations	Site coverage	Running time/s	Number of iterations
2	85.6%	126.1	62	87.2%	80.2	76	99.4%	32.2	11
4	84.2%	98.6	63	88.6%	81.5	62	99.7%	24.0	21
6	86.1%	101.2	55	86.1%	76.2	57	99.4%	26.4	16
8	86.4%	96.6	54	86.4%	66.5	54	99.3%	30.9	12
10	84.7%	94.2	55	84.7%	100.6	58	99.5%	28.2	8
Average value	85.4%	103.34	57.8	86.6%	81.0	61.4	99.46%	28.34	13.6

In this paper, the data on the factors influencing the effectiveness of online event marketing communication converged after 10 iterations, and the factor loading matrix is shown in Table 2. Categorized into four different common factors, the factor loading data ranged from 0.4 to 0.9, indicating that the factor has a certain degree of construct validity. Factor 1 includes a total of five elements from the hypothesized model: the cost savings factor in investment effectiveness, the traditional media coverage factor, the acceptance of the product factor, the control of word-of-mouth going factor in communication effectiveness, and the control of word-of-mouth continuation. The highest factor loading value of 0.766 indicates that controlling the direction of IWOM is strongly related to IWOM management or control strategies. Factor 2 consists of the four sub-items in the hypothesized model of self-search, community, time of attention, and momentum building together to form the factor. Community has the highest factor loading value in Factor 2 at 0.762. Meaning that community has a high weight in Factor 2 and is strongly correlated with some kind of community-related factor. Factor 3 includes three sub-items of microblogging, positivity, and lending as constituent factors, and Factor 4 consists of three sub-items of webpage, microblogging, and attention in the hypothetical model. Webpage has the highest factor loading value in Factor 4, which is 0.846. It indicates that webpage has a higher weight in Factor 4, which suggests that webpage plays an important role in Chinese language and text communication.

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Table 2. Factor loading matrix

	Ingredient			
	1	2	3	4
Controlling the direction of word-of-mouth	766	110	166	192
Peripheral Products	667	276	391	84
Cost saving	681	-44	144	832
Traditional strategy	664	66	198	366
Search on your own	22	485	154	318
Communal	189	762	196	78
Focus time	445	689	131	63
Create momentum	166	498	777	214
Microblog	413	445	521	31
Degree of participation	91	101	462	0
Borrow sb's authority	322	468	542	26
Web page	321	298	42	846
WeChat	192	140	53	628
Attention	189	169	539	698

7. CONCLUSION

In this paper, based on the pragmatic features in social and cultural contexts, we constructed a model of Chinese language text dissemination based on pragmatics theory and obtained the following conclusions:

1. The number of new learners after applying the constructed model peaks between 900-1500 hours of learning, with the highest peak in the Iranian region and the lowest in the Korean region. The cumulative number of learners peaked between 3300-4400 hours, with the earliest peak in the Italian region and the latest in the Korean region. It helps to gain a deeper understanding of the impact of geographical differences on learning behavior and provides an empirical basis for the allocation of educational resources in the relevant regions.

2. The migrated pragmatics theory has a better training starting point and only requires about 25 rounds of iterative training at the optimal running time, which is more efficient compared to about 35 rounds of iterative training for the no-

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theory approach. It is expected to promote the improvement of language learning and reduce the cost of learning time.

3. The pragmatics theory performs optimally in terms of coverage, and the average number of iterations of the pragmatics theory is the lowest, which is only 13.6, indicating that the pragmatics theory is able to more comprehensively consider the situations and contexts of language use, and improves the sensitivity to the features of language use.

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NOMOGRAM CONSTRUCTING AND VERIFYING OF PANCREATIC BODY AND TAIL NEUROENDOCRINE CARCINOMA PATIENTS

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ABSTRACT

Objective: To establish and evaluate a prognostic survival model for Pancreatic neuroendocrine carcinoma (panNEC) of body and tail based on the Surveillance, Epidemiology, and End Results (SEER).

Materials and methods: A retrospective study was conducted to collect data on panNEC of body and tail from the SEER database between 2005 and 2019, including clinical information and treatment regimens. A total of 246 patients were included, and they were randomly divided into a training set and a validation set at a ratio of 8:2. Based on independent risk factors identified through COX multivariate analysis, a nomogram model was constructed and compared with the performance of the 8th edition of the American Joint Committee on Cancer (AJCC) staging system in predicting survival.

Results: Tumor differentiation, age, and treatment modality were identified as independent risk factors for prognosis in patients with pancreatic endocrine tumors (P<0.05). The area under the receiver operating characteristic curve (AUROC) for the 1-year, 3-year, and 5-year overall survival rates for the nomogram in the training and validation sets were 0.850 vs. 0.992, 0.899 vs. 0.979, and 0.879 vs. 0.856, respectively. The nomogram had a higher AUROC compared than the AJCC staging. Calibration curves showed good calibration for the nomogram, and clinical decision curves showed that the nomogram had higher accuracy compared with the AJCC staging.

Conclusion: Based on the SEER database, the nomogram model can predict individualized survival outcomes for patients with panNEC of body and tail more accurately than the AJCC staging, providing a reference for treatment and follow-up.

KEYWORDS

SEER database, Pancreatic neuroendocrine carcinoma, Nomogram, Prognosis

https://doi.org/10.17993/3cemp.2024.130153.196-212

INDEX

https://doi.org/10.17993/3cemp.2024.130153.196-212

1. INTRODUCTION

In addition to pancreatic cancer, the second most common epithelial malignant tumor of the pancreas is pancreatic neuroendocrine neoplasms (panNEN), accounting for about 2%-5% of all pancreatic tumors. Its prognosis is often better than pancreatic cancer [1-3]. panNEN belongs to a type of neuroendocrine tumor and is transformed from APUD cells that originated from the endoderm during embryonic development. panNEN includes well-differentiated neuroendocrine tumors (panNET) and poorly differentiated neuroendocrine carcinomas (panNEC). Among them, panNEC is further classified into small cell type and large cell type. According to the 2022 WHO classification definition of neuroendocrine tumors, panNEN is classified into three grades based on mitotic rate and ki67 labeling index: G1 level (mitotic count <2/2mm² and/or ki67 index <3%); G2 level (mitotic count 2-20/2mm² and/or ki67 index 3%-20%); well-differentiated G3 level (mitotic count >20/HPF and/or ki67 index >20%) is called pancreatic high-grade neuroendocrine tumor (panNET). Poorly differentiated G3 level (mitotic count >20/2mm² and/or ki67 index >70%) is called pancreatic low-grade neuroendocrine carcinoma (panNEC). The incidence of panNEC is increasing year by year, with an incidence of about 0.8/100,000 in the United States and about 1.27/100,000 in Japan [4]. panNEC is classified into functional and non-functional types based on whether patients exhibit hormone-related clinical manifestations. Functional panNEC accounts for about 34%, including insulinoma, gastrinoma, somatostatinoma, vasoactive intestinal peptide tumor, glucagonoma, etc. Functional panNEC patients often exhibit symptoms of hormone over secretion, so they are usually detected and treated early in clinical practice. Non-functional panNEC accounts for about 66%, which usually has a concealed onset and no typical clinical manifestations in the early stage. It often presents with non-specific symptoms such as abdominal pain, abdominal distension, indigestion, weight loss, biliary tract obstruction, duodenal obstruction, jaundice, etc. The prognosis of pancreatic head and tail panNEC is different. Pancreatic tail panNEC has a lower incidence and this study explores the prognostic factors of pancreatic tail panNEC based on precision medicine concepts.

2. MATERIALS AND METHODS

The SEER database is one of the commonly used public databases in clinical practice. It includes a large number of retrospective clinical tumor studies in some US states and counties (about 35% of the US population). The data is easily accessible and publicly available free of charge, making it popular among researchers. The included tumors include breast cancer, colorectal cancer, lung cancer, prostate cancer, reproductive system tumors, lymphoma, leukemia, and other digestive system tumors as well as other types of tumors that have not yet been clearly identified. The included variables include the number of patients with the disease, age, race, time of diagnosis, tumor size, degree of differentiation, TNM staging, primary or metastatic, treatment method, radiotherapy and chemotherapy, survival time, and survival status at the last follow-up.

https://doi.org/10.17993/3cemp.2024.130153.196-212

This study used a retrospective cohort study method to retrospectively analyze the clinical data of 686 patients with pancreatic body and tail panNEC in the SEER database from 2005 to 2019. The following inclusion and exclusion criteria were used:

<I> Inclusion criteria:

1. Age ≥ 18 years old;
2. Lesion is a primary malignant tumor;
3. Have a clear TNM staging;
4. Follow-up information is complete;
5. Histological diagnosis of pancreatic body and tail neuroendocrine cancer, with histological code 8246/3 in the tumor disease classification code (ICD-O-3).

<II> Exclusion criteria:

1. Polymorphic tumor;
2. Follow-up information is incomplete;
3. Treatment method is unclear;
4. Tumor type and TNM staging are incomplete.

After strict inclusion and exclusion criteria, a total of 246 cases were included out of the original 686 data. The influencing factors studied included ethnicity, age, gender, marital status, number of primary tumors, tumor size, TNM stage, tumor differentiation, chemotherapy, and surgical intervention. The observation indices were the overall survival time (OS), which refers to the time interval from the date of diagnosis to death due to any cause, and the survival status at the last follow-up.

Collected clinical data and treatment methods of patients with pancreatic body and tail panNEC diagnosed clinically from the SEER database between 2005 and 2019. 246 collected data were randomly divided into a training set and a validation set at a ratio of 8:2. The training set was used for model establishment and internal validation, while the validation set was used for external validation. IBM SPSS was used for data analysis. Factors with significant univariate Cox regression analysis ($p<0.05$) were included in multivariate Cox regression analysis. Variables with $p<0.05$ in multivariate Cox analysis were plotted using the Kaplan-Meier survival curve. Multivariate analysis results ($p<0.05$) were used to construct nomograms using RStudio, and compared with the eighth edition of the American Joint Committee on Cancer (AJCC) staging system. The prognostic performance of the models was compared using consistency index (C-index), calibration curve, and area under the receiver operating characteristic curve (AUROC). Decision curve analysis (DCA) was used to quantify the net benefit at different threshold probabilities to evaluate the clinical utility of the model.

https://doi.org/10.17993/3cemp.2024.130153.196-212

3. RESULTS

The 246 cases were randomly divided into a training set (197 cases) and a validation set (49 cases) at a ratio of 8:2. The baseline data of the patients is shown in Table 1.

COX univariate analysis using IBM SPSS produced the following results: race (p=0.64), gender (p=0.44), age (p=0.01), marital status (p=0.39), T staging (p<0.01), N staging (p=0.09), M staging (p<0.01), tumor size (p<0.01), tumor number (p=0.25), systemic therapy (p=0.41), tumor differentiation (p<0.01), and surgical intervention (p<0.01). The variables with p<0.05 in the COX univariate analysis were included in the COX multivariate analysis, which produced the following results: age (p<0.01), T staging (p=0.96), M staging (p=0.40), tumor size (p=0.93), tumor differentiation (p<0.01), and surgical intervention (p<0.01). The training set univariate and multivariate analysis results are shown in Table 2.

Table 1. Characteristics of training cohort and validation cohort

Variable	Total (n=246)	Training Cohorts (n=197)	Validation Cohorts (n=49)
Age			
≤54	74 (30.08%)	62 (31.47%)	12 (24.49%)
55~74	137 (55.69%)	109 (55.33%)	28 (57.14%)
≥75	35 (14.23%)	26 (13.20%)	9 (18.37%)
Gender			
Male	146 (59.35%)	115 (58.38%)	31 (63.27%)
Female	100 (40.65%)	82 (41.62%)	18 (36.73%)
Race			
White	181 (73.58%)	146 (74.11%)	35 (71.43%)
Black	25 (10.16%)	21 (10.66%)	4 (8.16%)
Other	40 (16.26%)	30 (15.23%)	10 (20.41%)
Marital status			
Married	159 (64.63%)	127 (64.47%)	32 (65.31%)
Unmarried	87 (35.37%)	70 (35.53%)	17 (34.69%)
Chemotherapy			
Yes	20 (8.13%)	17 (8.63%)	3 (6.12%)
No	226 (91.87%)	180 (91.37%)	46 (93.88%)
Surgery			

https://doi.org/10.17993/3cemp.2024.130153.196-212

Yes	207 (84.15%)	163 (82.74%)	44 (89.80%)
No	39 (15.85%)	34 (17.26%)	5 (10.20%)
T			
T1	73 (29.67%)	57 (28.93%)	16 (32.65%)
T2	81 (32.93%)	64 (32.49%)	17 (34.69%)
T3	77 (31.30%)	64 (32.49%)	13 (26.53%)
T4	15 (6.10%)	12 (6.09%)	3 (6.12%)
N			
N0	168 (68.29%)	133 (67.51%)	35 (71.43%)
N1	78 (31.71%)	64 (32.49%)	14 (28.57%)
M			
M0	182 (73.98%)	145 (73.60%)	37 (75.51%)
M1	64 (26.02%)	52 (26.40%)	12 (24.49%)
Differentiation			
Highly	165 (67.07%)	137 (69.54%)	28 (57.14%)
Moderately	47 (19.11%)	32 (16.24%)	15 (30.61%)
Poorly	34 (13.82%)	28 (14.21%)	6 (12.24%)
Tumor size			
≤2cm	81 (32.93%)	63 (31.98%)	18 (36.73%)
＞2cm	165 (67.07%)	134 (68.02%)	31 (63.27%)
Tumor number			
Single	170 (69.11%)	139 (70.56%)	31 (63.27%)
Multiple	76 (30.89%)	58 (29.44%)	18 (36.73%)

https://doi.org/10.17993/3cemp.2024.130153.196-212

Table 2. Univariate and multivariate analysis for panNEC of the training cohort.

Variable	Univariate analysis HR(95%CI)	P-value	Multivariate analysis HR(95%CI)	P-value
Age				
≤54	2.274(1.382-3.743)	0.01	0.831 (0.337-2.049)	688
55~74			4.131 (1.615-10.562)	3
≥75				
Gender				
Male	1.289(0.673-2.470)	444		
Female				
Race				
White	1.101(0.737-1.645)	639		
Black				
Other				
Marital status				
Married	0.757(0.402-1.426)	389		
Unmarried				
Chemotherapy				
Yes	1.483(0.581-3.788)	410		
No				
Surgery				
Yes	0.076(0.039-0.151)	＜0.01	0.195 (0.070-0.542)	＜0.01
No				
T				
T1	2.158 (1.489-3.130)	＜0.01	——	938
T2				938
T3				940
T4				——
N				

https://doi.org/10.17993/3cemp.2024.130153.196-212

N0	1.703 (0.913-3.177)	94		
N1				
M				
M0	4.832 (2.582-9.040)	＜0.01	1.452 (0.615-3.429)	395
M1				
Differentiation				
Highly	3.275(2.274-4.717)	＜0.01	1.860 (0.690-5.017)	220
Moderately			4.367 (1.714-11.123)	＜0.01
Poorly			——	——
Tumor size				
≤2cm	9.618 (2.319-39.900)	＜0.01	——	926
＞2cm				
Tumor number				
Single	1.455 (0.766-2.766)	252		
Multiple				

The univariate analysis showed that age, T staging, M staging, surgery, tumor size, and tumor differentiation were related factors affecting the prognosis of patients with pancreatic body and tail panNEC ($p<0.05$). Multivariate analysis showed that age, tumor differentiation, and surgical intervention were independent risk factors for the prognosis of patients with pancreatic body and tail panNEC ($p<0.05$). Based on the results of the three multivariate analyses, a Kaplan-Meier curve was plotted, as shown in Figure 1.

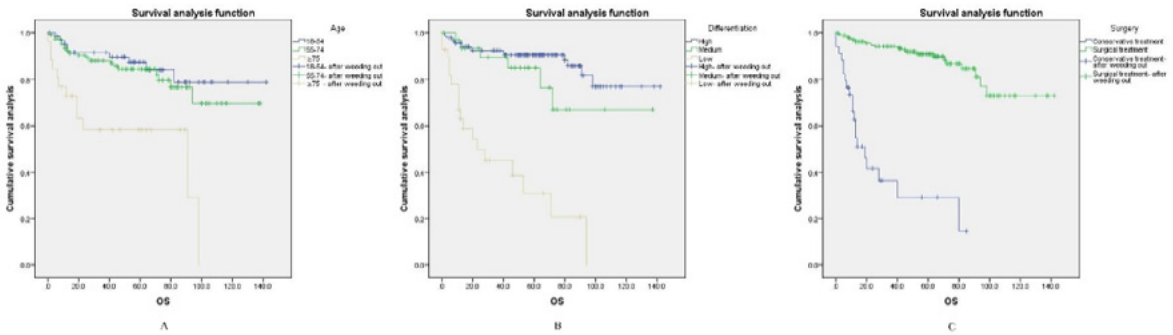

Figure 1. Kplan-Meier analysis for independent risk factor of panNEC: age(A), differentiation (B), surgery (C)

From Figure 1, it can be observed that as survival time increases, patients of older age have a faster decrease in survival probability. Patients who receive conservative

https://doi.org/10.17993/3cemp.2024.130153.196-212

treatment have a faster decrease in survival probability compared to those who undergo surgery. Additionally, lower tumor differentiation corresponds to a faster decrease in survival probability. This is consistent with previous research findings.

3.1. CONSTRUCTION OF NOMOGRAM

Nomogram, also known as an alignment diagram, is a graph that uses a family of disjoint line segments in a two-dimensional Cartesian coordinate system to represent a function with two independent variables. This type of graph is primarily used to express the relationships between variables in predictive models and can be applied in many fields, including medicine, meteorology, and economics.

In the field of medicine, nomograms can combine various clinical characteristics to predict individualized outcomes, allowing for more convenient and rapid access to targeted predictive outcomes, as well as intuitive observation of the results of regression analysis. For example, in tumor prognosis studies, nomograms can be used to predict the survival, prognosis, and recurrence risk of tumor patients. By constructing a multi-factor regression model, integrating multiple predictive indicators, and then using a graduated line segment drawn on a common plane according to a certain proportion, the relationship between each variable in the predictive model can be expressed. In this way, researchers can intuitively understand the patient's condition, predict the disease's development trend, and evaluate the treatment effect by observing the nomogram based on the patient's specific situation.

According to the results of the three COX multivariate analyses, we used RStudio to construct nomograms for predicting 1-, 3-, and 5-year survival rates. (Figure 2)

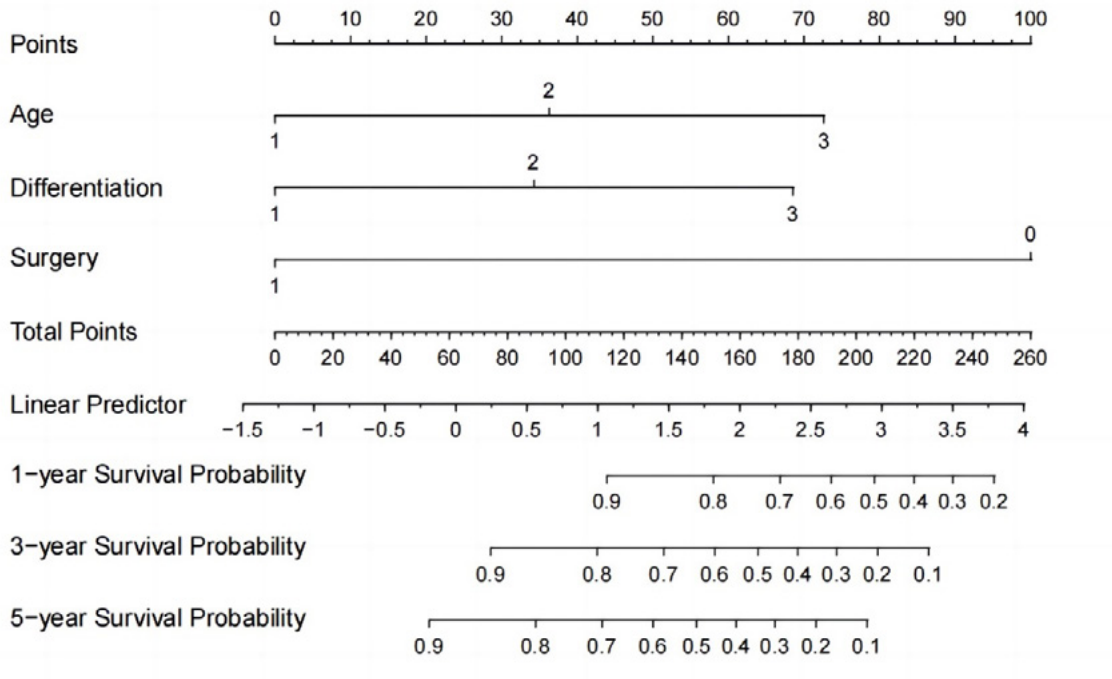

Figure 2. Prognostic nomogram for patients with pancreatic body and tal panNEC

https://doi.org/10.17993/3cemp.2024.130153.196-212

3.2. VALIDATION OF NOMOGRAM:

The C-index of Nomogram in the training set was 0.835, and in the validation set was 0.861. Calibration curves of Nomogram and AJCC staging were plotted in the training and validation sets (Figure 3). The 1-year overall survival rate calibration curve of Nomogram was in good agreement with the ideal slope of 1, suggesting that compared with AJCC staging, using the Nomogram established in this study to predict overall survival rate was more consistent with the actual results and more accurate. ROC curves of Nomogram and AJCC staging were plotted in the training and validation sets, including 1-year, 3-year, and 5-year survival rates (Figure 4). In the training set, the AUROC of Nomogram was 0.850, 0.899, and 0.879, while the AUROC of AJCC staging was 0.875, 0.830, and 0.777; in the validation set, the AUROC of Nomogram was 0.992, 0.979, and 0.856, while the AUROC of AJCC staging was 0.832, 0.817, and 0.836. From the above data, it can be seen that both in the training and validation sets, Nomogram had higher C-index and AUROC, showing better predictive performance without significant overfitting. To further evaluate the clinical value of Nomogram, clinical decision curves for 1-year, 3-year, and 5-year overall survival rates were plotted (Figure 5). The trend of DCA curve represented the predictive ability and accuracy of the model under different decision thresholds. The upper the curve is, the higher the predictive ability and accuracy of the model are. Obviously, DCA curve showed that Nomogram had better predictive efficiency than AJCC staging in this study.

