Research on the Impact and Application of VR Technology on Regional Red Cultural Inheritance

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Abstract

Red culture in the new era embodies the core of Chinese spiritual civilization, such as ideals, beliefs, indomitability and struggle. Integrating red culture with regional characteristics into the people's cultural genes, and better inheriting and carrying it forward is not only the requirements of the Party and the state for every Chinese since the 18th Party Congress, but also the core issue of concern in this study. Focusing on this issue, we first analyse the dilemma of red culture inheritance from the current situation of red culture inheritance, and propose that the immersive experience based on virtual reality (VR) technology is the way that can break through the inheritance dilemma. Through the VR data of red culture, the effectiveness of the application of VR technology is studied in the way of group experiment, and the results of the study show that: Comparing with the control group, the VR group demonstrated a better data influence effect, with six out of the seven experiments showing statistically significant differences. As the experiments progressed, the impact of the experimental group gradually and significantly increased, and the persistence of its influence was significantly better than that of the control group. At the end of the experiments, the overall impact of the experimental group was significantly better than that of the control group. Effect is significantly better than the control group. According to the experimental results, this study proposes to construct a comprehensive all-media communication system to expand the dissemination coverage of red culture. It is suggested to build immersive red culture exhibition halls supported by VR technology, so as to enrich the experiential dissemination channels of red culture. Efforts should be made to create distinctive red cultural industry brands and further improve the complete industrial chain of red culture. Diversified application modes need to be developed to avoid homogenization and rigid stylization in the practical application of VR technology. Multiple social entities should be encouraged to participate collaboratively, forming a multi-dimensional and diversified development pattern for red culture inheritance. These integrated strategies can facilitate the broader dissemination and sustainable development of red culture, and ultimately boost the prosperous inheritance and innovation of this cultural heritage.

Keywords

The red culture, Virtual reality, Empirical research, Immersive experience

Introduction

Red culture is a modern and advanced cultural form formed by the fusion of Marxism and China's indigenous outstanding culture. The beliefs, spirit, traditions and merits contained in red culture, which has been constantly summarised and formed from historical revolutionary events, are the valuable cultural heritage of the Chinese nation. We Communists have been concerned about the inheritance of red culture since the beginning. As early as in the revolutionary period, Comrade Li Dazhao pointed out that red events and culture exist in the memory and imagination of later people, which is a kind of inheritance. Since the 18th National Congress of the Party, the inheritance and promotion of red culture has received even more attention from the Party Central Committee. Local governments have widely implemented a range of initiatives, including red resource conservation and oral history documentation, yielding notable outcomes.

These efforts have transformed red resources into vivid educational materials that inspire patriotic sentiment and foster national spirit, thereby endowing red culture with renewed vitality. However, we should also objectively see that there are some discordant remarks in the network and reality, which are contrary to the mainstream values. People living in a peaceful era far from wartime hardships gradually weaken their emotional identification with red historical events and arduous revolutionary years. This phenomenon leads to an inheritance dilemma of red culture among college youth, impairs the effectiveness of red cultural heritage to a certain extent, and highlights the urgent need to strengthen the inheritance of red genes among contemporary young students [1,2].

How can we break through these inheritance dilemmas? It is necessary to integrate multiple perspectives and theories to inject innovation and technology factors of the new era, and seek innovative development paths. It should be acknowledged that modern science and technology may indirectly provide opportunities for the spread of foreign cultural trends and nihilistic thoughts. Nevertheless, modern technology also offers strong support for the inheritance and promotion of red culture, enabling red culture to achieve continuous reshaping and innovative development amid contemporary changing perspectives. Red culture “is constantly being reshaped in the changing perspectives of the present”. In short, it should be supported by theory and realised by new technology, so as to give constant vitality to red culture and help it to be better inherited and promoted.

Dilemma and opportunity of red culture inheritance

General Secretary Xi Jinping has repeatedly emphasised that we should be firm in our cultural self-confidence, and has asked us to pass on and carry forward the excellent traditional Chinese culture in the light of the conditions of the new era. Red culture, as a valuable spiritual wealth gradually formed through the historical war, is an important part of the excellent traditional Chinese culture, which should be inherited and carried forward. The application of modern technology to the innovative development of red culture aligns with national policy imperatives, including calls to revisit red memories, promote the revolutionary spirit, and strengthen cultural confidence. As a representative of next-generation information technology, virtual reality (VR) offers broad applicability and high interactivity, making it particularly engaging for young audiences. This topic takes red culture as the research object, explores the new path of red culture innovation and inheritance, and the research conclusions and promotion have a certain reference role in the construction, development and inheritance of red culture.