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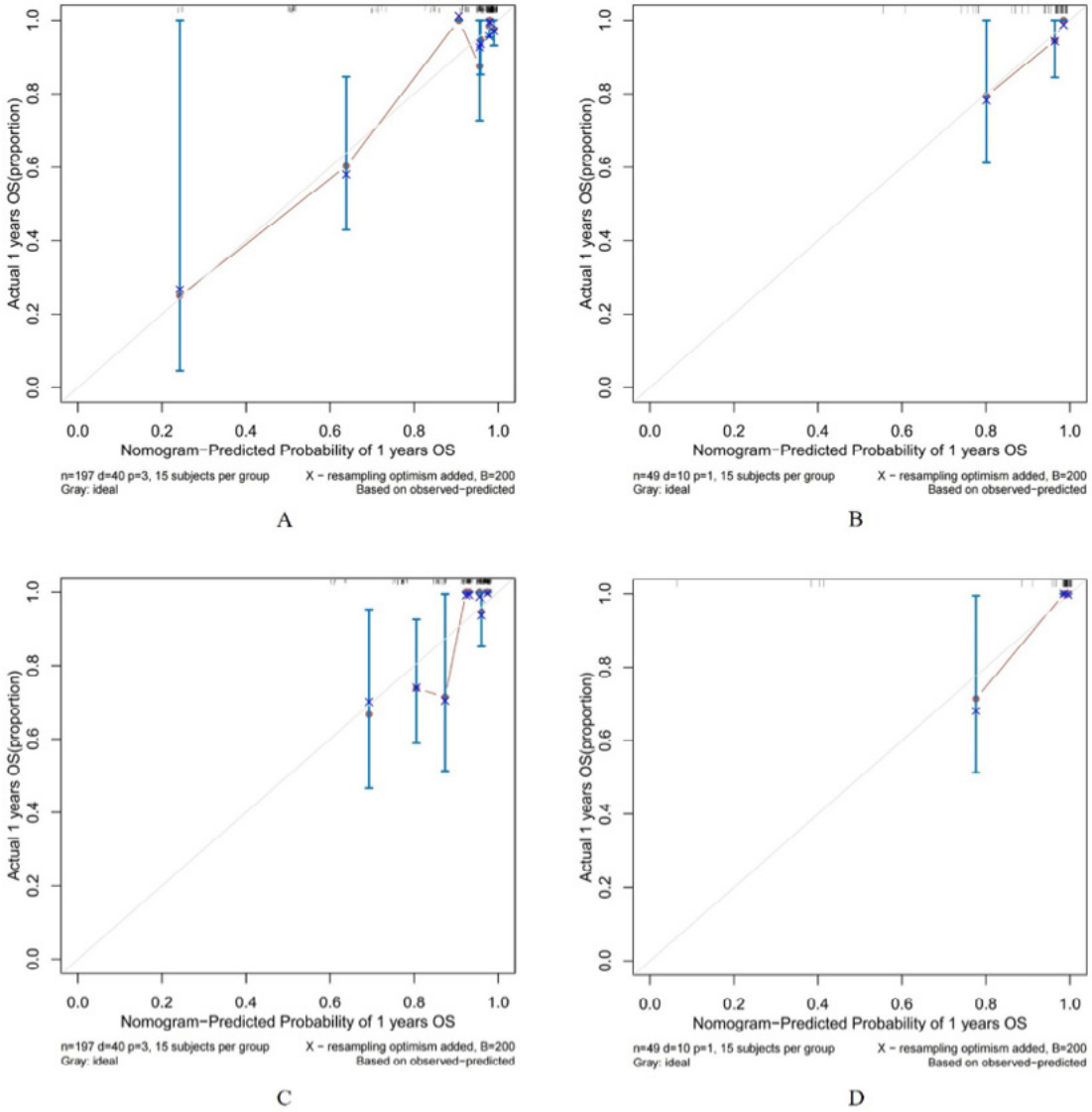

Figure 3. Calibrationcurves of nomogram and AJCC staging (A: training calibrationcurve, B: validation calibrationcurve, C: AJCC training calibrationcurve, D: AJCC calibrationcurve)

https://doi.org/10.17993/3cemp.2024.130153.196-212

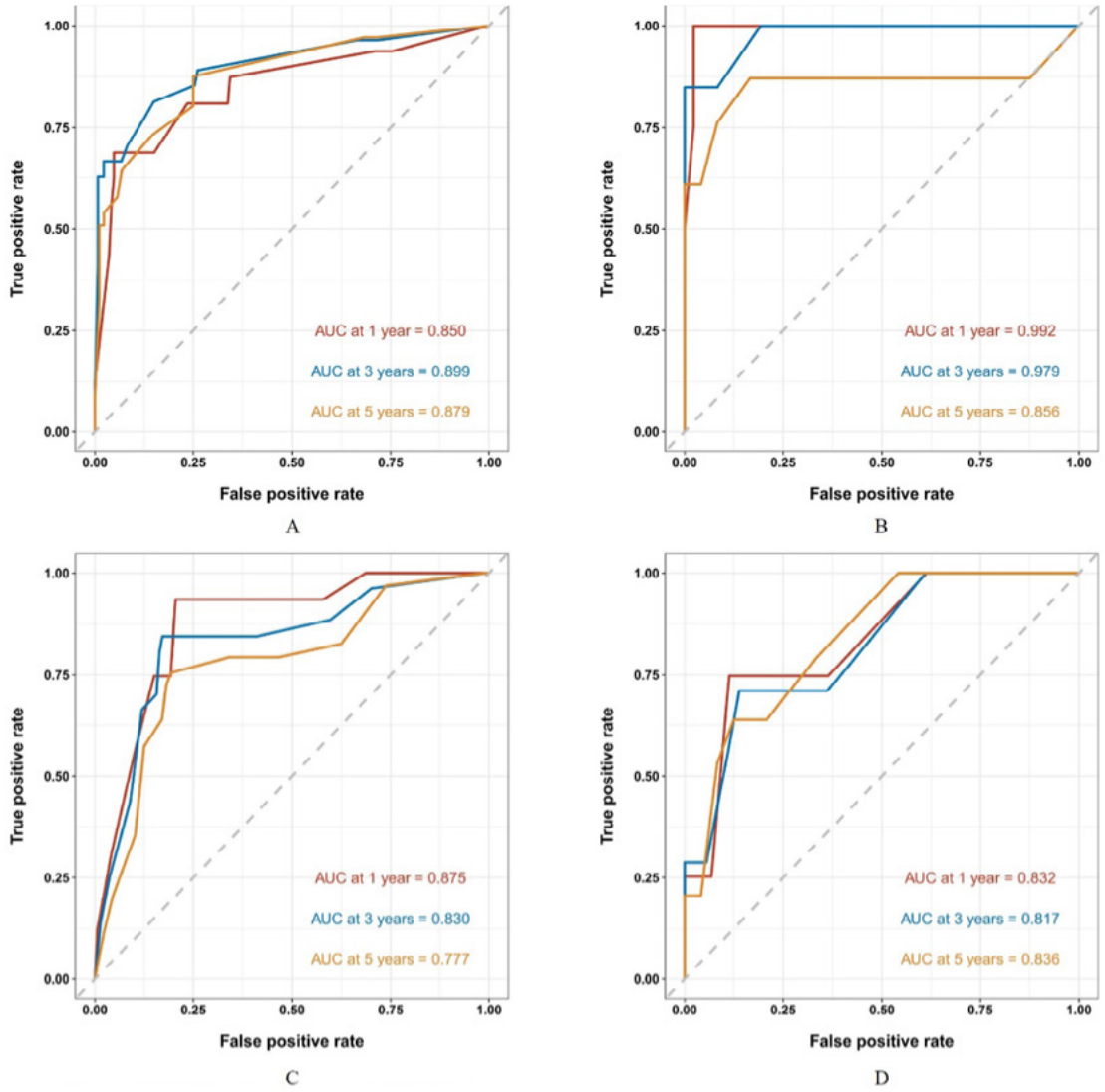

Figure 4. AUROC of nomogram and AJCC staging (A: training AUROC, B: validation AUROC C: AJCC training AUROC D: AJCC validation AUROC)

https://doi.org/10.17993/3cemp.2024.130153.196-212

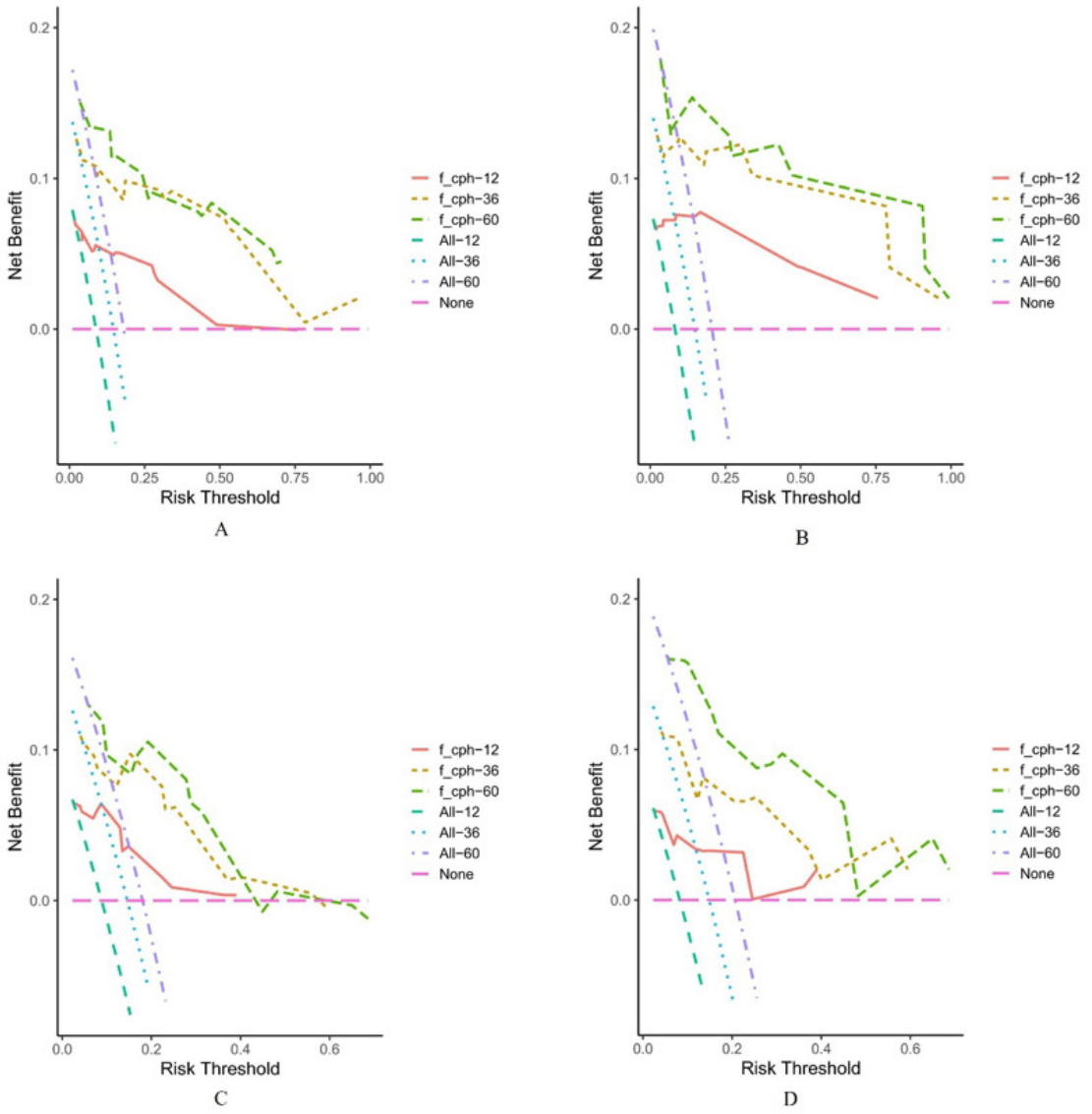

Figure 5. Decision curve of nomogram and AJCC staging (a: DCA of training, b: DCA of validation, c: DCA of AJCC training, d: DCA of AJCC validation)

4. DISCUSSION

4.1. THE IMPACT OF AGE ON PROGNOSIS

The COX multivariate analysis shows that age is an independent risk factor for the prognosis of patients with pancreatic endocrine neoplasms (panNEC) in the body and tail of the pancreas. This may be related to the following aspects:

1. Previous studies have shown that with increasing age, immune function decreases and DNA repair abnormalities increase, which directly leads to tumorigenesis [5]. Epidemiological investigations have also suggested that elderly patients with cancer have a poor prognosis, which is consistent with the conclusion of this study.

https://doi.org/10.17993/3cemp.2024.130153.196-212

2. The mechanism of poor prognosis in elderly patients may be related to the overactivation of related signaling pathways [6]. Compared with non-elderly patients, there are differences in the expression of tumor-related genes in elderly patients. With increasing age, mutations in tumor suppressor genes lead to the loss of control of tumor signaling, with the Akt/mTOR-representing pro-tumor signaling pathway expression increasing, making tumors more prone to development, growth, and metastasis.

3. Elderly patients often have more underlying diseases, more conservative treatment options, early symptoms not obvious, poor family economic conditions, and less active treatment, which leads to a worse prognosis compared to younger patients.

4.2. THE IMPACT OF SURGERY ON PROGNOSIS

The COX multivariate analysis shows that surgical resection is an independent risk factor for the prognosis of patients with pancreatic endocrine neoplasms (panNEC) in the body and tail of the pancreas. The Kaplan-Meier curve shows that patients who undergo surgery have a better prognosis than those who receive conservative treatment. This is consistent with previous literature reports, where surgical treatment is the preferred treatment option for most resectable panNEC patients [7-8]. Surgery can reduce disease-related symptoms, alleviate patient suffering, and improve quality of life and survival time. Whether patients with metastatic panNEC require aggressive surgical intervention has long been controversial. Some studies have shown that for patients with panNEC who cannot undergo radical resection, debulking surgery (removing as much of the tumor as possible, including the primary tumor and metastatic deposits) can also alleviate clinical symptoms and improve long-term outcomes [9-12]. Haugvik [13]and colleagues studied 119 patients with panNEC and found that patients who underwent radical resection had a 3-year survival rate of 69%. Even for patients with metastatic disease, removing the primary tumor can improve patient prognosis. For elderly patients, patients with poor general condition, or patients who cannot tolerate surgery, if conservative treatment has no significant effect, palliative surgery can still be performed to treat tumor-related complications [14].

4.3. THE EFFECT OF TUMOR DIFFERENTIATION ON PROGNOSIS

The COX multivariate analysis shows that tumor differentiation is an independent risk factor for the prognosis of patients with pancreatic endocrine neoplasms (panNEC) in the body and tail of the pancreas. The degree of tumor differentiation has a significant impact on the prognosis of panNEC. Generally speaking, the higher the degree of tumor differentiation, the better the prognosis is usually. This is consistent with multi-center studies [15-18]. In panNEC, well differentiated tumors have a cell

https://doi.org/10.17993/3cemp.2024.130153.196-212

morphology and biological behavior similar to normal neuroendocrine cells, with a lower proliferation rate and lower aggressiveness. This type of tumor is usually associated with a good prognosis and a longer survival time after surgical resection. In contrast, poorly differentiated tumors have a cell morphology and biological behavior that differ significantly from normal neuroendocrine cells, with a higher proliferation rate and stronger aggressiveness. This type of tumor is prone to metastasis and recurrence, usually has a poor prognosis, and a shorter survival time.

4.4. THE SHORTCOMINGS OF THIS STUDY

Despite the large volume of data in the SEER database, which covers a majority of the US population and has follow-up data for each patient, this study extracted data with the same characteristics. However, there are still some unavoidable limitations: (1) The database does not include specific information on radiotherapy and chemotherapy, with only whether the patient received chemotherapy being recorded, without specific regimens and doses; radiotherapy information only includes the site and some techniques (such as particle implantation or external irradiation, etc.), without important treatment information such as surgical margin status. (2) The follow-up outcome only includes death and the cause of death, which limits research on recurrence, metastasis, or progression. (3) Some cases in the database have incompletely recorded surgical methods.

5. CONCLUSION

In summary, in this study, age, treatment modality, and tumor differentiation were independent risk factors for the prognosis of patients with pancreatic endocrine neoplasms in the body and tail ($p<0.05$). The nomogram based on the SEER database can more accurately assess patient prognosis and predict survival time, providing a feasible prediction model for clinicians to better individualize treatment plans for patients, which has certain significance.

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/11/

EXPLORING FOOD CULTURE AND REGIONAL CHARACTERISTICS IN ANCIENT LITERATURE USING TEXT CLUSTERING MODELS

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ABSTRACT

In order to explore the connection between food culture and regional characteristics in ancient literature, a text clustering model is used to bring together literary works with similar food culture descriptions. First, selection criteria such as era, region, and author's social background are set. Then, the works are iteratively assigned to the closest cluster centers by the K-Means algorithm, and these cluster centers are continuously updated to find the best clustering results. In the text preprocessing stage, keywords related to food culture were extracted from each work to form a basic feature set. Finally, the K-Means algorithm is used to identify food culture themes with different regional characteristics. The entropy values of the text clustering model are 92.85 and 72.6, which reveal the common dietary elements of the literary works in each cluster and reflect the close relationship between regional characteristics and dietary habits.

KEYWORDS

Text clustering; K-Means algorithm; cluster center; text preprocessing; food culture

https://doi.org/10.17993/3cemp.2024.130153.214-230

INDEX

https://doi.org/10.17993/3cemp.2024.130153.214-230

1. INTRODUCTION

The traditional Chinese culture is so broad and profound that the traditional food culture is the one with the most enduring vitality, deepest influence and most conscious dissemination [1]. In the long period of feudal empire, no matter how the kingdoms and mountains changed, no matter how the dynasties changed, it must be the food culture that has always been firmly passed on to the world [2]. Food culture not only reflects the geographical location, living habits, social customs and national character of a region or tribe, but also reveals the deeper historical and cultural qualities such as religious culture, international exchanges, and the rise and fall of national power [3]. Taking food culture as a breakthrough to study the historical change process of a tribe, nation and country is undoubtedly a more documentary, persuasive and creative research angle [4]. However, in addition to the intergenerational transmission by word of mouth, there is no better way of transmission of food culture, as a slang culture which is parallel to the elegant art, there are not many records about food culture in the education system or in the proper historical documents, and the reason why the Chinese food culture has been able to flourish for thousands of years is mainly realized by the folk education of the word of mouth [5-6].

Adams, S. A explores the ways in which ancient authors used mnemonic language to express apparent inter- and intra-textual allusions, using specific language and expressions to quote, echo, or reinterpret allusions in other texts [7]. Peterson, M. R et al. examined the characterizations discussed by ancient literary theorists in their works, comparing these characterizations with the differences and similarities between the main structural relationships identified by David R. Bauer, and Robert A. Traynor to identify the similarities and differences between the major structural relationships [8]. Baumard, N et al. employed a combination of qualitative and quantitative methods to build a database of ancient literary fiction, using probabilistic generative models to reconstruct the potential evolution of love and to assess the respective roles of cultural diffusion and economic development on the growth of love [9]. Kellner, A explored the possible dialog between ancient Greek and Mesopotamian chronicles, proposing the idea that fragmentary preservation of Greek texts and cuneiform tablets may have influenced the development of the Greek script, and that reviewing textual evidence from ancient Greek and Mesopotamian chronicles can lead to a better understanding of the similarities and differences, and for this purpose the history of Greek and Akkadian temples can be used as a test case [10]. Chiu, B et al. propose a graph-based representation to reconstruct two sets of features and use GAE to aggregate this paper. , by clustering the learned representation and using vector dimensions to classify the document. The results show that the features learned by this method such as word frequency inverse document frequency and average embedding outperform other existing features in terms of document clustering performance [11]. Yu, P et al. proposed a model based on potential space energy with good interpretability in text modeling and attempted to solve some of the problems of data space EBMs. By introducing a novel relationship between diffusion models and potential space EBMs, and a regularization method based on geometric

https://doi.org/10.17993/3cemp.2024.130153.214-230

clustering, this model performs well in interpretable text modeling [12]. Ghosal, A et al. briefly describe the types of clustering methods available, and then survey the areas in which clustering analysis has been effectively applied in pattern recognition and knowledge discovery [13]. Su, H et al. introduce a new method called INSTRUCTOR to compute the text embedding of a given task instruction. Unlike previous methods, INSTRUCTOR is a single embedder that generates text embeddings applicable to different downstream tasks and domains without additional training [14].

Since existing studies have not targeted the connection between diet and geography, this paper uses text clustering models, especially the K-Means clustering algorithm. First, the selection criteria of literary works are established to ensure the representativeness and diversity of the samples, including the era span, author background, and genre categories. Then, after selecting the works, keywords and expressions related to food culture and regional characteristics are extracted from the text, such as food names, cooking styles, and food sources. The basic process of clustering starts with randomly selecting K centroids, classifying the text features according to their similarity to these centroids, and optimizing the centroid positions in each round of iteration until the optimum is reached or the stopping condition is satisfied. Finally, the clustering results reveal the geographical distribution patterns of food elements in ancient literature, and observe the differences and connections of food culture among different regions.

2. CRITERIA AND SOURCES FOR THE SELECTION OF LITERARY WORKS

It is crucial to select appropriate literary works that not only need to cover a wide range of different historical periods and geographic regions, but also be able to reflect the diversity and richness of food culture [15]. The criteria for the selection of literary works and the sources of the works are as follows:

1. The selected literary works should cover different historical periods in ancient China, such as the pre-Qin, Han, Tang, Song, Ming, and Qing dynasties, in order to analyze the changes in food culture in different eras.

2. Considering the vast area of China, different regions have their own unique food cultures, so it is necessary to select literary works that reflect different regional characteristics.

3. The diversity of genres includes works in different genres such as poetry, prose, novels, opera, etc., in order to comprehensively capture the many manifestations of food culture.

4. Preference will be given to literary works that involve more descriptions of food and drink, especially those that depict food, eating habits, and eating scenes in detail.

https://doi.org/10.17993/3cemp.2024.130153.214-230

5. Select classic works that have an important position and wide influence in the history of Chinese literature.

6. Many ancient literary works have been organized and published, and these publications are one of the main sources for acquiring texts. For example, the Chinese Philosophical Books Electronic Program and the Ancient Books Library of the National Library of China, these databases provide a large number of digitized ancient literary texts. Referring to scholars' research in the field of ancient literature and food culture, the frequently cited literary works in them are selected.

A key step in the text clustering process is to calculate the similarity between texts [16]. The commonly used method is cosine similarity, which is calculated as follows:

$$(A, B) = \frac{A \cdot B}{\| A \| B \|} \quad (1)$$

where A, B is the two text vectors, A, B is the dot product of the vectors, and $\| A \|$ and $\| B \|$ are the modes of the vectors.

3. TEXT CLUSTERING MODEL

3.1. K-MEANS CLUSTERING ALGORITHM

3.1.1. FUNDAMENTALS

k-means is an iterative relocation method that minimizes the sum of squared errors as an objective function, and each iteration consists of two steps [17]. In textual data, each literary work can be considered as a data point, and the words and expressions about food and drink contained therein constitute a multidimensional feature space. Using the K-means algorithm, the works can be assigned to different clusters based on their descriptions of dietary culture, each representing a specific geo-cultural feature. Given the center of the cluster, each data point is assigned to the cluster where the closest clustering center is located according to the nearest neighbor principle. The clustering centers are adjusted so that the data points in the cluster where they are located have the smallest SSE to the cluster center, i.e., so that the similarity between the cluster center and the other data points in the cluster is maximized.

$$sse = \sum_{i=1}^{k} \sum_{x \in c_i} \mathrm{dist}\left(x, o_i\right)^2 \quad (2)$$

Where k is the number of clusters, o_i is the clustering center of the i rd cluster c_i, and $\mathrm{dist}\left(x, o_i\right)$ refers to the dissimilarity between data points o and o_i. Different

https://doi.org/10.17993/3cemp.2024.130153.214-230

dissimilarity calculations often lead to different clustering results, and the Euclidean distance metric is usually used.

3.1.2. BASIC CLUSTERING PROCESS

In order to reduce the effect of different magnitudes on clustering, the data needs to be standardized, using a method of departure normalization so that the data falls on the interval [0,1]. The deviation normalization is as follows:

$$x_p^* = \frac{x_p - \min_p}{\max_p - \min_p} \tag{3}$$

Where $\max_p$ and $\min_p$ are the maximum and minimum values on the p attribute respectively. The basic process is shown in Fig. 1, using the definition to normalize the data in the dataset, the number of iterations $t = 0$, calculate the mutual distance between the data points in the dataset, if $t = k$ then the algorithm terminates. Otherwise redefine, if $\| M \| = 0$, it means that there is not yet a data point in the set of clustering centers, take each data point in the dataset as a clustering center, calculate its corresponding sse, select the data point corresponding to the smallest sse as the first initial clustering center Z_1 and add it to the set M. Record the distance from data point x_j to Z_1. md_j^1, otherwise, according to the definition, select the data point that can minimize the sse as the clustering center Z_t for the tth iteration and added to the set M. Update the shortest distance md_j^1 from all data points x_j in the dataset to the set M. The number of iterations t is incremented by 1 and go to $t = k$.

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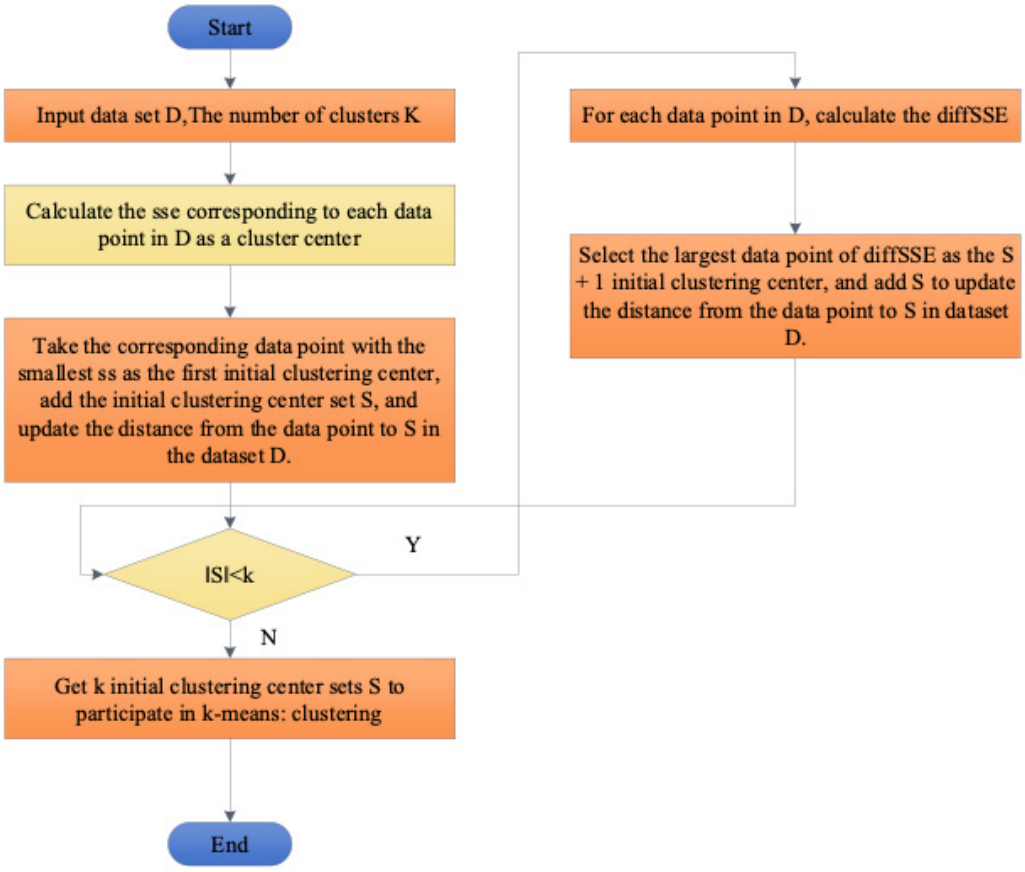

Figure 1. Basic clustering process

4. EXTRACTION OF CHARACTERISTICS OF FOOD CULTURE AND REGIONAL FEATURES

4.1. TEXT FEATURE EXTRACTION

Feature selection has a basic assumption that each feature is independent of each other, but this assumption does not hold true for text data, because the phenomenon of proxemics and polysemy, which is common in text data, makes the text of each feature between the existence of extremely complex semantic links [18-19]. The problem of near-synonyms and polysemous words cannot be solved by feature selection and can only rely on feature extraction.

4.1.1. DOCUMENT FREQUENCY

The document frequency of a lexeme is the number of documents in which the lexeme occurs in the training corpus.4 DF is used as the feature extraction, and it is basically assumed that the lexeme with DF value below a certain threshold is a low-frequency lexeme, which does not contain, or contains less information about the category [20]. Removing such words from the original feature space not only reduces

https://doi.org/10.17993/3cemp.2024.130153.214-230

the dimensionality of the feature space, but also has the potential to improve the classification accuracy.

Document frequency is the simplest feature extraction technique and can be easily used for large-scale corpus statistics due to its linear computational complexity relative to the size of the training corpus. However, in information extraction studies it is commonly recognized that words with low DF values have more information relative to words with high DF values and should not be removed completely.

4.1.2. CHI STATISTICS

The CHI statistic measures the degree of correlation between lexical entry t and document category C and assumes that the x-distribution with first order degrees of freedom is met between t and C. The higher the value of the X2 statistic of a lexical item for a category, the higher the correlation with that category and the more category information it carries. Let N denote the total number of documents in the training corpus, C is a particular category, t denotes a particular lexical item, A denotes the frequency of documents belonging to category C and containing t, B denotes the frequency of documents not belonging to category C but containing t, C denotes the frequency of documents belonging to category C but not containing t, and D is the frequency of documents belonging to neither C nor t. The CHI value of t for C is calculated by the following formula:

$$\chi^2(t,c) = \frac{N \times (AD - CB)^2}{(A+C)(B+D)(A+B) + (C+D)} \tag{4}$$

For multi-category problems, the CHI value of t for each category is calculated separately. The CHI value of lexeme 1 for the whole corpus is then calculated using the following formula and tested separately:

$$\chi^2_{\max}(t) = \max_{t=1}^{m} \chi^2\left(t, c_i\right) \tag{5}$$

where m is the number of categories. The lexical entries below a specific threshold are removed from the original feature space, and the lexical entries above that threshold are retained as the features of the document representation [21]. By this method, the most relevant words and phrases related to food culture and regional features in ancient literature can be identified. Removing words and phrases below a specific threshold from the original feature space while retaining words and phrases above that threshold as features for document representation optimizes the performance of the clustering model and ensures that the model focuses on the most informative features, thus revealing more accurately the deep connection between food culture and regional features in literature.

https://doi.org/10.17993/3cemp.2024.130153.214-230

4.2. MUTUAL INFORMATION

Mutual Information MI is widely used in statistical language modeling. If we use A to denote the frequency of documents containing lexeme 1 and belonging to category C , B is the frequency of documents containing but not belonging to C , C denotes the frequency of documents belonging to C but not containing t, and N denotes the total number of documents in the corpus, the mutual information of t and C . The mutual information of 5 and 6 can be calculated by the following formula:

$$MI_{\max}(t) = \max_{i=1}^{m} I(t, c_i) \tag{6}$$

Where m is the number of categories. The words below a specific threshold are removed from the original feature space, the dimension of the feature space is reduced, and the words above the threshold are retained.

In conclusion, although CHI and MI perform well in the English text classification problem, their performance is far less than that of DF. After careful analysis, it is found that the reasons for this difference come from the fact that the feature extraction methods using category information rely on low-frequency words and the fact that Chinese has a higher dimension of the feature space compared with English.

4.3. REPEATED STRING FEATURE EXTRACTION

Most clustering algorithms regard a document as a collection of words only, completely ignoring the order and co-occurrence relationship between words, which may provide important information for document clustering. Therefore, we extract the key repetitive strings from the whole document collection as text features. In order to quickly extract most of the repetitive strings, the introduction of maximized repetitive strings is necessary and sufficient. It can capture all the meaningful repetitive structures of the strings in a very concise way, and also avoids generating a lot of unnecessary output. Non-maximized repeated strings do not need to be reported, because the text must be contained in some maximized repeated strings. However, not all maximized repetitive strings are useful, many of them are only part of phrases, which are semantically incomplete and meaningless, so further filtering is needed to filter out the meaningful and interesting parts of them.

The algorithm first scans each document in the corpus and removes deactivated words and non-word symbols such as numeric punctuation. A document is treated as a string, and all documents are concatenated into a pseudo-document. Each word is converted to a 2-byte integer so that each English word or Chinese character can be treated as a unit. At the same time, each subscript in the record string corresponds to the document number to which the character belongs, and the documents are separated by a specific boundary symbol, which does not appear in any of the original documents. Obviously, across the document boundary of the substring, is meaningless, we limit the algorithm to find the duplicate string in a document. More

https://doi.org/10.17993/3cemp.2024.130153.214-230

strictly, since sentence boundaries often imply a change of topic, repeated strings can also be limited to a sentence. This also reduces the cost of the duplicate string discovery algorithm. The output of the preprocessing is a string containing all the documents in the corpus and the corresponding document number records.

Through all substrings, which are clustered into a relatively small number of classes, the statistical information of all substrings can be obtained by calculating the frequency of at least 2N-1 substrings. The data structure used is the array of suffixes and the corresponding array of maximal common prefixes created from the input text strings. This part of the algorithm outputs all the maximized repeated strings and their frequency statistics. A complete repeated string should be both left-maximized and right-maximized. After obtaining the complete repeated strings and their frequencies in document T, it is easy to calculate the stability and independence of each repeated string. The quality of each clustering algorithm is significantly improved when using repetitive strings as features.

4.4. EXTRACTION PROCESS

In exploring the food culture and regional characteristics in ancient literature, the extraction process using the text clustering model is shown in Figure 2. Firstly, ancient literary texts need to be collected, including various literary works, historical records and cultural documents. Then, these texts are preprocessed, including text cleaning, word splitting, removal of deactivated words, and other operations to prepare the data. Next, the features of the texts are extracted, which can be achieved through TF-IDF, Word Embeddings, or topic modeling. Subsequently, an appropriate text clustering model, such as K-Means or hierarchical clustering, is selected to cluster the text features. Once the model training is completed, the text content in each clustered cluster will be analyzed to identify the food culture and geographical features in it. Finally, the results are presented through visualization tools with in-depth analysis and conclusions [22]. This process can help to gain a deeper understanding of cultural characteristics and regional differences in ancient literature.

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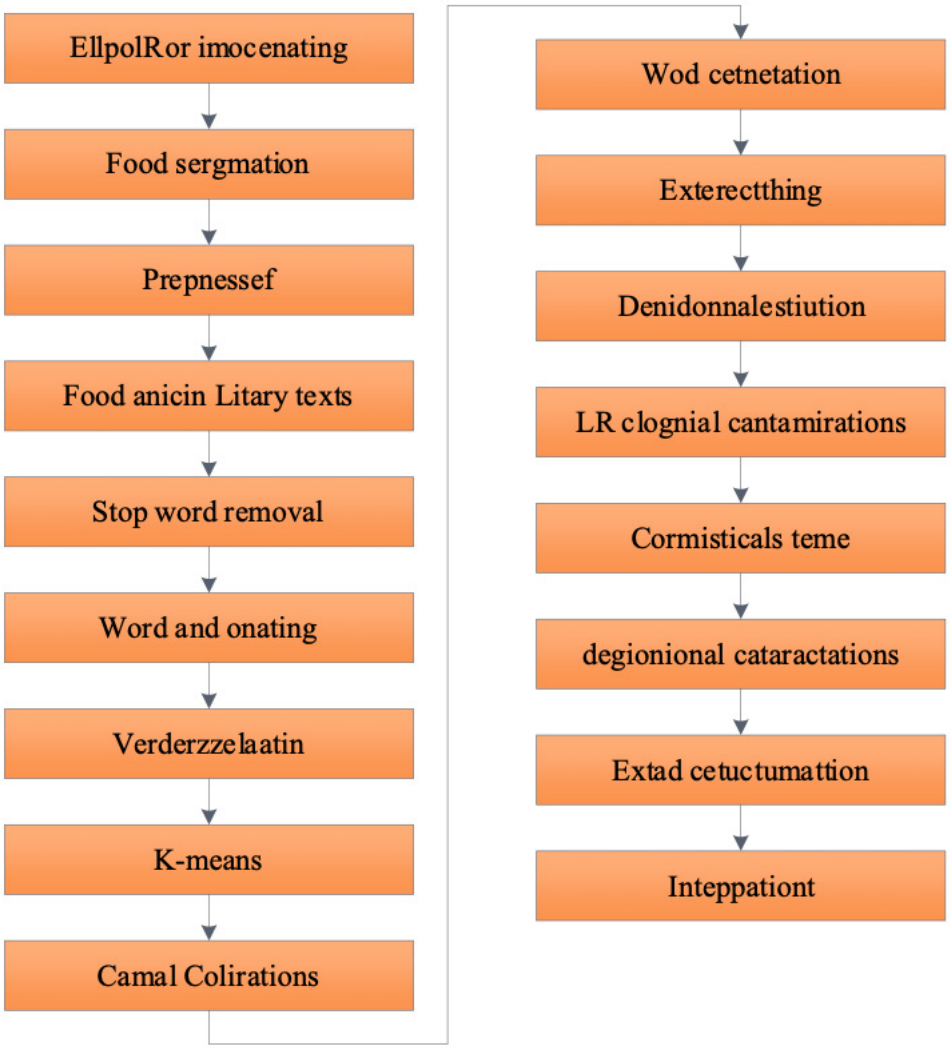

Figure 2. Feature extraction process

5. THE CONNECTION BETWEEN FOOD CULTURE AND REGIONAL CHARACTERISTICS IN ANCIENT LITERATURE

As an important cultural element, food culture is not only a subject matter in ancient literature, but also a carrier that conveys the cultural characteristics of a specific region through literary works.

First of all, food culture in ancient literature reflects the resources and climatic conditions of the region. The ingredients and cooking styles of different regions are often influenced by the local natural environment, which is vividly expressed in literary works. For example, literature located in seaside regions may emphasize the importance of seafood and seafood products, while mountainous regions may highlight mountain delicacies and wild foods. This way of reflecting regional characteristics not only enriches the depiction of literary works, but also enables readers to better understand the geographical distribution of the society at that time. Secondly, the relationship between food culture and regional characteristics is also

https://doi.org/10.17993/3cemp.2024.130153.214-230

reflected in the cultural exchange and integration in literary works. Ancient literature often describes cultural exchange and borrowing between different regions, of which food culture is an important aspect. For example, the trade on the Silk Road made the food culture of the East and the West influence each other, which was often reflected in literary works. The exchange and fusion of regional characteristics make the literary works more diversified and also convey the importance of cultural exchange. Finally, the relationship between food culture and regional characteristics in literature also reflects social and cultural changes. With the evolution of history, the food culture of different regions has changed, which can be traced back to the depiction of different historical periods in literary works. Through literature, one can understand the evolution of food supply, eating habits and cooking skills in ancient societies, thus gaining a deeper understanding of the historical process and cultural development.

To sum up, the relationship between food culture and regional characteristics in ancient literature is multi-layered and multi-dimensional, intertwined, and together they constitute a rich and colorful literary work.

6. ANALYSIS OF CLUSTERING RESULTS

6.1. THEME IDENTIFICATION

A series of ancient literary works were collected, which cover the cultural backgrounds of different regions and periods. These textual data were entered into a textual clustering model to group them into clusters with similar themes. A suitable number of clusters was chosen in order to categorize food culture and regional characteristics into two main themes. The clustering results of different texts were analyzed and calculated by the model to determine the themes of each cluster. The clustering results of the first-level and second-level texts are shown in Table 1, in which the frequency and relevance of keywords and the semantic information of the text content were paid attention to ensure the accuracy and consistency of the theme identification.

Table 1. Results of first - and second-level text clustering

Class variety	Number of samples included	Conceptual structure of text	Theme
C1	54	Ingredients + dishes + techniques	Menu
C2	53	Dishes + Restaurants + Ingredients	Food guide
C3	50	Celebrity + Dish + ingredients	Cultural story
C4	28	Ingredients + a few other concepts	Ingredients introduction
C11	26	Other cuisines + various ingredients	Recipes Other than Sichuan Cuisine Recipes of Sichuan cuisine
C12	25	Sichuan cuisine + various ingredients	Recommend the famous dishes around the food guide

https://doi.org/10.17993/3cemp.2024.130153.214-230

C21	24	Cuisine + various ingredients	Recommend the famous restaurants around the food guide
C22	28	Restaurants + various cuisines	Recipes Other than Sichuan Cuisine Recipes of Sichuan cuisine
C31	30	Celebrities + various cuisines	Cultural stories related to food in different places
C32	23	Non-vegetable ingredients	Introduction to non-vegetable ingredients
C41	24	Vegetable based ingredients	Vegetable ingredients introduction

The comparison of entropy value of the first layer clustering results is shown in Table 2, in the text clustering model, the entropy value is 92.85, indicating that the clustering effect of this model is relatively good. In the feature word clustering, the entropy value is 221.25, which is relatively high, indicating that the clustering effect of this model is poor. The text clustering model proposed in this paper is more effective, similar to the original knowledge base grouping, and can effectively improve the clustering accuracy of text.

Table 2. Clustering results of the first layer

Evaluation index	Entropy value	The number of samples contained in a class cluster			
		C1	C2	C3	C4
Evaluation index	92.85	54	53	50	28
Feature word clustering	221.25	125	88	6	4

The results of the second layer clustering are shown in Table 3, in the text clustering model, the evaluation index is 72.6, which is lower than the 144.8 of the feature word clustering, the evaluation index of the text clustering model is lower, indicating that its clustering effect is relatively good, and it is more suitable to be used in the text clustering task. The higher evaluation index of feature word clustering indicates that its clustering effect is relatively poor and may be less suitable for text clustering tasks. Therefore, the text clustering model may be more suitable for clustering tasks in ancient literature.