At the same time, it is noteworthy that the Party and the state have always strongly advocated the inheritance and promotion of red culture. Nevertheless, some discordant remarks contrary to mainstream values still prevail online and in reality, trends such as foreign capitalist culture and historical nihilism persistently disparage and erode the connotation of red culture. Against the backdrop of the new era, the generation and dissemination of inappropriate remarks have exhibited distinct new characteristics. Such remarks permeate the ideological cognition of young people whose world outlooks, life attitudes, and values are not yet fully mature via the Internet and other channels, thereby questioning the socialist system and even inducing hostility toward state institutions and leaders. If such negative trends are not addressed timely and properly, they may erode the spiritual connotation and core values of red culture and further hinder its effective inheritance. Therefore, new challenges and dilemmas face the process of passing on and promoting regional red culture in the new era.

By analyzing online incidents triggered by similar inappropriate remarks, the essential cause behind these issues can be clearly identified. The departure of witnesses to red historical events implies that vivid first-hand memories of revolutionary history are gradually fading as an objective social reality. This trend weakens later generations’ immersive perception and cognitive understanding of red events and the revolutionary spirit of predecessors, thereby placing the inheritance of red culture under unprecedented new challenges and dilemmas. How can we break through these inheritance dilemmas? It is essential to integrate contemporary innovation and technological elements into red culture and explore innovative development pathways, red culture to be continuously reshaped amid evolving contemporary perspectives. Such integration endows red culture with enduring vitality, thereby

facilitating its effective inheritance and promotion [3].

Theoretical foundations

Current status of research on red culture

Since the 18th National Congress of the Party, under the guidance of the Party and state policies, red culture and red resources have gradually become a hot issue in the academic world, and although the relevant research started late, the research results are becoming more and more fruitful. Current research primarily focuses on conceptual interpretations of red culture from a cultural studies perspective, as well as its developmental pathways, the deconstruction of red cultural resources, the value of red cultural inheritance, and the role of subjective agency in inheritance practices.

Therefore, for the “red” culture, it is very important to understand the role of red culture and red resources. Therefore, there are more achievements on the meaning of key terms such as “red”, “resources” and “red culture”, and the protection, development and utilisation of resources in reality, but the research on how to better inherit and reconstruct the red resources is still not complete. However, the research on how to better inherit and reconstruct the red resources is still in the initial stage, and there are relatively few relevant studies, especially the lack of research on the inheritance path or reconstruction path [4].

In terms of inheritance practice, after nearly three years of the storm of the epidemic, people have become more appreciative of the superiority of socialism, and patriotic passion has continued to rise, setting off a fervour to revisit the red culture in the country. It is more of an opportunity for us to spread the story of red culture and pass on the genes of red culture. At the same time, it should be recognized that abundant red cultural resources spanning different historical periods are widely distributed across China. These resources present distinct spatial characteristics featuring extensive coverage and obvious regional agglomeration, accompanied by unique local styles and folk customs. Furthermore, the comprehensive development capacity of different regions and cities is difficult to achieve balanced progress. Accordingly, notable disparities currently exist in the inheritance and development of red culture across different regions and cities in China.

Advantages of VR technology

The new generation of information technology represented by VR has been gradually applied to the inheritance of red culture, compensating for the insufficient experiential perception and cognitive engagement inherent in traditional publicity and promotion methods, and serving as a crucial supporting approach for future red cultural heritage preservation. The immersive experience delivered by VR technology - allowing participants to fully engage with red cultural scenarios through high concentration and sensory integration into the cultural context - also constitutes the core research focus of this study. The “immersive” experience it provides, that is, the way in which the experiencer integrates into the cultural situation with highly concentrated attention and a sense of personal experience, and participates in the red cultural scene, is also the focus of this study.

VR technology is the abbreviation of virtual reality technology, which essentially originates from the advanced development of digital information technology. Relying on a virtual environment and taking visual perception as the main medium, it can offer participants immersive, interactive and multi-sensory experiential engagement [5,6].

Research on the application of VR technology

At present, scholars have explored the application of VR technology in red cultural inheritance. For instance, research indicates that the inheritance and reconstruction of red culture should balance objective conditions and subjective initiative, leveraging virtual technology to enhance experiential and cognitive engagement and embed red culture into public awareness. Studies have proposed that VR-enabled immersive communication can address the dissemination dilemmas of regional red culture. Based on ideological and political education reforms in higher education, research has confirmed that VR technology facilitates red cultural integration into college curricula, advocating innovative application models to overcome educational bottlenecks. Further work has highlighted the necessity of VR technology in secondary school Party history education, identifying challenges such as inadequate resources and low application frequency in current practices. Additionally, scholars have advocated the digital development and utilisation of red historical and cultural resources via VR technology, proposing embedded application frameworks for technological

integration.