Table 3. Results of second-layer clustering

Evaluation index	Entropy value	The number of samples contained in a class cluster						
Evaluation index	72.6	C11	C12	C21	C22	C31	C32	C41
		26	25	24	28	30	23	24
Feature word clustering	144.8	C1	C2	C3	C4	C5	C6	C7
		100	47	26	15	12	8	2

https://doi.org/10.17993/3cemp.2024.130153.214-230

6.2. MODEL PERFORMANCE ANALYSIS

In this paper, K-mean clustering is chosen as the method of text clustering. The text data of literary works are input into the model and the optimal number of clusters is found by adjusting different numbers of clusters. After performing K-mean clustering, we obtain a set of clusters of literary works. Each cluster contains literary works with similar textual features. The food traditions of different regions are evident in the literary works, and the text clustering model shows a good performance in analyzing these relationships.

The clustering results are shown in Fig. 3, and it can be seen that the points within each cluster are similar to each other, and the eigenvalues vary in the range of 2-4, while there is a certain distance from the points in other clusters, which indicates that the clustering effect is good.

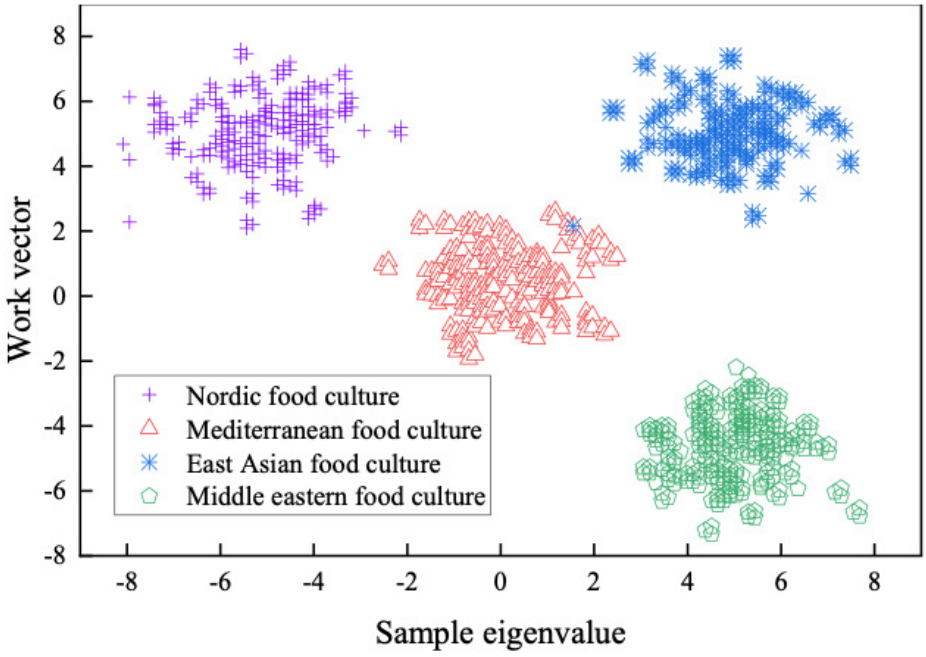

Figure 3. Clustering results

7. DISCUSSION

In future research, the scope of the study can be further expanded to cover more ancient literary works and historical documents in order to gain a more comprehensive understanding of food culture in different regions and periods. Reveal more regional characteristics and cultural differences to provide more in-depth insights for cultural and historical research. Or explore more advanced text clustering models and natural language processing techniques to improve clustering accuracy and efficiency of text feature extraction. The application of methods such as deep learning and neural networks can help to better mine the hidden information in the text for finer analysis and theme identification. Furthermore, the application of the research results to the fields of cultural heritage protection and cultural tourism can promote the inheritance

https://doi.org/10.17993/3cemp.2024.130153.214-230

and promotion of ancient literature, as well as enrich cultural exchange and understanding.

8. CONCLUSION

In this paper, when using the text clustering model to study the connection between food culture and regional characteristics in ancient literature, it is verified that the text clustering model shows high effectiveness. Compared with feature word clustering, the text clustering model showed a significantly lower evaluation index in the second level of clustering, 72.6 vs. 144.8, indicating that it can more accurately identify and group similar food culture descriptions. In addition, the lower entropy value exhibited by the model in the first level of clustering, 92.85 vs. 221.25, confirms its high consistency and accuracy in clustering ancient literature. The visualization of the clustering results further reveals the high degree of intra-cluster similarity and clear inter-cluster boundaries. Overall, the text clustering model is not only suitable for this type of research task, but also provides highly accurate clustering results that strongly support a deeper understanding of the connection between dietary elements and regional characteristics in literary works.

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/12/

EXPLORATION OF DIGITAL TRANSFORMATION MECHANISM AND DEVELOPMENT LEVEL OF ENTERPRISE ECONOMIC MANAGEMENT

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ABSTRACT

This paper is based on the digital economy, the traditional enterprise economic management of digital transformation. Utilizing supply chain technology to establish cooperation channels to provide customers with quality services to complete the transformation of management mode. Integrate information technology in the production process to improve the quality of the enterprise's products, improve the enterprise's sales model to achieve the purpose of performance transformation. The impact of digital technology on the economic transformation of enterprises is examined by constructing a quality model, and the stability of the economic quality development of enterprises is examined by regression analysis. The results show that the growth rate of operating income of digital enterprises is more than 50%, the market share of digital products has reached 33.8%, and the digital economic variables are significantly greater than 0, indicating that the digital transformation of the enterprise's economic management can improve the sustainable competitiveness of the enterprise and promote the development of the enterprise's economic quality.

KEYWORDS

Digital transformation; economic management; supply chain technology; information technology; regression analysis

https://doi.org/10.17993/3cemp.2024.130153.232-250

INDEX

https://doi.org/10.17993/3cemp.2024.130153.232-250

1. INTRODUCTION

With the rapid growth of the digital economy and the deep integration with the real economy, the digital transformation of enterprise management has increasingly become a focal issue in the academic world. Enterprise management digitalization, as a key process of enterprise digital transformation, generally refers to the systematic reshaping of enterprise structure, management mode, operation mechanism and production process through the introduction of through technology in the existing enterprise management structure [1-2]. Management of digital investment can enhance the sustainable competitiveness of enterprises, help to reduce enterprise costs, improve enterprise output and performance. However, the overall strength of the economy in some regions is still not strong, especially the low level of enterprise digitization, weak high-tech industries, and the development of industrial clusters is not obvious [3]. There are also problems within each enterprise such as financing difficulties, informal enterprise management, and insufficient advantages in talent introduction. This is due to the small scale and slow development of enterprises, largely caused by the enterprise itself, especially the backwardness of the enterprise management concept. A large number of small and medium-sized enterprises still use family-style enterprise management mode, and the core management team often has rich production experience, but lacks advanced enterprise management experience, or does not have the ability to manage large enterprises [4-5]. Therefore, it is important to utilize network and information platforms centered on communication technology and intelligent control technology to manage logistics and production processes, which in turn improves the efficiency of factories and enhances their competitive advantages. Eliminate various barriers and make full use of new digital technologies to upgrade traditional production and operation, so as to realize the sustainable development of enterprises [6].

This paper focuses on the digital features to build the configuration and study the digital transformation path of the enterprise network. First of all, through the supply chain technology to establish a rapid channel of cooperation and communication with suppliers and distributors, at the same time, the digital technology developed by information technology enterprises into the production process, product content, and improve the enterprise's sales model to achieve high-quality development. Then the impact of the digital economy on the transformation of enterprises is reflected by constructing an economic quality model, and finally the economic development level of digital enterprises is verified through the analysis of the impact of the digital economy on the transformation of enterprises, the analysis of the economic benefits of digital enterprises, and the robustness test. It is proved that the digital transformation and upgrading of the enterprise improves the overall production level of the enterprise, reduces the unit cost and brings more profits.

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2. LITERATURE REVIEW

Chen, Q analyzed blockchain technology and smart contracts with future supply chain management applications based on the development of the marine economy through an explanatory framework model. The model examines the structure and process of marine supply chain risk mechanisms, provides a scientific framework for marine supply chain risk control, and makes corresponding recommendations for reducing and monitoring marine supply chain risks [7]. Vasin, S et al. considered decision-making models and methods for enterprise competitiveness management from the perspective of benchmarking, and a competitive interaction model in the form of coupled Vanderbilt equation system with time lag introduced was successfully tested in radio physics. The methodology uses the enterprise's own competitive advantages to achieve the highest score of actual competitiveness of an industry in order to improve the quality of produced products, reduce production costs and increase labor efficiency [8]. The subject of the research Shevchenko, A is the prospects of development of the forest sector and rural areas in the digital economy, with the goal of developing theoretical prescriptions and practical recommendations for the improvement of interactions. Methodological approaches of general scientific and specific nature were used, targeted actions were taken to provide a new system of scientific support for the development of the forest sector and rural areas, which contributes to the improvement of the quality of life in rural areas [9]. Subaeva, A. et al. in order to form a modern system of training of personnel in agriculture in the digital economy, designed a cluster of advanced training and training of personnel in conditions of digital transformation of agriculture model of a network platform that adapts the educational potential of the curriculum to specific requirements and the formation of digital competencies; an effective system of end-to-end and continuous acquisition of new competencies in the digital economy by bringing together representatives of science, government and business in a single digital space [10].

Klymchuk, M presents a model of development of recursive convergence approach to the formation of business development strategies based on the digital economy. The model of formation of the enterprise development strategy taking into account the digital economy is proposed, and the problems of management of investments in the digital transformation of the enterprise are studied. It allows to distinguish the directions of development of digital technologies, to incorporate them into the advantages of productive business activity of the enterprise and to provide the basis of theoretical tools for the study of the problems of investment in digital processes [11]. Batova, M. Development of methodological and practical tools for effective digital transformation of high-tech enterprises develops the concept of transformation of the enterprise by means of innovative modernization, affecting the product, technological operations, as well as organizational and production structural changes. Development of an organizational design methodology for flexible robotic structures and a model for determining the flexibility and productivity parameters of robotic structures [12]. Rossini, M evaluates the transformation models of companies in the digital economy by studying several manufacturing companies and analyzing the insights from the cases to determine the direction of transformation based on the leanness and maturity

https://doi.org/10.17993/3cemp.2024.130153.232-250

of the companies. The results of the study show that the introduction of Industry 4.0 technology is an effective way to improve the leanness of companies, and that this technology allows the integration of traditional manufacturing companies with digital technology, thus promoting the development of the company [13]. Charalampidis, I. et al. develop a macro-economic regional model, where the new manufacturing technologies and infrastructures are evaluated to achieve a dynamic and fully endogenous agglomeration-dispersion mechanism. The model considers national economic trends as boundary conditions and simulates the impact on the regional economy, inducing macroeconomic changes in the national and regional economy in terms of activity and employment [14].

3. THE ROLE OF DIGITAL TECHNOLOGY IN THE ECONOMIC MANAGEMENT OF ENTERPRISES

3.1. ENTERPRISE DIGITAL TRANSFORMATION PATH

Enterprises form enterprise networks due to the connection between them, and the way of node connection not only affects all kinds of behaviors between nodes, but also determines the digital transformation path of enterprise networks [15]. The era of the digital economy requires nodes to carry out digital cooperation at the enterprise network level, and the cooperative linkage makes digital resources further integrated into the enterprise network, which then forms the basis of network digital transformation, that is to say, the enterprise network empowers nodes to digitize through relational linkage, and the network linkage drives the digital transformation of the enterprise network from the micro level [16-17]. Figure 1 shows the path diagram of enterprise digital transformation, considering the internal and external factors of the process of enterprise network digital transformation, selecting a reasonable and representative nucleated enterprise network as a sample, grouping and constructing around the digital features, researching the enterprise network digital transformation path, and further exploring the basic logic and evolution characteristics of the enterprise network digital transformation in the context of the digital economy.

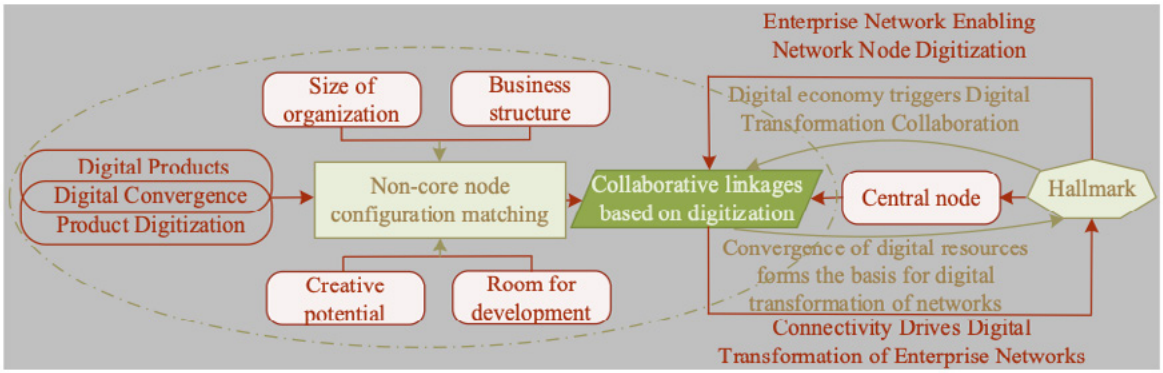

Figure 1. Roadmap for enterprise digital transformation

https://doi.org/10.17993/3cemp.2024.130153.232-250

3.2. DIGITAL PRODUCTION MANAGEMENT

In order to seize the opportunity of the development of the digital economy, enterprises make every effort to promote the digital transformation of the management mode of design and research and development, production services and other links. Under the background of digital economy, enterprise management tends to be more grid mode, and the management transformation of traditional manufacturing enterprises can be carried out through the application of digital technology in enterprise production and manufacturing, sales and logistics, product innovation and other links [18-19]. In this way, enterprises can improve customer experience, innovate value propositions, and enhance organizational effectiveness. Figure 2 shows the enterprise production digital management process, combined with the background characteristics of the digital economy era, in which the supply chain management, the establishment of rapid cooperation and communication channels with suppliers and distributors, supply chain oriented to the market point of view of the entire business activities of the planning, design and implementation of the overall structure. Production and R&D, the key is to optimize the production process, reduce production costs and improve production efficiency. Customer relationship management, the rapid development of data and its related technology in the era of digital economy, the use of data and information to improve customer relationship management has become the key. Data information plays an important role in providing customers with quality services and establishing good relationships, etc. The effective use of data information to improve customer relations has become the key to the digital transformation of enterprise management.

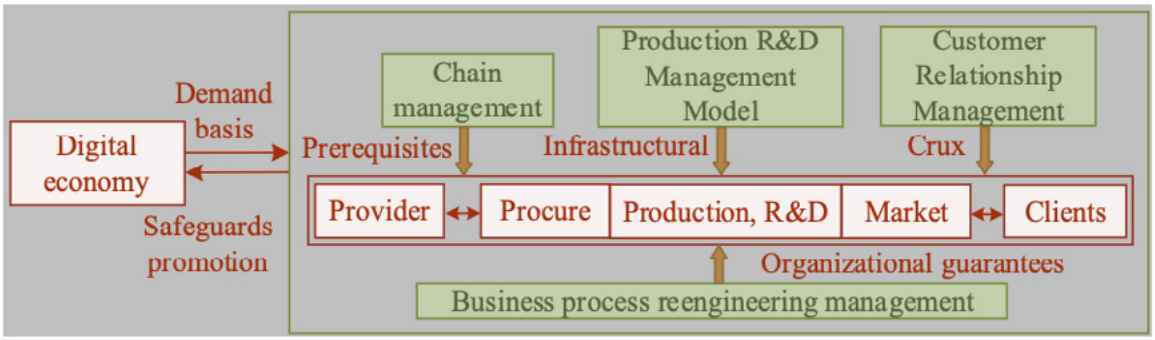

Figure 2. Enterprise production digital management process

3.3. PRODUCTION PERFORMANCE TRANSFORMATION

In the era of digital economy, with the continuous change of production technology and sales technology, enterprises are forced to adapt to the new market demand, maintain and improve the competitiveness of enterprises. Small and medium-sized manufacturing enterprises do not have talent and capital support, and lack advantages in active development and innovation, but digital technology provides a channel for indirect innovation of enterprises [20]. The integration of digital economy

https://doi.org/10.17993/3cemp.2024.130153.232-250

technologies with traditional enterprises mainly enhances the transformational performance of enterprises through three channels, namely, promoting indirect innovation, reducing the cost of sales, and improving production efficiency [21]. Figure 3 shows the schematic diagram of the digital economy to promote the transformation of enterprise performance, the enterprise can integrate the digital technology developed by information technology enterprises into their production process and product content to improve the quality of enterprise products, improve the sales model of the enterprise, and realize the transformation and upgrading and high-quality development of the enterprise. The use of big data, cloud computing and other technologies to effectively combine data flow, capital flow and talent flow can enable enterprises to more accurately grasp market dynamics and customer demand, meet more complex personalized needs, constantly change their product characteristics and sales positioning, and promote the enterprise can be more active, proactive, scientifically involved in product innovation, sales innovation and organizational innovation, to form a diversified, market-oriented and networked Precision innovation system. The use of digital economy technology by enterprises can make production more intelligent, management more data-oriented and sales more humanized, realize the fundamental transformation of enterprises in production, organization and sales mode, promote the transformation and upgrading of enterprises, and also improve the operating efficiency of enterprises.

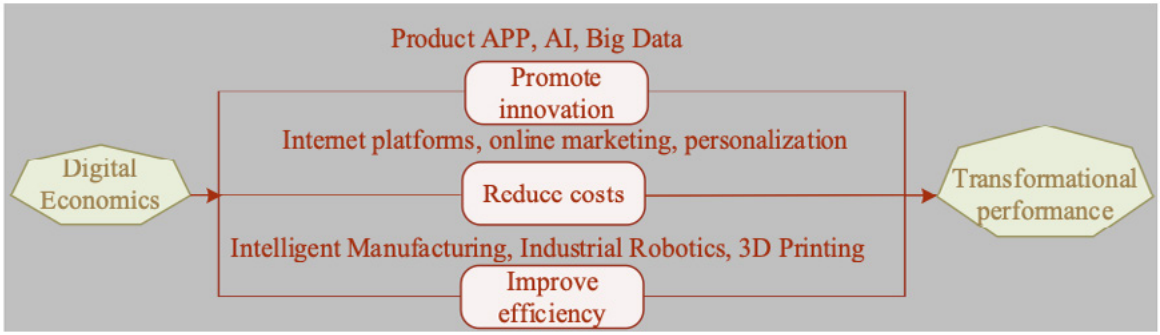

Figure 3. Schematic diagram of enterprise performance transformation

4. CONSTRUCTING A QUALITY MODEL FOR THE TRANSFORMATION OF THE ENTERPRISE'S ECONOMIC MANAGEMENT

4.1. QUALITY MODELING

In order to test the impact of the application of digital technology on the economic transformation of enterprises and the path of transformation, the following model is established for observation under the condition of limited data indicators:

$$\text{per}_{it} = C + \alpha_1 \times DE_{it} + \sum \gamma_j \times \text{control}_{j,it} \quad (1)$$

https://doi.org/10.17993/3cemp.2024.130153.232-250

$$Z_{it} = C + \beta_1 \times DE_{it} + \sum_j \gamma_j \times \text{control}_{j,it} \quad (2)$$

$$\text{per}_{it} = C + \beta_2 \times Z_{it} + \sum_j \gamma_j \times \text{control}_{j,it} + \varepsilon_{it} \quad (3)$$

In the above equation, per_{it} is the transformation performance of the ind enterprise t years, DE_{it} is the digital economy application status of the ith enterprise t years, $\text{control}_{j,i}$ is the control variable, C is the constant term. Z_{it} is the ith enterprise t years of potential transformation path variables, equations (2), (3) are used to observe in the equation (1) holds on the basis of Z variables whether the SME digital economy application for enterprise transformation and upgrading of the intermediate path.

Table 1 shows the content definition of each indicator; enterprise economic transformation is measured by return on total assets and operating profit margin, and the control variables include enterprise size and debt ratio. The intermediate path variables include gross profit margin, which measures the improvement of the enterprise's product competitiveness, sales expense ratio, which measures the cost reduction, and labor productivity, which measures the production efficiency. The digital economy is expressed using the number of types of digital economy technologies applied by the firm in the current year.

Table 1. Definitions of each indicator

Variable type	Variable	Variable symbol	Metrics
Explanatory variables	Business performance	roa	Return on total assets
		pro	Operating margin
Explanatory variables	Digital economy	DE	The number of types of digital economy applied
Mediation variables	Product quality improvement	mrate	Gross profit margin of the enterprise
	The cost of sales decreased	cost	Selling expense ratio
	Productivity	productivity	Labour productivity
Control variables	The size of the enterprise	size	The natural logarithm of total assets
	Financial leverage	lev	Debt-to-asset ratio

4.2. REGRESSION MODELS

Considering the impact of the timeliness and lag of the digital transformation policy on the productivity of enterprises, this paper conducts the test of the impact of time policy on digital transformation. In order to ensure the robustness of the test results, construct a dummy variable of whether the enterprise carries out digital

https://doi.org/10.17993/3cemp.2024.130153.232-250

transformation, assign a value of 1 if the enterprise carries out digital transformation, otherwise assign a value of 0 to measure the enterprise's digital transformation, and construct the following regression model:

$$\text{Logit}(\text{restate}_{i,t}) = \alpha_0 + \beta_1 \text{dcg}_{i,t} + \beta_2 \text{roa} + \beta_3 \text{pro} + \beta_4 DE + \beta_5 \text{mrate} + \beta_6 \text{cost} + \beta_7 \text{productivity} + \beta_8 \text{size} + \beta_9 lev + \sum \text{ind} + \sum year + \varepsilon_{it} \quad (4)$$

where $\text{restate}_{i,t}$ denotes the economic restatement, $dcg_{i,t}$ denotes the degree of digital transformation of firms, and i denotes different firms. t denotes different years, $\varepsilon_{it}$is the random error term, α_0 is the constant term, and β_1 is the regression coefficient of the variable to be estimated.

5. EXAMINATION OF THE LEVEL OF DEVELOPMENT OF THE ENTERPRISE'S DIGITAL TRANSFORMATION ECONOMY

5.1. ANALYSIS OF THE IMPACT OF THE DIGITAL ECONOMY ON BUSINESS TRANSFORMATION

In order to better mention the mechanism of the impact of digital technology on the transformation of the economic management of enterprises, this paper reflects the level of economic development of the company by constructing a quality model. Therefore, this paper shows the simple statistical results of each variable by analyzing the financial information of enterprises in a region after digital transformation. Table 2 shows the statistical results of each variable, and the average return on total assets of the sample companies is 2.7%, and the average net operating profit margin is 5.5%. Of the digital economy applications, the average number of overall digital economy applications was 1.478. Of the three potential transformation paths, the average gross profit margin was 35.8%, the average sales expense ratio was 10.1%, and the natural logarithm of the average labor productivity was 13.266. Of the four control variables, the natural logarithm of the total assets of the firms averaged 18.403, and the gearing ratio averaged 26.2%. Enterprise economic management digital transformation type in the specific guidance of digital technology, make full use of the through the network, blockchain and artificial intelligence and other technologies, through the digital technology and management of business intertwined, but to promote the enterprise to create greater value.

https://doi.org/10.17993/3cemp.2024.130153.232-250

Table 2. Statistical results of each variable

Variable	Number of observations	Mean	Standard deviation	Minimum	Maximum
Business performance	427	27	85	-0.45	383
Digital economy	427	1.478	1.277	0	5.000
Product quality improvement	427	358	190	-243	901
The cost of sales decreased	427	101	106	0	722
Productivity	427	13.266	578	10.452	16.741
The size of the enterprise	427	18.403	633	15.545	20.008
Financial leverage	427	262	226	10	1.645

Digital transformation of business management is positively correlated with high quality development of business economy. However, since total factor productivity is affected by many factors, further regression checks need to be done. Fixed effects were chosen by determining the model and period effects were controlled. Table 3 shows the results of the impact regression analysis, in which the first three columns are proxied by the return on total assets for enterprise performance, and the results show that the digital economy variable is significantly greater than 0 at 1% probability, and the positive effect is stronger. It shows that digital economy application can promote the transformation performance of SMEs through cost reduction and quality improvement, so enterprises should make full use of the advantages of the digital economy, increase the investment in R&D, reduce the investment in physical advertisements, make more use of the digital economy technology to promote the commodities, and utilize the cutting-edge production technology to create the products with higher efficiency and more popular in the market, in order to stimulate the creativity of the enterprise and enhance the competitiveness of the enterprise in the market.

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Table 3. Affects the results of regression analysis

Variable	Return on total assets	Operating margin				
	(1)	(2)	(3)	(4)	(5)	(6)
Digital economy	0.078*** (0.010)			0.198*** (0.050)		
The size of the enterprise	0.092*** (0.017)	0.096*** (0.018)	0.086*** (0.017)	0.311*** (0.082)	0.323*** (0.083)	0.298*** (0.083)
Financial leverage	-0.302*** (0.043)	-0.315*** (0.046)	-0.326*** (0.003)	-0.108*** (0.207)	-1.139*** (0.211)	-1.172*** (0.207)
Constant terms	-0.634*** (0.339)	-1.721*** (0.360)	-1.488*** (0.344)	-5.550*** (1.630)	-5.778*** (1.659)	-5.190*** (1.643)
Period	Control	Control	Control	Control	Control	Control

5.2. ANALYSIS OF THE ECONOMIC EFFICIENCY OF DIGITAL ENTERPRISES

5.2.1. PROFITABILITY ANALYSIS

The monitoring and management of the overall operation process of a digital enterprise can improve the information transfer efficiency and synergy between various departments, reduce related costs and improve the operational efficiency of the enterprise. This paper selects an enterprise A for digital transformation in 2013, and analyzes the economic development level of the enterprise after transformation. Figure 4 shows the changes in operating profit after the transformation of the enterprise, compared with the pre-transformation, the gross profit margin of enterprise A has been accelerating significantly since 2013 and has been maintaining a good trend of steady increase. There was a turning point in 2017, when the year-on-year growth rates of both revenue and costs for Enterprise A exceeded 50%, but the increase in operating costs was about 4.8% higher than the increase in revenue. The trend of net profit margin throughout the interval is basically the same as that of gross profit margin, and in 2017, on the basis of a very small gap between the enterprise's sales revenues and costs, there was a certain increase in period expenses, especially selling expenses, which led to a smaller rise in the enterprise's net profit, which increased by 17.33% year-on-year, ultimately causing a year-on-year decrease in Enterprise A's net profit margin in 2017. The operating profit margin also shows the same trend of change as the previous two indicators, and because it does not take into account non-operating income and expenditure as well as corporate income tax, the volatility of this indicator was reduced in 2017. It shows that the digital environment has guided SMEs to realize the necessity and urgency of enterprise

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digital transformation and upgrading, which has improved the overall production level, reduced the unit cost, and brought more profits.

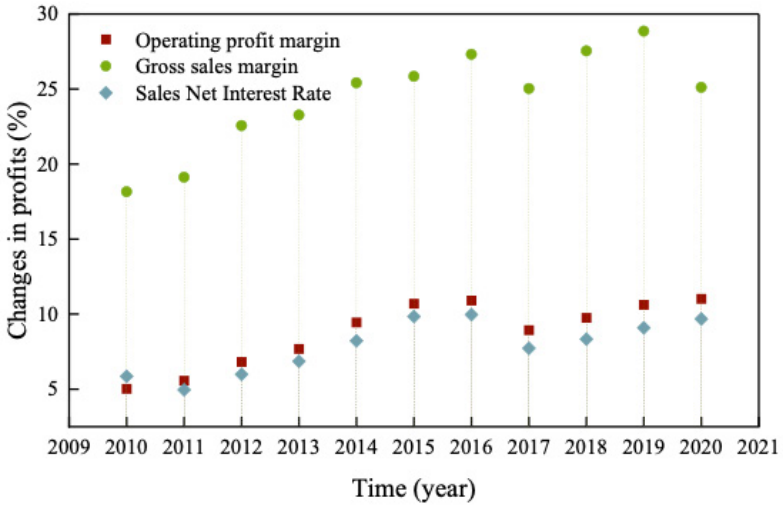

Figure 4. Changes in operating profit after the transformation

After vertically comparing the performance of Enterprise A before and after digital transformation, and based on the four different perspectives of profitability, operations, debt service and growth, the performance of the four aspects of the ability of Enterprise A is compared with the average of Enterprises B and C and the industry, and the two enterprises did not carry out the digital transformation, and attempts to further validate whether the performance of Enterprise A has been effectively improved after digitization through cross-sectional comparative analysis. Effectively improved after digitization. Figure 5 shows the results of the average net interest rate comparison analysis, first of all, through the comparison of the net interest rate can be seen that the net interest rate level of enterprise A is above the industry average in the whole interval, and the net interest rate in each year is higher than that of enterprise C, and the whole shows a good growth trend. However, the net interest rate level of Enterprise A is lower than that of Enterprise B throughout the interval, and the gap gradually increases from 2015 until 2018 when the gap starts to shorten from. Since 2017, the average net interest rate of enterprise B has continued to decrease from 15.18% to 13.25%, while enterprise A has continued to increase from 7.73% to 9.68%, and the continuous increase in the scale of period expenses has directly led to the lower level of net interest rate of enterprise A than enterprise B, which promotes the creation and increase of the gap between the two enterprises' net interest rates. It shows that the digital transformation of enterprises helps to improve the productivity of enterprises, promotes the automation and intelligence of production through digital technology, and enables workers to get rid of low-end repetitive labor, thus improving the input-output ratio of enterprises.

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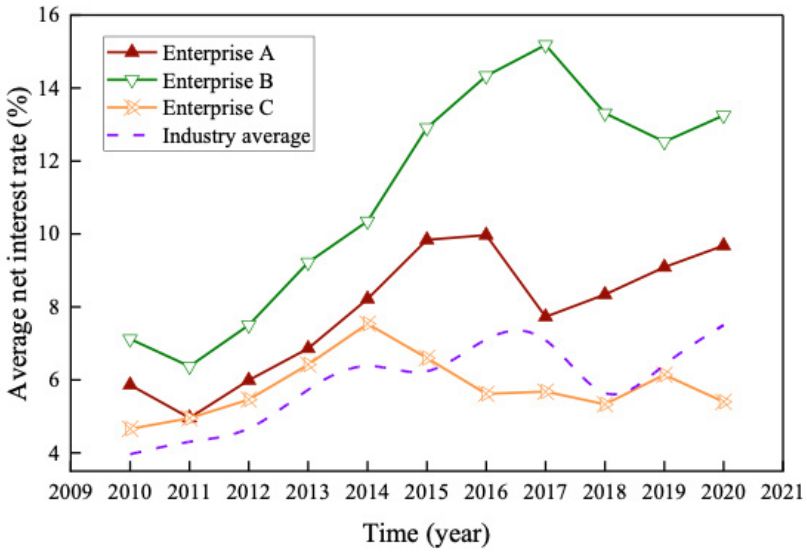

Figure 5. Comparative analysis of average net profit margin

5.2.2. MARKET SHARE OF DIGITAL PRODUCTS

In 2013 after a digital transformation to create a new growth point for A enterprise. Started to devote to the research and development of the intelligent industry, enhance consumer access through product intelligence, provide customers with a variety of scenarios of smart home solutions, to achieve new development of the enterprise. From 2013 to the present, Enterprise A's digital strategy runs situations to realize the intelligence of individual products. Then through the establishment of a platform to realize the interconnection between individual smart products and the remote control of users. And in-depth cooperation with other companies, to break down the barriers between platforms, so that external platforms and products can access the management system, to achieve multi-product, multi-platform interoperability. Table 4 shows the results of the analysis of the market share of digital products, which began to be transformed through intelligentization in 2013, and the market share of enterprise A has thus been significantly expanded. Until 2019, the sales volume of Enterprise A's digital products exceeded 70 million units globally. In addition to this, the market share of the 3 products in the market has gradually increased since 2014, with Product A reaching 33.8%. It can be seen that the implementation of the digital transformation strategy of enterprise economic management has promoted the process of product high-end, all kinds of advanced intelligent technology empowered by the product makes its functions become more diverse and complex, and then equipped with advanced design concepts, high-end materials and precision manufacturing, giving birth to a high-end product that combines a variety of high-quality conditions.

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Table 4. Analysis results of digital product market share

Year	Products1%	Products 2%	Products 3%
2011	22.7	6.5	17.5
2012	19.7	9.3	16.5
2013	21.6	7.3	16.8
2014	24.7	8.2	18.4
2015	25.2	9.6	21.3
2016	23.9	10.5	23
2017	24.6	10.7	24.6
2018	25	11	26
2019	28.9	12.6	27.4
2020	33.8	12.5	26.4

5.2.3. DIGITAL PRODUCTS OPERATING REVENUE PERCENTAGE

After the transformation of the enterprise's products, its gross profit rate of sales will appear a certain decline, because in the huge impact of e-commerce enterprises, enterprises strongly support the expansion of the Internet business, but the market competition is particularly fierce, in order to quickly occupy the market share, the enterprise needs to carry out frequent promotional activities online, coupled with the digital products in the operating categories still occupy a larger share, so the gross profit rate will appear a certain decline in the Phenomenon. Figure 6 shows the proportion of operating income from digital products, which basically remains above 30%, and after the digital model transformation in 2013, the proportion of its products in operating income increased year by year, reaching 39.5% in 2017, realizing the fundamental transformation of the enterprise's production, organization, and sales model, promoting the transformation and upgrading of the enterprise, and also improving the enterprise's operating efficiency.

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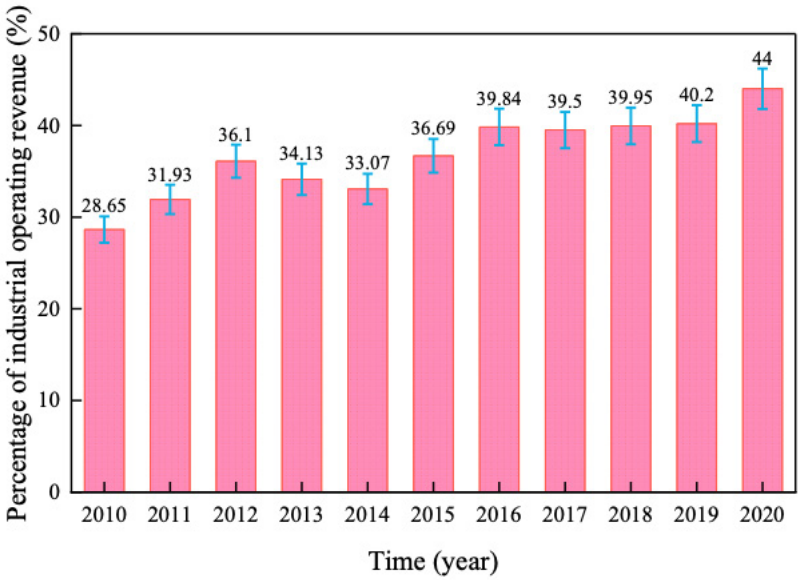

Figure 6. Proportion of operating income of digital products

5.3. ROBUSTNESS TESTS

The development of digital economy may promote the technological innovation level of enterprises by promoting innovation synergy among different subjects. Table 5 shows the results of the innovation synergy effect test, in which column (1) is the benchmark regression and column (2) tests whether the digital economy has a significant impact on the degree of enterprise innovation synergy. The results show that the impact of the digital economy in terms of deep connectivity and reduced collaboration costs significantly enhances the degree of collaboration among innovation agents. (3) Column uses the number of enterprise innovations to regress the digital economy and the degree of innovation synergy, and finds that innovation synergy has a significant positive effect on the number of enterprise innovations, indicating that the deepening of the degree of inter-agency innovation collaboration significantly increases the innovation output of enterprises. Meanwhile, the estimated coefficient of the degree of digital economy development declined after adding the degree of innovation synergy, indicating that innovation synergy is one of the mediating effects of the digital economy to promote the technological innovation level of enterprises. Further, columns (4)-(6) provide a test on the mediating effect of the degree of innovation synergy on the quality of innovation, and the results are consistent with the quantity of innovation. It shows that innovation synergy and technology absorption are important mechanisms for the digital economy to promote technological innovation of enterprises, and that the innovation promotion effect of the digital economy has a certain degree of correlation with the characteristics of enterprises.

Table 5. Test results of innovation synergy

https://doi.org/10.17993/3cemp.2024.130153.232-250

Variable	Number of innovations			Innovative quality		
	(1)	(2)	(3)	(4)	(5)	(6)
Digital economy	0.1476*** (3.34)	0.0023** (4.20)	0.0673 (23.52)	0.0668** (4.00)	0.0023** (4.20)	0.0605 (3.43)
Period	Control	Control	Control	Control	Control	Control
	432	0.3153	0.4345	0.2418	0.3153	0.2419
Observations	427	427	427	427	427	427

6. CONCLUSION

This paper takes the digital transformation mechanism of enterprise economic management as the research objective, uses digital technology to enhance enterprise production, and tests the formula development water by constructing economic quality model, and the conclusions are as follows:

1. In the impact analysis, the digital economy variable is significantly greater than 0 at 1% probability, and the positive effect is stronger. It indicates that the digital economy application can promote the transformation performance of SMEs through cost reduction and quality improvement in order to stimulate the creativity and enhance the market competitiveness of enterprises.

2. In the analysis of economic benefits, the growth rate of operating income of digital enterprises is more than 50%, and the market share of digital products has reached 33.8%, and the proportion of operating income is basically maintained at more than 30%. It shows that the digital transformation of the enterprise helps to improve the productivity of the enterprise, thus improving the input-output ratio of the enterprise.

3. The robustness test shows that the digital economy brings deep connection, collaboration cost reduction and other aspects of the impact of the digital economy significantly enhanced the degree of collaboration between innovative subjects, and has a significant positive impact on the number of enterprise innovation.

7. DISCUSSION

With the rapid development of technology, the digital transformation of the economic management of enterprises will enter a more in-depth and complex stage. In the future, one can look forward to the emergence of more intelligent and personalized digital management tools that will better meet the growing needs of

https://doi.org/10.17993/3cemp.2024.130153.232-250

enterprises. The widespread application of cutting-edge technologies such as artificial intelligence, big data analytics and the Internet of Things will provide enterprises with more accurate data support and help decision makers make strategic decisions more quickly and intelligently. There will be a focus on flatter and more flexible organizational models, collaboration among employees will be more efficient, and decision-making hierarchies will be more flexible, driving more resilient overall business operations. Digital transformation will also promote closer interaction between the enterprise and the external environment, strengthening the links between the enterprise and its customers, suppliers and partners, and forming a closer business ecosystem.

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/13/

INTELLIGENT MANAGEMENT METHODS OF WATER ENVIRONMENT RESOURCES IN THE CONTEXT OF GREAT ECONOMY

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ABSTRACT

In this paper, under the background of big economy, firstly, we integrate the life community of mountains, water, forests, fields, lakes and grasses, combined with the construction of wastewater treatment and the supporting pipeline network, and complete the architecture of the overall governance framework of the management system. Secondly, based on information resources and infrastructure, design the application functions and application system architecture of the intelligent management system to realize the integrated management of the whole life cycle of water environment resources. It also describes the attribute values of cloud computing service processing capability, sets the feature item labels between sensing, and lays the foundation for the clustering distribution of management function modules. Finally, scientific and technological innovation is proposed as an important means to improve the utilization efficiency of water environmental resources, to realize the mutual promotion of high-quality economic development and total water consumption control, industrial structure transformation and upgrading. The results show that the overall situation of water environment resource intelligent development is very good, with good satisfaction accounting for 84% of the overall, and the highest system evaluation of 4.93 points, which proves the effectiveness of this paper's water environment resource intelligent management system.

KEYWORDS

Big economic background; intelligent management; system architecture; cloud computing; cluster distribution

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INDEX

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1. INTRODUCTION

Intelligent management of water environment resources is an important content to promote the modernization of water environment governance system and governance capacity, and a major change to promote the construction of ecological civilization, modernization of governance system and modernization of governance capacity [1-2]. With the rapid development of social and economic development and industrialization, people are increasingly aware of the importance of promoting green development, strengthening the construction of water environment infrastructure and improving the quality of water environment [3]. And it is of great significance to design intelligent management methods for water environmental resources to reasonably determine the scale of the project, improve regional water resources planning and rational allocation, establish a strict water resources management system, and improve the efficiency of water resources utilization [4-5]. At present, the research on water environment management mainly focuses on the research and development of water environment management related technologies, while the research on water environment resource management ideas and their applications based on intelligent management is less [6]. Therefore, it is necessary to comprehensively sort out the engineering construction of water environment resource management, search for the optimal management path, provide conditions for comprehensively and efficiently implementing the intelligent management of water environment resources, and design the intelligent management system of water environment resources in the context of the large economy in order to effectively achieve the management objectives [7].

Influenced by climate change, human activities and socio-economic development, water resources management in river basins is facing more and more uncertainty and complexity. On this basis, Wang, Y et al. proposed a GIS-based water resources visualization knowledge map to visualize and quantify the knowledge base, domains and structures of water resources management by applying bibliometrics and knowledge mapping to safeguard the health and integrity of the ecosystems from the perspectives of sustainable and adaptive development, and by applying bibliometrics and knowledge mapping methods. The results of the study show that the research on water resources management in watersheds is on the rise [8]. With the acceleration of economic and industrialization processes, more and more chemical substances are emitted into the environment, and these chemical pollutants are potentially harmful to human health, especially prolonged exposure to the atmosphere can cause lipid metabolism disorders. Therefore, Zheng, S et al. found a positive correlation between NAFLD and long-term exposure to pollutants by analyzing the results of population and toxicological studies, and the study will help to better understand the mechanism of liver damage caused by pollutants in the water environment [9]. Acciarri, M. F et al. proposed a set of integrated solutions of water resources management and renewable energy development for ecologically fragile areas based on the summary of the existing research results. Renewable energy development in ecologically fragile areas. Firstly, the main research content of the project is presented, then the main research content of the project is introduced and the feasibility study of the project is conducted. Finally, in each alternative, water homogenization cost and water

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homogenization emission were calculated separately [10]. Soil moisture information is an important basis for understanding global climate change, and the validity of soil moisture information is very limited by the limitation of field observation means, especially in the mountains. Osenga, E et al. took the Southern Rocky Mountains of Colorado, USA as the research object, and by constructing a set of new set of interactive roaring bifurcation observation network based on multi-disciplines, such as climate, soil, and ecology, etc., the preliminary study was carried out. Through the implementation of the project, it can provide new ideas for mountain ecological meteorological research, and it can provide a reference for long-term monitoring work [11]. Literature [12] adopts a scientific and efficient way to enable everyone and anyone in the organization to participate in personnel management. Big data analytics and information technology (IT) are used to explore how IT can be utilized to solve the current problems faced by companies. Through the application of data mining theory, human resource management theory, the process of data mining and analysis methods, and its intrinsic connection is deeply analyzed, and the problems are discussed in depth, so as to provide a reference for improving the management level of human resource managers. With the management of water resources and environment, the reliability of medium- and long-term hydrological prediction has been put forward higher requirements. Bogner, K et al. Based on the previous work, they carry out the research on hydrological prediction method of watersheds based on numerical simulation and apply it to the monthly meteorological observation data to analyze the value of its application in hydrological prediction. Taking four catchments with real measurement data as an example, post-processing techniques were used to eliminate bias and diffuse errors, and they were validated and evaluated [13]. The problem of water scarcity has become a prominent issue in economic and social development, in order to ensure the supply of water resources, on the basis of the survey results, LI, W et al. planned six emergency water sources, and discussed the amount of water withdrawn from each source and the corresponding management countermeasures. In the long term, the utilization of aquifers as reservoirs and the joint utilization of surface water and groundwater are of great significance in ensuring water security and sustainable management of water resources [14].

In the context of large economy, intelligent management of water environment resources is particularly important. In order to improve the utilization efficiency of water environmental resources, the key elements such as the overall governance framework, the intelligent service application system, the value of cloud computing service attributes and the utilization efficiency of water environmental resources are fully considered. A framework that organically integrates the resources and strengths of all parties is established to ensure the full implementation of the intelligent management system. This includes the participation of the government, enterprises, research institutions and other parties to form a cooperative and win-win governance model. Second, the design of the intelligent service application system is the core of improving management effectiveness. Combining advanced technologies such as the Internet of Things and big data, a real-time monitoring, prediction and scheduling system for water environment resources is established to realize data sharing and

https://doi.org/10.17993/3cemp.2024.130153.252-271

intelligent processing of information, and to enhance the scientific and precise nature of decision-making. The intrinsic relationship between data is deeply excavated, and the utilization efficiency assessment model of water environment resources is established to realize the scientific, efficient and sustainable development of intelligent management of water environment resources in the context of big economy.

2. INTELLIGENT MANAGEMENT SYSTEM DESIGN FOR WATER ENVIRONMENT RESOURCES

2.1. OVERALL GOVERNANCE FRAMEWORK

Follow the governance policy of prioritizing protection, integrating water and land, adapting to local conditions, focusing on practicality, overall planning, step-by-step implementation, rational design, organic integration, clear responsibility, division of labor, broadening channels, and multiple inputs, and integrating the intelligent management of the community of life of mountains, water, forests, fields, lakes, and grasses [15]. Through the construction of sewage treatment and supporting pipeline network, rainwater and sewage diversion renovation, urban point and surface source pollution management, comprehensive improvement of rivers and building water ecosystems and other measures, to effectively cut down the river pollution in the watershed. To build a smart watershed, comprehensively improve the water environment monitoring and early warning and risk prevention capabilities, and provide scientific auxiliary decision-making for scientific water transfer, response to environmental emergencies and comprehensive environmental remediation in the watershed [16-17]. The overall governance framework is shown in Figure 1, and the overall governance of intelligent management of water environment resources mainly contains interception and pollution control project, landscape enhancement project, water ecology project and intelligent watershed management system.

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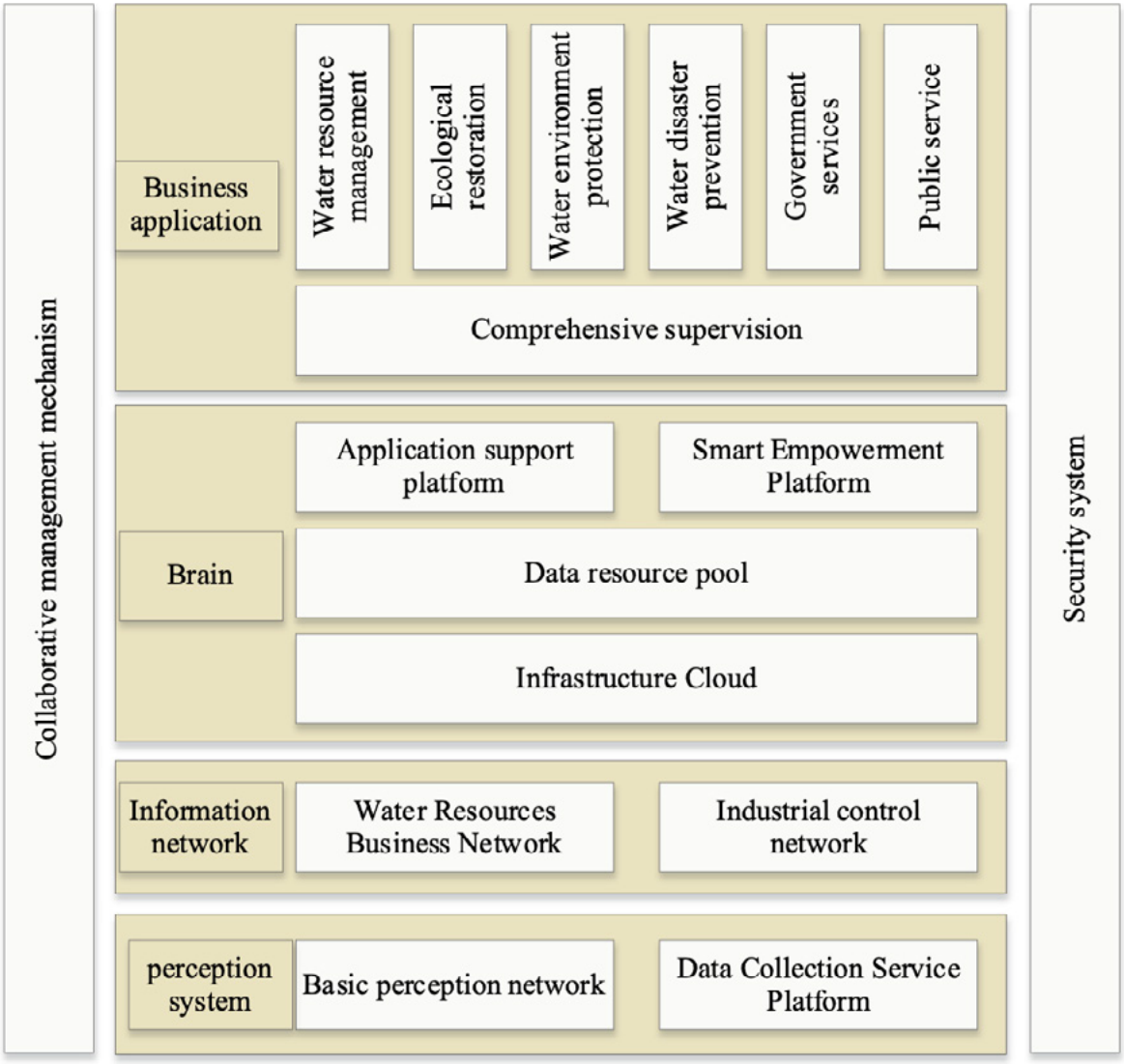

Figure 1. Overall governance framework for smart management

It makes full use of existing intelligent technologies such as Internet of Things, big data, cloud computing, artificial intelligence, etc., and combines basic information resources and scientific and technological means to realize visual management, simulation, prediction and analysis of daily water environment resource management work in the watershed. Based on B/S+MI/S architecture and integrated GIS development technology, it realizes the interconnection of mobile terminal and web terminal, and consists of four horizontal and two vertical structural layouts of business application, basin brain, information network, perception system, security system and cooperative management mechanism. Among them, the main function of the business application is to realize the basin water resources management, water ecological restoration, water environmental protection, water disaster prevention and control, government services and public services in the river basin brain to provide strong data support and computing power, the above business information and data to carry out comprehensive supervision, forming the water environment resources intelligent service application system.

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Intelligent water treatment is an important part of the construction of intelligent management of water environment resources. Compared with the traditional water treatment method relying on chemicals and physical filtration, which has high cost and the effect is difficult to guarantee, the adoption of information technology and intelligent equipments can realize automatic monitoring and automatic regulation of water quality, so as to accurately control the effect of water quality treatment, avoid the over-standard of water quality and the wastage of resources as well as to reduce the treatment cost. Intelligent equipment can automatically record water quality data and upload it to the cloud to realize the sharing and interaction of water quality data. Through the analysis of water quality data, we can understand the trend and law of water quality changes, optimize the water treatment process, and improve the effectiveness and stability of water quality treatment. Intelligent water treatment has four obvious features: intelligent management, cost saving, high-efficiency water treatment and data analysis.

2.2. INTELLECTUALIZED SERVICE APPLICATION SYSTEM

The intelligent service application system is based on information resources and infrastructure, and according to the business requirements of water conservancy functional departments, the application functions and application system architecture of intelligent management are designed to realize intelligent perception, intelligent simulation, intelligent diagnosis, intelligent early warning, intelligent scheduling, intelligent disposal, intelligent control and intelligent service of intelligent management of water environment resources, so as to serve the water-related businesses such as flood control, drought mitigation and water resources management, water ecology management, and water environment management. Management of water environment management and other water-related businesses.

The functional architecture of the intelligent service application system for water and environmental resources is shown in Figure 2. Through the construction of the intelligent service application system, it realizes the integrated management of intelligent perception intelligent simulation, intelligent diagnosis, intelligent early warning, intelligent scheduling intelligent disposal intelligent control and intelligent service for the whole life cycle of water services. It provides technical support for the protection of water resources security, water environment security, water ecological security and engineering security, serves the four major business areas of flood control management, water resources management, water environment management and water ecological management, provides different feedbacks for the situation of daily status and emergency status, and comprehensively supports the management business.

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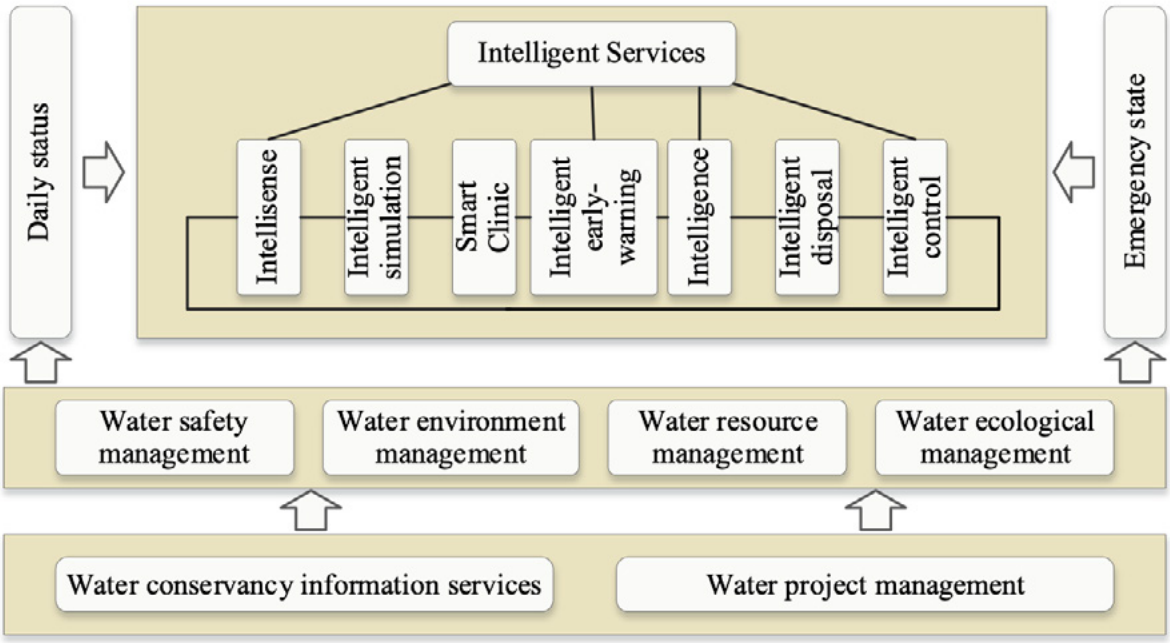

Figure 2. Functional architecture of intelligent service application system

The intelligent service application system is designed based on the software-as-a-service of cloud computing, and the intelligent management business of water environmental resources is constructed through each different service module, and each module builds a business application that meets its own needs according to the characteristics of the business requirements, and the design of the application module is shown in Figure 3. The construction mode can effectively avoid repetitive construction of the system, easy system upgrade and transformation, and realize the openness and dynamic sustainable development of the system. In the process of system upgrade and transformation, only the functional modules need to be upgraded, and a unified upgrade can be carried out for the common modules. Software as a service can easily access a variety of application components, and ultimately exposed to the user in the form of interfaces to call, and at the same time, through a unified portal single sign-on, unified authentication and other technical means, to achieve a single portal, a variety of services, and future access to the system is also the same through the registration of the service to achieve, rapid deployment of applications. Application of cloud computing to take a modular construction model that is the water information service module, water business management function module, water decision support function module and water emergency management function module.

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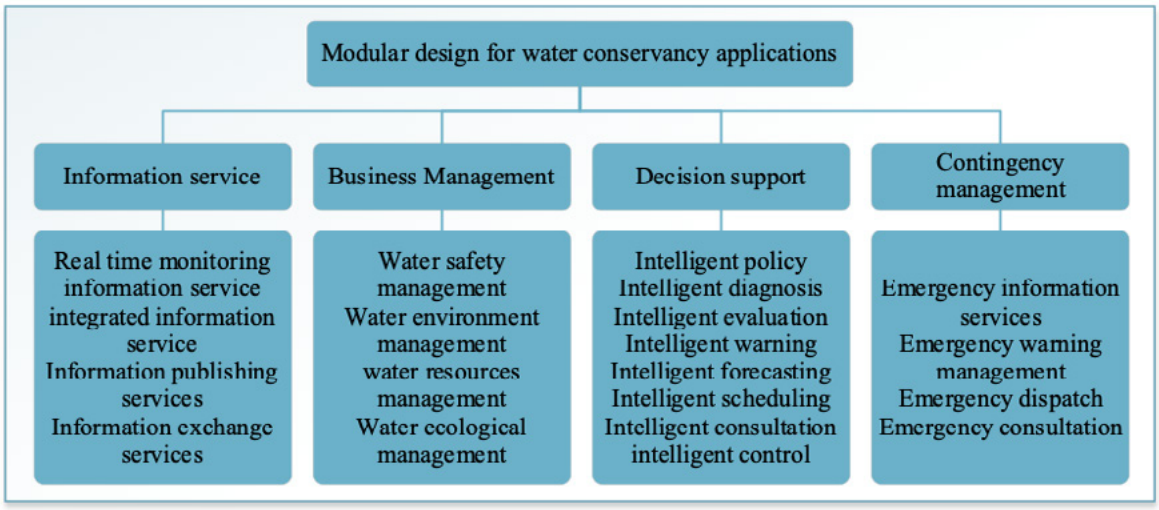

Figure 3. Application module design of intelligent service application system

2.3. CLOUD COMPUTING SERVICE ATTRIBUTE VALUES

Cloud service S in the cloud computing operating model is denoted as:

$$S = \{S_1, S_2, \cdots, S_i, \cdots, S_n\} \quad (1)$$

where n is the number of sensing services on the cloud platform and S_i is the ird cloud service. Attribute S which reflects the service level and processing capability in the cloud service is denoted as:

$$S = \{S_F, S_N\} = \{S_1, S_2, \cdots, S_k, \cdots, S_m\}, k \in [1, m] \quad (2)$$

where m is the attribute dimension of the cloud service,S_F is the functional attribute that reflects the sensing level of the service, S_N is the non-functional attribute of the cloud service, and S_k is the kth dimensional attribute of the sensing cloud service. As a result, the ith sensing cloud service S_i can be expressed as:

$$S_i = \{x_i^F, x_i^N\} = \{x_{i,1}, x_{i,2}, \cdots, x_{i,k}, \cdots, x_{i,m}\}, k \in [1, m] \quad (3)$$

Where x_i^F is the value of the functional attribute of the ind cloud service S_i, x_i^N is the value of the non-functional attribute, and $x_{i,k}$ is the value of the attribute of the ith sensing cloud service S_i on the kth dimensional attribute S_k.

For non-functional attributes such as sensing time and sensing speed, the sensing services on the cloud platform need to be divided into batch number ranges in advance when clustering, and set up different grades, and the service provider needs to give the sensing time and speed of the sensing services of this class for different batch grades [18-20]. The triangular fuzzy number is used for description, and its mathematical expression is:

https://doi.org/10.17993/3cemp.2024.130153.252-271

$$x_{i,k} = \left[x_{i,k}^{NL}, x_{i,k}^{NM}, x_{i,k}^{NU}\right], 0 < x_{i,k}^{NL} \leq x_{i,k}^{NM} \leq x_{i,k}^{NU} \quad (4)$$

Where $x_{i,k}^{NU}$ and $x_{i,k}^{NL}$ are the upper and lower bounds on the values of the non-functional attributes, i.e., the maximum and minimum values of sensing time, or the slowest and fastest values of service speed, required by the service provider to complete the service at the corresponding batch level. $x_{i,k}^{NM}$ is the most likely value of the non-functional attribute, i.e., the sensing time and the sensing speed that the service provider most often employs to provide this type of service at the corresponding batch level. By describing the values of the cloud computing service processing capability attributes and setting the labels of the feature items between sensing, a foundation can be laid for managing the clustering distribution of the functional modules.

2.4. WATER ENVIRONMENT RESOURCE UTILIZATION EFFICIENCY

As an important means to improve the utilization efficiency of water environment resources, the mechanism of science and technology innovation in the context of big economy can be expressed as the mechanism of influence on the utilization efficiency of water environment resources, which can be expressed as the science and technology innovation in the context of big economy accelerates the promotion and application of water-saving technology, effectively controls the total amount of water consumption and reduces the total consumption of water environment resources. Science and technology innovation optimizes the water consumption structure by promoting the innovation of the development mode of traditional industries, accelerating the transformation of the production mode, and promoting the transformation and upgrading of the industrial structure. Science and technology innovation in the context of the big economy promotes the high-quality development of the economy, realizes the mutual promotion of high-quality development of the economy and the control of the total amount of water consumption, the transformation and upgrading of the industrial structure, and ultimately improves the efficiency of the utilization of water environment resources, and the influence mechanism is shown in Figure 4. Due to the differences in the level of regional science and technology innovation, the application scope of water-saving technologies and key industries are different, and the degree of transformation and upgrading of industrial structure is different, so the effect of the level of innovation on the utilization efficiency of water environment resources in the context of the big economy is not the same. The level of science and technology innovation in the context of large economy significantly improves the utilization efficiency of water environment resources, and there are significant spatial differences in the effect of the level of innovation on the utilization efficiency of water environment resources in the context of large economy.

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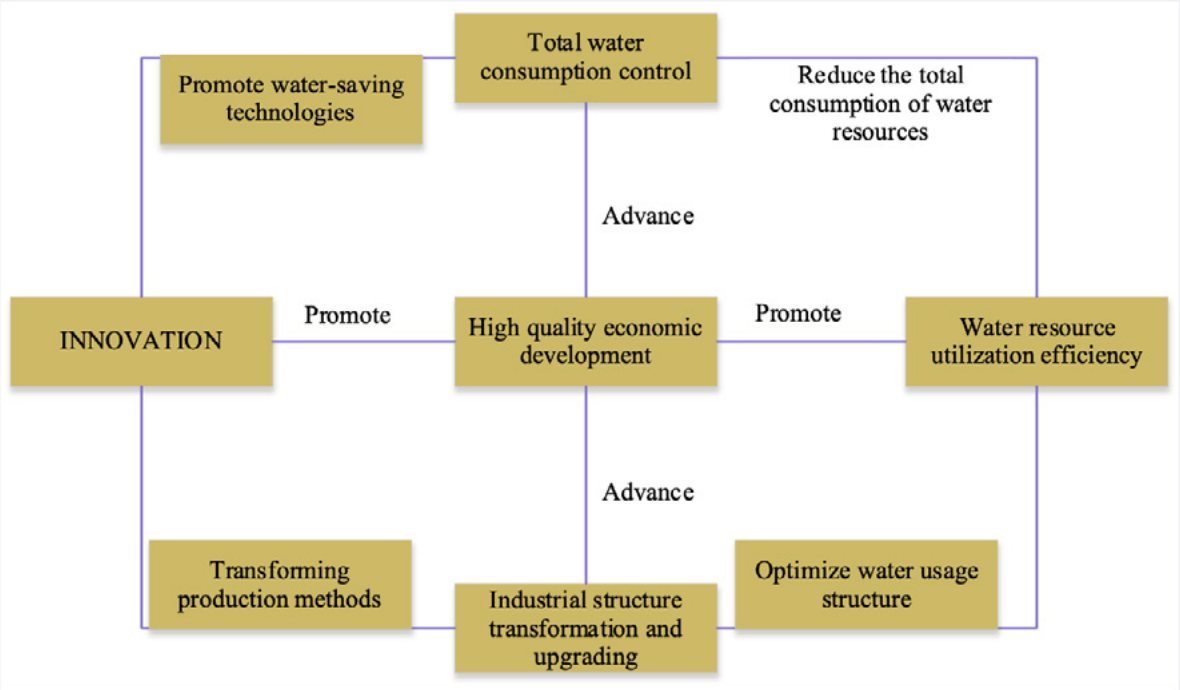

Figure 4. Mechanisms affecting resource utilization efficiency in the water environment

3. MODELING OF WATER ENVIRONMENT RESOURCE UTILIZATION EFFICIENCY

Spatial econometric modeling is used to construct a model of the effect of the level of innovation on the efficiency of water environment resource use in the context of the large economy [21-22]. The formula is expressed as:

$$W_{it} = \beta_0 + \beta_1 I_{it} + \beta_2 U_{it} + \beta_3 R_{it} + \varepsilon_{it} \quad (5)$$

Where U_{it} denotes the degree of industrial upgrading in region i in year t, R_{it} denotes the intensity of water environment regulation in region i in year t, β_0 denotes the constant term, β_1、β_2、β_3 denotes the elasticity coefficient of I_{it}, U_{it}, R_{it} respectively, and ε is the random error term.

Construct the generalized production function model, which can be expressed as:

$$W_{it} = A I_{it}^{\beta_1} U_{it}^{\beta_2} R_{it}^{\beta_3} e^{u_{it}} \quad (6)$$

where A denotes the environmental constant and u_{it} denotes the random error term. Taking logarithms for both sides of Eq. (6) yields:

$$\ln W_{it} = \ln A + \beta_1 \ln I_{it} + \beta_2 \ln U_{it} + \beta_3 \ln R_{it} / R_{it} \quad (7)$$

According to Equation (7), the elasticity coefficients of the variables in the model are estimated using Equation (5) to find the difference, which can be presented in the form of growth rate of the function model:

https://doi.org/10.17993/3cemp.2024.130153.252-271

$$\Delta W_{it}/W_{it} = \beta_1 \Delta I_{it}/I_{it} + \beta_2 \Delta U_{it}/U_{it} + \beta_3 \Delta R_{it}/R_{it} \quad (8)$$

According to Equation (8), divide both sides by $\Delta W_{it}/W_{it}$ at the same time and multiply by 100% to get:

$$100\% = \beta_1 \frac{\Delta I_{it}/I_{it}}{\Delta W_{it}/W_{it}} \times 100\% + \beta_2 \frac{\Delta U_{it}/U_{it}}{\Delta W_{it}/W_{it}} \times 100\% + \beta_3 \frac{\Delta R_{it}/R_{it}}{\Delta W_{it}/W_{it}} \times 100\% \quad (9)$$

Then Equation (9) represents the contribution of the level of science and technology innovation, the degree of industrial upgrading, and the intensity of water environment regulation to the efficiency of water environment resource utilization in Region i in Year t in the context of large economy.

4. INTELLIGENT MANAGEMENT SYSTEM SIMULATION ANALYSIS

4.1. QUESTIONNAIRE DESIGN

This paper adopts a combination of questionnaire survey method and interview method to conduct an in-depth investigation and research on the development of intelligent management of water environment resources in the context of J Group's large economy. In order to ensure that the information obtained from the interview is more comprehensive and objective, the interview adopts in-depth interview, according to the outline of the interview content and the interviewee one by one, the outline of the interview content adopts open-ended questions in order to obtain more in-depth details of the problem. In the interview process, in order to seek the effectiveness of the results of the interview, and the interviewees to clarify the meaning of each question, and basically control the content of the interview and the guidance of the interview questions. The main content of the interview includes how to feel about the use of the intelligent management of water environment resources in the context of the use of the big economy, what are the satisfactory and unsatisfactory aspects of the Group's intelligent management of water environment resources, and what optimization suggestions are put forward in the light of their own use. In order to ensure the effectiveness of the interview results, the interview subjects were selected from employees and managers related to the intelligent management of the company's water environment resources, and relevant scholars who understand the operation of the intelligent management system, and sampling was carried out according to different classifications, and a total of 10 people were selected to conduct open-ended question interviews. After the interviews with the 10 selected subjects, the contents of the interviews were organized and summarized.

Details of the questionnaire survey design are shown in Table 1, and the questionnaire content contains two parts, a total of 29 questions. The first part is about the basic situation of employees and managers of J Group, with a total of 5 questions, and the second part is a survey on the development of intelligent management of the

https://doi.org/10.17993/3cemp.2024.130153.252-271

group's water and environmental resources, including the overall situation of the group's intelligent development of water and environmental resources, intelligent management, operation and maintenance, intelligent planning and management, intelligent talent system, intelligent protection, with a total of 24 questions. The survey questionnaire was issued in 1 month, during which 200 questionnaires were issued and 187 valid questionnaires were retrieved, with a recovery rate of 93.5%, the questionnaire validity is good, and the data is relatively perfect.

Table 1. Basic information about Group J's survey sample

Category	Characteristics	Frequency	Percentage
Age	20-30	31	16.6
	31-40	103	55.1
	41-50	30	16
	Above 50 (not including 50)	23	12.3
Academic qualifications	Below Bachelor's Degree	18	9.6
	Undergraduate	131	70.1
	Postgraduate (Masters)	26	13.9
	Graduate student (PhD)	12	6.4
Monthly income	Below 5000	89	47.6
	5000-7000	53	28.3
	7001-10000	34	18.2
	10000 above	11	5.9
Length of service	Less than 5 years	61	32.6
	5 to 10 years	63	33.7
	11-20 years	43	23
	More than 20 years (excluding 20)	20	10.7
Department	Group Headquarters	12	6.4
	Water Supply	31	16.6
	Drainage	51	27.3
	Engineering department	26	13.9
	Water sales department	14	7.5
	Dispatch Center	31	16.6
	Others	20	10.7

https://doi.org/10.17993/3cemp.2024.130153.252-271

From the samples of this questionnaire survey, most of them are in the age of 31-40 years old, with bachelor's degree and 5 to 10 years of working experience. This indicates that the main users of the intelligent management system of water environment resources are mainly technicians who have certain working experience as well as cultural level.

4.2. ANALYSIS OF INTERVIEW RESULTS

The result of the research is the internal opinion of Group J on the application of intelligent management system of water environment resources, which shows that there are three representative problems in the development process of intelligent management of water environment resources in Group J. One of them is that there is no unified intelligent water underlying architecture in terms of technology, so that the intelligent management of water environment resources within the group is restricted to deal with only their own water operation data, without interoperability between the management, which also leads to valuable data can not be efficiently transmitted, stored, converted into formats, and so on. Intelligent management at all levels can not be interoperable, but also led to the imperfect function of the pipe network geographic information system, there is no unified intelligent management, resulting in the level of safety and security of intelligent management at all levels is uneven. Therefore, using the intelligent management system of water environment resources in the context of the big economy designed in this paper, the use of feelings, satisfaction and optimization suggestions are summarized, and the effectiveness of the intelligent management system of water environment resources in this paper has been verified.

Table 2 for the intelligent management system adoption rate interviews, the industry scholars relatively high requirements for the Group's intelligent management system for water environmental resources of the basic functions of higher recognition, but some aspects of the existence of a greater space for development, and that its functionality is targeted, the system structure is relatively simple and stable. At the same time, they gave optimization suggestions, thinking that it is necessary to seek cooperation with a third party, increase the scale of management, and focus on improving the technical level of the staff, so as to guarantee the stable operation of the intelligent management system. From the comprehensive analysis of the internal and external parts of the interviews, the intelligent management system of water environmental resources in the context of the big economy designed in this paper has a complete system architecture, and the interoperability between the various system operations forms a stable data source. However, with the process of intelligent development in the context of a large economy, the traditional system of talent introduction and training can not meet the needs of intelligent development of water and environmental resources, resulting in the Group for the intelligent management system for the actual use of personnel did not reach the expected level, but also indirectly affects the level of technical support to continue to develop. The development of intelligent management system of water environment resources is mainly based on its own intelligent construction, adding a collaborative management

https://doi.org/10.17993/3cemp.2024.130153.252-271

mechanism to achieve win-win cooperation, but still need to cooperate with third parties to strengthen the intelligent management of water environment resources. Comprehensively, the intelligent management system of water environment resources in the context of the big economy designed in this paper is very effective in the overall intelligent management benefits, but it still needs to be combined with optimization suggestions for improvement, so as to accelerate the speed of intelligent development.

Table 2. Intelligent management system adoption rate

Interview Title	Managers	Technical staff	Water Industry Scholars
Feeling of use	Save time.	The interface is perfect and neat	Data storage time is shorter.
	Operation is more complicated.	System response is rapid.	Not much different from the industry's leading edge systems.
	Data interoperability, easy to share.	Flexible functions and strong calculation ability.	Small differences, easy to operate.
Satisfaction	Replace manual work.	Saving time.	The system structure is stable.
	Relatively stable, not easy to fail.	Simple process.	High simulation degree.
	Decision construction.	Huge memory, easy to operate	Low cost.
Dissatisfaction	Less update.	Transmit the same data over and over	Shortage of talents
	Single operator interface.		Limited funds.
Optimization Suggestions	Optimize the operation interface.	Optimize interface flow	Seek cooperation with the third party.
	Timely update	Increase memory	Improve personnel skills
	Strengthen hardware construction	Add storage	

4.3. ANALYSIS OF QUESTIONNAIRE RESULTS

According to the questionnaire results statistics to get the overall situation of the development of water environment resource intelligence, the statistical results are shown in Figure 5. Most of the investigators think that the overall situation of the development of water environment resource intelligence in the context of the big economy is very good, accounting for 60%, 24% of those who think that the development is very good, 3% of those who think that the development is not good, 2% of those who think that the development is very bad, and 84% of those who have a good degree of satisfaction in the whole, which proves the validity of this paper's design of the intelligent management method.

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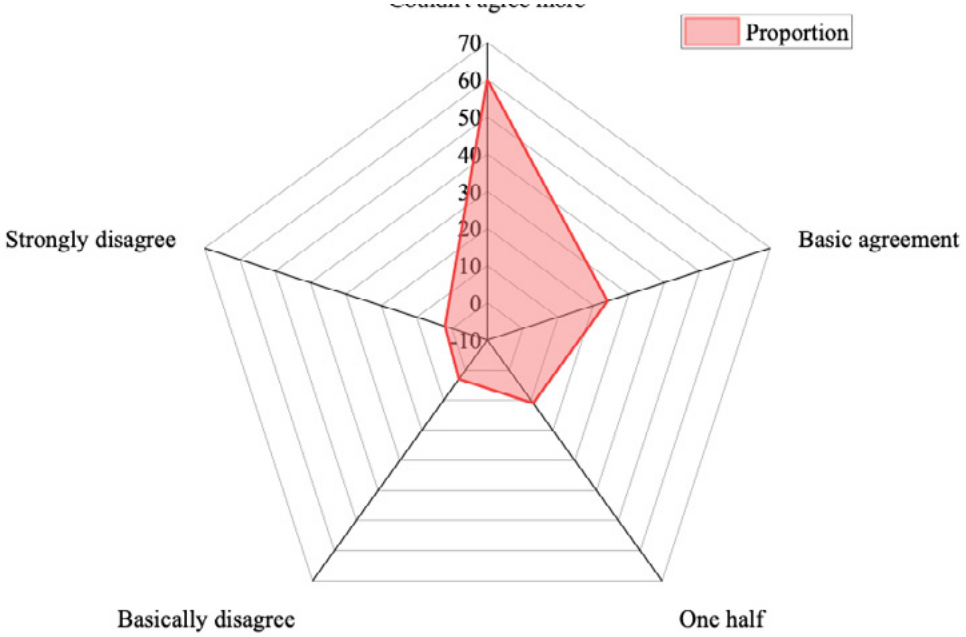

Figure 5. Satisfaction statistics of the development of water environment resource intelligence

Based on the questionnaire results, Figure 6 shows a comparison between the original data and the survey results on the intelligent development of water environmental resources. The samples agree on the effectiveness of implementing the intelligent management system for water environmental resources in the context of the big economy. The system comprehensively improves the efficiency of water environmental resource operations, reduces workload, aids in decision-making, and accelerates economic development. Based on the scores of very compliant, basically compliant, general, partially non-compliant, and very non-compliant (ranging from 5 to 1), it is evident that the original management method, with the aid of management decision-making, scored a minimum of 2.71 points. It accelerated economic development by 3.13 points, achieved a comprehensive score of 3.35 points, and scored the highest in improving operational efficiency with 3.82 points. This paper evaluates the implementation of an intelligent management system for water and environmental resources in the context of a large economy. The system's intelligent development scored 4.76 points, while its impact on operational efficiency and workload reduction scored 4.89 and 4 points, respectively. The intelligent development of water and environmental resources contributed 4.62 points to decision-making management, and 4.93 points to economic development. The economic development score was 4.93. Thus, this paper demonstrates that the intelligent management system for water and environmental resources in the context of a large economy has improved overall development, operational efficiency, and management decision-making while reducing the workload of management, ultimately contributing to economic development.

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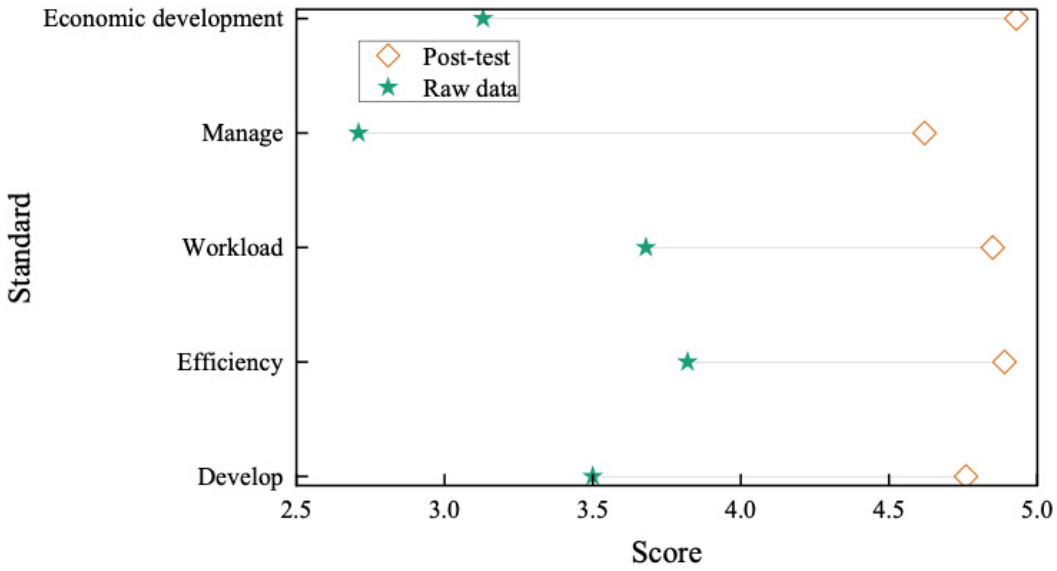

Figure 6. Comparison of the development of water environment resource intelligence

5. CONCLUSION

This paper presents the governance framework for the intelligent management system of water environmental resources. The framework is structured around information resources and infrastructure, and utilizes existing intelligent technologies such as the Internet of Things, big data, cloud computing, and artificial intelligence. By combining basic information resources and scientific and technological means, the framework enables visualization management, simulation, prediction, and analysis of water environmental resources management work. The application system for intelligent management of water environment resources is designed to lay the foundation for clustering distribution of management function modules. Finally, the questionnaire and interview methods were combined with research to simulate experimental verification. The results showed that the implementation of the system described in this paper comprehensively improved the intelligent development of water environmental resources, operational efficiency, and reduced workload. It also aided in management decision-making and accelerated economic development. The scores were 4.76, 4.89, 4.85, 4.62, and 4.93, respectively. It is evident that the original management methods scored the lowest at 2.71 points under the management decision-making score. However, there was an improvement of 1.91 points in the management system's effectiveness after the application. This proves the effectiveness of the intelligent management system for water environment resources in the context of the big economy.

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/14/

ANALYSIS OF THE EMOTIONAL LOGIC OF MEDIATISATION OF ANCIENT LITERATURE ORIENTED ON OVERSEAS DISSEMINATION OF CHINESE CULTURE

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ABSTRACT

This study analyzes the emotional logic of the mediatization of ancient literature oriented to the overseas dissemination of Chinese culture by constructing an emotion analysis model and an emotion logic model. The sentiment analysis model includes key parts such as the model structure, the basis of sentiment analysis, and the sentiment intensity and activation tuning value. Then, through the sentiment logic model, the process of updating the sentiment subject and the system structure are studied to better understand the mediatization process of ancient literature overseas. Through the stage tasks of data crawling and sentiment categorization, rich literary works and related information were obtained from multiple channels. In the correlation analysis stage, taking literary themes as an example, it was found that the level of emotional engagement was medium-high and correlated with a reading frequency score of 7.0, and that there was a strong correlation between the emotional experience of ancient literary works and the elements of cultural transmission. Overseas readers' reading frequency during work/study leisure and before going to bed accounted for 70% and 60%, respectively, revealing that ancient literature has a high level of attention in readers' daily life, and providing an in-depth and clear perspective for understanding the dissemination effect of literature in overseas.

KEYWORDS

Sentiment analysis model; sentiment logic; ancient literature; mediatization; data crawling; sentiment classification

https://doi.org/10.17993/3cemp.2024.130153.273-289

INDEX

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1. INTRODUCTION

In reality, in the process of cultural development, as the development of ancient Chinese literature has gone through a relatively long period of time, its own medium of communication has also gone through various stages such as spoken medium written medium, printed medium and electronic medium [1-2]. The oral communication form of ancient Chinese literature has different distinctive features in different historical periods [3]. In the rapid development of the present information age, the oral communication forms of ancient Chinese literature have also become richer [4]. Combined with the actual situation of the development of ancient Chinese literature, in-depth analysis of the oral communication forms of ancient Chinese literature has a positive significance for the promotion of the dissemination and inheritance and development of ancient Chinese literature. Literary communication media and communication methods, the impact on literature is often also multidimensional [5]. The change of media not only has a close relationship with literature, but also has a certain connection with the development of science and technology and society in the same period. The spirit and appearance of literature in each era also have different characteristics and changes under the role of media [6].

Digital technology and multimedia expression play an important role in cultural inheritance, Zhang, J et al. proposed robust multi-view fuzzy clustering algorithm for image segmentation of Chinese literati paintings to achieve effective extraction of ancient paintings. Through effective extraction, the electronic and digital transformation and preservation of literati paintings are realized. This preservation method is more capable of preserving the artistry of literati paintings than traditional scanning, and is of great value for the re-expression and dissemination of cultural heritage [7]. Gu, L integrates and optimizes ancient literary information resources through big data technology in order to improve the systematicity and completeness of literature. The research mainly focuses on literary works and related collation, annotation, and textual research results, and is committed to making it easier for readers to find and browse ancient literature by dividing the scope of each subtopic according to genre [8]. Zeng, Y et al. deepened the theoretical understanding of virtual reality tourism from an emotional perspective, and by establishing a moderating mediator model, examined how virtual reality tourism can enhance, through digital technology, the tourists' experiential value and enhance people's sense of pride, thus influencing tourists' behavioral intention of cultural dissemination [9]. Cui, C et al. emphasized how to raise the younger generation's awareness of intangible cultural heritage preservation and dissemination, and by taking the WeChat-based platform of Hangzhou's traditional gastronomy and culture light game design as an example, they demonstrated the skill of skillfully integrating intangible cultural heritage elements into the game design, which offers a practical solution for the help of digital games to It provides a practical example for promoting the inheritance of intangible cultural heritage with the help of digital games [10].

Turton, A et al. proposed that Emotional Logic Coaching categorizes ELDP statements, into two categories: personal and relational competency changes. It was

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found that the development of personal comprehension helps to enhance participants' self-care in new and challenging environments and reduces dependence on professional or other aspects. By measuring the outcomes of a truly values-based action plan [11]. Tursunovich, R. I The main goal is to consider the point of view direction in literary translation, focusing on how to accurately convey words and ideas related to the language and culture. In order to better perceive cross-cultural differences, translators need to understand and study the mentality of people in the original language. The quality of translation can be improved by applying lexical, grammatical and stylistic skills in translation practice and following translation norms on-site [12]. Ashton, D explores the relationship between entrepreneurial orientation and emotional labour, analysed through an empirical study of cultural organizations in the UK. The paper examines emotional labor in the entrepreneurial process in terms of two themes or relationships, namely emotional labor in patronage relationships and emotional labor in audience relationships. The analysis of these themes highlights the impact and consequences of ongoing emotional labor on cultural organizations and cultural workers [13]. Widmann, T used a novel sentiment dictionary to analyze large amounts of textual data, including over 700,000 press releases and tweets from three European countries. The study found that populist parties are more likely to use negative emotional appeals, such as anger, fear, disgust, and sadness, than mainstream parties. And positive emotional appeals, such as joy, enthusiasm, pride, and hope were relatively rare. It was also found that political actors adjusted the use of emotional appeals according to the communication media and the status level of the politicians in order to achieve different political objectives [14].

In order to explore the deeper level of changes in sentiment logic, a comprehensive sentiment analysis framework is constructed by integrating LSTM, recurrent neural network and Bayesian classification to explore the sentiment logic of ancient Chinese literature in overseas dissemination. Firstly, LSTM and recurrent neural network structures are used to capture the long-distance and short-distance emotional dependencies in ancient literature to improve the accurate modeling of emotional information. Subsequently, the concepts of emotional intensity and activation value are introduced, which not only can more accurately measure the expressive power of emotions in ancient literature, but also help to more deeply understand the impact of emotions in the communication process. Finally, the dynamic change of the emotional subject in ancient literature is modeled, taking into account the updating process of the emotional subject and the overall architecture, as well as the construction of an organic architecture to reflect the development of emotion in the overall narrative. At the same time, the stage tasks of data crawling and emotion classification, as well as word classification and emotion word determination are clarified to provide support for the training and validation of the emotion logic model.

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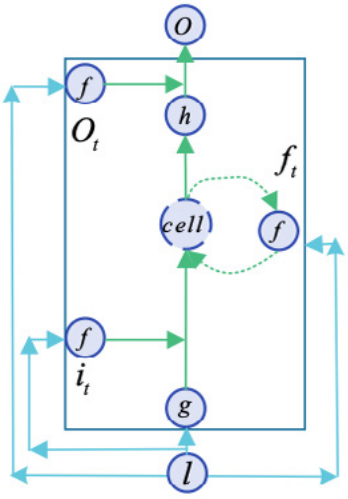
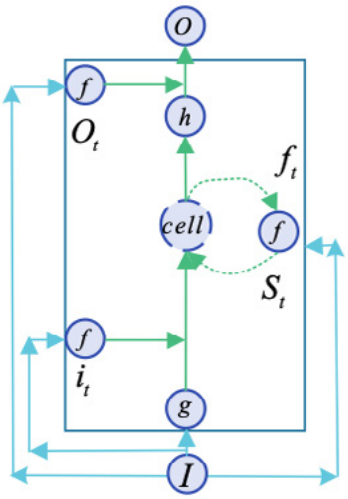
2. CONSTRUCTING A SENTIMENT ANALYSIS MODEL

2.1. MODEL STRUCTURE

The powerful sequence modeling capability of LSTM can be applied to different research directions to form a series of variants, and in this paper, we use recurrent neural networks to analyze the emotional color in ancient literature [15]. Figure 1 shows two grid cell structures, Figure 1(a) shows the basic structure of LSTM cell, which is the most common LSTM variant. Figure 1(b) shows the SentiSTM cell, which is based on the standard LSTM with emotion gates added to realize the storage of emotion values, whereby the emotion values of the text sequences will not be forgotten with the increment of the time step, and thus the accuracy of the emotion classification can be improved [16].



(a) LSTM unit



(b) Senti-LSTM cell

Figure 1. Cell structure

https://doi.org/10.17993/3cemp.2024.130153.273-289

Each LSTM cell consists of an input gate i_t, a forgetting gate f_t, an output gate O_1, and a memory cell c_t, with I representing the cell input at the current moment and O representing the cell output at the current moment Assuming that the dimension of the memory cell is d, the LSTM can be formulated as follows:

$$i_t = \sigma\left(W_i x_t + U_i h_{t-1} + b_i\right) \tag{1}$$

$$\begin{cases} f_t = \sigma\left(W_f x_t + U_f h_{t-1} + b_f\right) \\ c_t = f_t \odot c_{t-1} + i_t \odot \\ \tanh\left(W_c x_t + U_c h_{t-1} + b_c\right) \\ o_t = \sigma\left(W_o x_t + U_o h_{t-1} + b_o\right) \\ h_t = o_t \odot \tanh\left(c_t\right) \end{cases} \tag{2}$$

where σ is the activation function sigmoid, $\odot$ is the dot product operation, W_* and $U_*$are the coefficient matrices, b_* is the bias vector, i_t, f_t and o_t are the computation of the input gate, the forgetting gate, and the output gate, respectively, c_t is the computation of the MEMORY cell at moment t, and h_t is the output of the LSTM cell at moment t.

The SentiISTM model with the addition of the sentiment gate has two different updating methods, i.e., the sentiment update of the sentiment gate S_t versus the update of the memory cell c_t:

$$s_t = \sigma\left(W_s x_t + U_s h_{t-1} + b_s\right) \tag{3}$$

$$c_t = f_t \odot c_{t-1} + s_t \odot c_{t-1} + i_t \odot \tanh\left(W_c x_t + U_c h_{t-1} + b_c\right) \tag{4}$$

2.2. FOUNDATIONS OF SENTIMENT ANALYSIS

Due to the special structure of recurrent neural networks, when using them for sentiment classification, it is necessary to consider how to use the hidden state of each moment for the final sentiment classification [17]. An intuitive approach is to use the hidden state of the last moment of the RNN as a feature for sentiment classification, the hidden state h_t of the last moment, theoretically encodes the semantics of the entire input sequence in it, and the subsequent sentiment classification uses this semantic encoding as an input to the Softmax classifier, and the probability of the sentiment polarity belonging to class c is calculated as:

$$p\left(y = c \mid h_t, U, b\right) = \exp\left(h_t U_c + b_c\right) / \sum_{l=1}^{n} \exp\left(h_t U_t + b_l\right) \tag{5}$$

U, b is the parameter of Softmax classifier.

https://doi.org/10.17993/3cemp.2024.130153.273-289

For texts of long length, encoding all semantic information into a fixed-length vector will to some extent have a loss of information, which affects the effectiveness of classification [18]. In order to utilize the semantic information of each moment, a Mean pooling layer is added between the RNN and Softmax layers to average the hidden states of each moment, i.e.:

$$\bar{h} = \sum_{k=1}^{t} h_k / t \tag{6}$$

Then, $\bar{h}$ is used as an input to the Softmax classifier, unlike the RNN-last model which uses only the last moment hidden state RNN-mean uses each moment's hidden state for the final sentiment categorization by incorporating a Mean pooling layer, which is equivalent to a single vote for the final categorization at each moment with the same weight [19].

3. CONSTRUCTING AN EMOTIONAL LOGIC MODEL

3.1. EMOTIONAL INTENSITY AND ACTIVATION THRESHOLDS

The role and influence of emotion in the mediatization of literature is analyzed by relating emotional messages to the elements of cultural communication in literary works [20]. Emotion intensity is influenced by many factors, including internal affective factors, such as emotional self-attenuation and external affective factors, stimulation by external events [21]. These affective factors correspond directly to the corresponding emotion generators and are categorized into excitatory and inhibitory factors according to their strengthening or weakening effect on emotion intensity.

Assuming that there is k basic emotion, the emotion intensity can be defined as:

$$I_{e,t} = \Psi\left(I_{e,t-1}\right) + \delta_t\left(e_l\right) + \sum_{k,k\neq i} \lambda_{ki} I_{e,t} \tag{7}$$

where $I_{e_i,t}$ denotes the intensity value of the emotion e_i at the t moment, $\Psi 0$ is the decay function specifying the way in which the emotion e_i decays, $\delta_t\left(e_l\right)$ is the sum of the total effects of all the emotion generators at the t moment, and λ_{ki} is the factor of the influence of the emotion e_k on the emotion e_i, both inhibitory and excitatory. If the emotion e_i inhibits the emotion e_j, then $\lambda_{ij} < 0$ the inhibitory factor, if the emotion e_i strengthens the emotion e_j, then $\lambda_{ij} > 0$ the excitatory factor, and if the emotion e_i has no direct effect or $i = j$ on the emotion e_j, then $\lambda_{ij} = 0$.

The intensity of a certain emotion reaches a certain level will activate this emotion,, when the personality differences in the magnitude of the intensity of the emotion directly affect the level of the activation threshold, which is described as:

https://doi.org/10.17993/3cemp.2024.130153.273-289

$$\omega = (1+\varepsilon)\omega_0, \varepsilon \in [-0.5, 0.5] \quad (8)$$

where ω denotes the activation queue value, ω_0 is the activation value constant, which represents the average activation level of the individual, and ε denotes the influence factor of personality on the affective value [22].

The affective state of the individual at moment t is given by the vector E_t, , $E_t = \left(e_{0,t}, e_{1,t}, \cdots e_{i,t}, \cdots e_{k,t}\right), i = 0, \cdots, k$ i.e:

$$e_{i,t} = f\left(I_{e_{i,t}}, \omega\right) = \begin{cases} 1, \cdots, I_{e,t} \geq \omega \\ 0, \cdots, I_{e,t} < \omega \end{cases} \quad (9)$$

The emotional state of a literary work may change over time, and as the emotional state changes, the emotional state vector is updated.

3.2. EMOTIONAL SUBJECT RENEWAL PROCESS AND ARCHITECTURE

Cognition plays a key role in the process of emotion generation, but the cognitive process is exceptionally complex, and there is currently no recognized model in cognitive science and psychology. Through the synergistic action of the subject's beliefs, desires, norms and other cognitive elements, according to the calculation and judgment of the intensity of emotion and the rules about emotion generation that already exist in the subject's knowledge, so that the subject will update his or her own emotion and express the emotion through the corresponding behavior.... The process of updating the subject's emotion includes the following steps:

1. The subject perceives the external environmental events through the perception module, and the existing beliefs update their beliefs through the belief update module.

2. According to the new beliefs, the subject interacts with the existing desires, norms, preferences, etc. under the guidance of the emotional rule base, calculates the emotional intensity, makes a judgment on the intrusion value, and implements emotional activation.

3. A new emotional state is generated through the emotion update module acting on the intelligent subject's emotions [23].

4. Under the action of new beliefs and new emotional state, the subject generates new wishes through the wish update module, and then generates new goals and intentions until the behavior is generated under the action of intention and commitment to act on the external environment.

Embedding the emotion update module into the model of the original BDI subject, we propose an emotion subject architecture based on the calculation and judgment of

https://doi.org/10.17993/3cemp.2024.130153.273-289

emotion intensity, which contains the above emotion update process, and the emotion master map is updated as shown in Figure 2. The emotion update module in the figure represents the cognitive evaluation part, and a subject with normal emotion will continuously repeat the above process in the environment to make emotion update and response to the changes in the external environment. The role of the emotion master map update module is to update the emotion master map, a system that records the subject's current emotional state and cognition of changes in the external environment. The cognitive evaluation part involves the subject's cognitive evaluation of changes in the external environment, including the subject's perception and assessment of events, behaviors, or beliefs in the environment. Under normal circumstances, the subject has a certain emotional base and makes corresponding emotional updates to changes in the external environment. The subject will continuously repeat the above process in the environment, which is a dynamic process, and the subject's perception and emotion of the environment may constantly change with time and external events, and this system helps the subject to better adapt and respond to the changing environment.

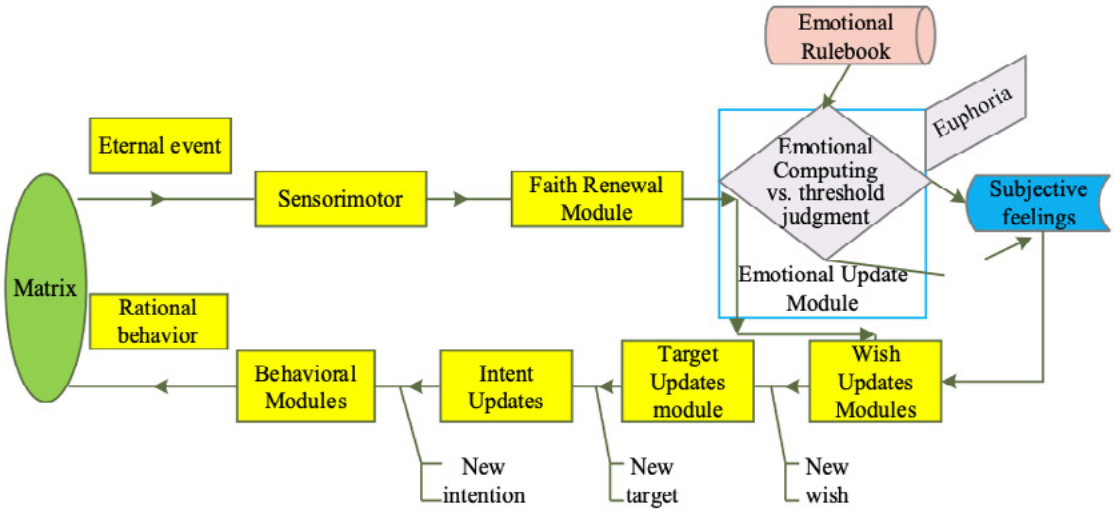


Figure 2. Emotionally intelligent subject update architecture

3.3. STAGE TASKS

3.3.1. DATA CRAWLING AND SENTIMENT CLASSIFICATION

Run a circular web crawl of ancient literature to crawl the data into the web. At this time there is no classification, labeling all the data mixed together.

First of all, the text of the web page obtained from the download is preprocessed to remove web page tags, such as $\langle a \rangle \langle \mid a \rangle$, etc., and remove meaningless symbols. In this paper, ICTCLAS software is used to carry out word division and lexical labeling, removing deactivated words, including pronouns, auxiliaries and so on. After

https://doi.org/10.17993/3cemp.2024.130153.273-289

completing the above processing, a piece of literary text is represented as a string of word combinations.

3.3.2. WORD CLASSIFICATION AND SENTIMENT WORD DETERMINATION

For textual sentiment analysis this paper uses the sentiment word judgment method and the classifier for words uses the plain Bayesian classifier [24]. The following describes the sentiment word judgment and word classifier used in this paper respectively.

The plain Bayesian classifier is based on Bayes' theorem as follows:

$$p(q \mid W) = \frac{P(W \mid q)P(q)}{P(W)} \tag{10}$$

In the equation, q denotes emotions, positive, negative and objective, and W denotes a type of overseas dissemination of literature network. For different emotions, $P(W)$is the same, and in the training corpus of texts, it is assumed that the number of tweets for several emotions is equal, so the size of $p(q \mid W)$ depends only on $P(W \mid q)$, and $p(q \mid W) \sim P(W \mid q)$ is obtained.

For the classified corpus, the sentiment words are then used to determine and analyze the utterance sentiment. After processing the textual information the emotional tendency label of the text is obtained, and each ancient literary work carries a label corresponding to it. Then the works with the same kind of label are stored in the same folder, so that the collection of works with the same kind of emotional tendency is obtained by classification.

4. ANALYSIS OF THE MEDIATIZATION OF ANCIENT LITERATURE ABROAD

4.1. DATA ACQUISITION AND SELECTION

1. Ancient literature is selected from the pre-Qin to Qing dynasties, such as poetry, prose, and opera.

2. Data sources include ancient literature, digital libraries, ancient literature databases, etc. Digital libraries provide online access to a large number of ancient literary works, while ancient literature databases focus on specific periods or literary genres.

3. Works from different literary genres, authors, and themes were collected to ensure diversity in the study.

https://doi.org/10.17993/3cemp.2024.130153.273-289

4. Using LSTM and recurrent neural network sentiment analysis models, the works of ancient literature were automatically sentiment labeled to extract the sentiment information in them. The sentiment information is further verified and adjusted through Bayesian classification to improve the accuracy of sentiment analysis. Combined with theme modeling and other techniques, the contextual relationship of the sentiment information is deeply excavated to reveal the deeper level of sentiment logic in the literary works.

4.2. RESULTS OF SENTIMENT ANALYSIS OF LITERARY WORKS

To gain a deeper understanding of overseas readers' reading habits and emotional engagement with ancient literature, in order to further reveal the emotional logic of the mediatization of ancient literature oriented to the overseas dissemination of Chinese culture. Table 1 shows the reading frequency of ancient literature by overseas readers in different time periods. Overseas readers' reading frequency is relatively high in their leisure time at work/study and before going to bed, which are 70% and 60% respectively. It shows that ancient literature plays an important role in readers' daily life and is widely used for relaxation and immersion in literary atmosphere. And this group of readers showed a high degree of emotional engagement while reading, covering a wide range of emotional elements, such as joy, sadness, anger and so on. Medium-frequency readers are 2-3 times a week and once a week, between 5% and 18%, and this group of readers shows some emotional engagement while reading, covering a medium range of emotional elements. Low-frequency readers were 2-3 times per month, with the lowest percentage of 2%, and this group of readers showed relatively low emotional engagement while reading, covering a more limited range of emotional elements. A relationship was found to exist between emotional engagement and cultural communication elements.

Table 1. Frequency of reading of ancient literature abroad

Time period	Percentage	Emotionally invested
Leisure time at work/study	70 %	High
Before going to bed	60 %	Middle
Holidays	29 %	Lower
On the way to work	18 %	Middle
Almost every day.	80 %	High
4-5 times per week	5 %	Middle
2-3 times per week	5 %	Middle
Once a week	4 %	Lower
2-3 times per month	2 %	Lower

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4.3. ANALYSIS OF THE ASSOCIATION BETWEEN EMOTIONS AND CULTURAL COMMUNICATION ELEMENTS

As Chinese culture continues to spread overseas, ancient literary works, as elements of cultural communication, carry rich emotional connotations and have attracted extensive research interest. This section aims to reveal the associations between emotions and cultural communication elements in order to understand more comprehensively how emotions affect the communication effects of ancient literary works overseas. The association between emotion and cultural communication elements is shown in Table 2, and the level of emotional engagement of different elements is obtained after emotional analysis of each cultural communication element, which is categorized into low, medium and high levels. The reading frequency scores of different cultural communication elements among overseas readers are expressed in the form of 1-10 points, with higher scores indicating higher reading frequency.

Literary themes showed high scores of 7.0 for both emotional engagement level and reading frequency, indicating that readers are highly interested and emotionally engaged in literary themes. Literary geography, literary social background, and literary values, emotional investment water: low, reading frequency scores of 0.5, 0.4, and 0.2, because of the relative abstraction or relatively low audience demand. Literary cultural heritage emotional investment level in the reading frequency rating of 6.0, showing that the literary work heritage traditional cultural elements can trigger the interest and emotional investment of readers. Among the elements with higher reading frequency ratings, such as literary themes, characterization, and plot settings, they all show a higher level of emotional engagement. This suggests that in the process of mediatization of ancient literary works, more compelling plots and profound characterization may be important factors that prompt readers to have a strong emotional experience.

Table 2. Association between emotions and elements of cultural communication

Cultural Communication Elements	Emotional engagement level	Reading Frequency Score
Literary Themes	Medium-high	7.0
Characterization	High	6.0
Literary Style	Medium	2.9
Literary Historical Context	Medium	1.8
Plot Setting	High	8.0
Literary Language	Medium High	0.5
Literary regions	Low	0.5
Literary social context	Medium-high	0.4
Literary values	Medium-high	0.2
Literary and Cultural Heritage	Medium	6.0

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4.4. EMOTIONAL CHANGES AND CULTURAL COMMUNICATION EVENTS

Emotional change plays a crucial role in the interaction between readers and literary works, and the close relationship between emotion and literary communication is revealed through the emotional logic analysis of cultural communication events. Table 3 shows the association between affective changes and cultural communication events, covering multiple aspects of cultural communication events, including literary festivals, movie screenings of literary adaptations, and traditional literary exhibitions. The affective changes triggered by each cultural communication event were assessed and categorized as low, medium, and high. The ancient literary works involved in each cultural communication event were clarified, and the readers' emotional feedback, such as enthusiasm, warmth, excitement, etc., during different cultural communication events were recorded.

Readers felt enthusiasm and warmth when reading "A Dream of Red Mansions", which inspired a strong interest in the literary festivals. Traditional literature exhibitions showed a moderate level of emotional changes, and readers felt intoxicated and reflective in The Book of Poetry. The translation of the new version of the Analects of Confucius triggered a medium-high level of emotional change, with readers feeling emotion and identification, showing that translation work has a positive impact on the re-expression of traditional literature. The recitation triggered a medium-high level of emotional change, with the ancient literary work Zhuangzi. Sense and resonance were experienced in that conveying literature through sound can stimulate a profound emotional experience. The digital display triggered a medium-high degree of emotional change, and the overseas communication of Zuozhuan felt moved and amazed, indicating that digital technology provides a new form of communication for literary works.

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Table 3. Association between emotional changes and cultural communication events

Cultural Communication Events	Degree of emotional change induced	Ancient Literary Works Involved	Emotional Feedback from Readers
Literary Festivals	Medium-high	Dream of the Red Chamber	Enthusiasm, warmth
Movie Adaptation of Literary Works Released	High	Journey to the West	Excited, expectant
Traditional Literature Exhibition	Medium	The Book of Poetry	Enchantment, reflection
New Translation of Ancient Literary Works	Medium-high	The Analects of Confucius	Sentiment, recognition
Web Promotion of Ancient Literary Works	High	The Water Margin	Praise, concern
Ancient Literature Recital	Medium-high	Zhuangzi	Feeling, resonance
Literature Forum	Medium	The Records of the Grand Historian	Discussion, exchange
Digital Display of Ancient Literary Works	Medium-high	Zuo Zhuan	Touching, marveling
Literary Education Promotion Activities	Medium	Lun Heng	Learning, Inspiring
Social Media Sharing of Ancient Literature	High	Chu Ci	Sharing, Liking

5. DISCUSSION

Future research could focus on the feedback and interaction of overseas audiences, and gain insight into the actual impact of literature in cross-cultural communication by investigating and analyzing the emotional resonance and interpretation of ancient literary works by overseas readers. This will help construct a more comprehensive model of literary communication that considers two-way influence and cultural dialog. In addition, with the development of digital technology, future research can also make use of emerging technological means such as virtual reality and digital media to explore how to present ancient literary works more vividly and improve the emotional engagement and experience of overseas audiences. Focusing on the communication impact of literary works in the context of international political and economic changes, we will explore how ancient literature has become a representative of cultural soft power at a specific historical moment, and what kind of emotional logic effect it has on the shaping of national image and cognition.

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6. CONCLUSION

Through constructing sentiment analysis and sentiment logic model, the following points are drawn from the in-depth understanding of overseas readers' reading habits and emotional commitment to ancient literary works:

1. Overseas readers' reading frequency during work/study leisure and before going to bed are 70% and 60% respectively, indicating that ancient literature plays an important role in readers' daily life. It is not only a reflection of the role of literature in relaxing the body and mind and immersing oneself in the literary atmosphere, but also implies that literature is widely used among overseas readers.

2. The emotional engagement level of the element of literary and cultural heritage is high, with a reading frequency score of 6.0. It indicates that in the process of mediatization of ancient literary works, emphasizing the heritage of traditional culture in literary works is an important factor in attracting readers.

3. "A Dream of Red Mansions" and literary festivals, the translation of the new version of "The Analects of Confucius" and emotional changes, as well as recitals and "Chuang Tzu" highlight the emotional impact of ancient literary works in cultural communication events, and provide substantial data support for the mediatization of literary works overseas.

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