In the practice of technological innovation for red culture, the application of VR technology in the preservation and dissemination of red heritage has become widespread in China's first-tier cities. For instance, in Jing'an District of Shanghai - a core area of the Party's early revolutionary activities - Red Cultural venues have leveraged "cloud live broadcasts" to guide audiences through the history of the Party's founding and the early workers' movement. Additionally, initiatives such as the "Explore Jing'an with One Mobile Phone - Jing'an Cultural Tourism VR Panoramic Map" have introduced QR code-based navigation, transforming revolutionary history into an audible, visual, and participatory experience [7,8].

In 2019, online and offline QR code-based tours covered 75% of Jing'an's memorial venues, serving as an effective mechanism for red cultural preservation and a distinctive branding vehicle for the district's red heritage. In Huangpu District's immersive Party history education in schools, the game "Sheathe the Sword" is played through VR glasses, an immersive interactive experience that allows participants to empathise with the revolutionaries of the past hundred years, and to feel a deeper sense of the good life of today.

In March 2021, an AI-generated anchor was launched in Beijing to introduce red cultural tourism resources and recommend 26 themed travel routes, offering audiences an innovative and immersive experience. On 1st July 2021, on the occasion of the 100th anniversary of the founding of the Communist Party of China (CPC), young netizens used AI technology to make revolutionary martyrs, such as Li Dazhao and Chen Yannian, "smile" through AI technology. "Smile", enabling a cross-century "eye-to-eye" connection with the audience. This transforms static textbook images into vivid, lifelike scenes, delivering a powerful psychological impact on viewers. Such immersive experiences evoke profound emotional resonance, reshaping red memories and fostering a deeper connection between red culture and the public.

Existing studies have laid a solid theoretical foundation for this research. In particular, the advent of the 5G era and the rapid advancement of new media and social platforms have provided robust technical support and feasible application pathways for the implementation of VR technology. Nevertheless, the application of VR technology in China remains in its initial stage; relevant scholarship mainly focuses on theoretical discourse while lacking sufficient empirical verification [9]. In addition, China's vast territory, regional characteristics are obvious, the level of economic and technological development is not balanced, resulting in the application of VR technology has an uneven development of the status quo, some small and medium-sized cities and the country's first-tier cities compared to the hardware facilities, the degree of attention or financial investment there is an obvious gap. This study expects to combine VR technology with business model innovation, transform the graphic red stories and red resources into hands-on scenarios, stimulate the emotional identity of the experiencers, create a local red culture brand effect, enhance the attractiveness of cultural communication, and expand the audience. To this end, this study is a group experiment to study the effect of applying VR technology in red culture communication.

Experimental design and development

Experimental participants

This study was limited by the relatively small number of VR devices and low adoption status locally, and thus took advantage of the convenience of VR devices at a 985 university to recruit undergraduate students from the university to participate in this group experiment, with a total of 20 participants, 10 males and 10 females.

Research design and analysis

(1) Twenty participants were divided into two groups, the experimental group (E) and the control group (C), with 10 participants in each group, numbered (E1-E10, C1-C10). In order to minimise the effect of gender differences in the experiment, a 1:1 ratio combination of men and women was taken for each group.

(2) The experimental group watched red culture VCR through the VR equipment, while the control group watched the graphic description of the same scene and story as the VCR. The experiment was conducted 7 times, once a day.

(3) The experimental data were collected by means of a questionnaire before the beginning and after the end of each experiment.

(4) Based on questionnaire survey data, preliminary analysis was performed using Excel, and further

analysis was conducted with SPSS 19.0. The experimental results were discussed to evaluate the application effect of VR technology more reliably.

Selection of key variables

To verify the effect magnitude of VR technology on the dissemination of red culture, three core variables were selected in this study. As a critical contextual atmosphere provider throughout the process, VR technology enables participants to effectively generate patriotic enthusiasm via personal perception and emotional investment derived from experimental engagement, whereby stronger patriotic emotion naturally corresponds to a better dissemination effect. The stronger the patriotic emotion, the better the immersive intervention effect. The fundamental experimental purpose of this study is to systematically observe the perception and commitment of the experiencers in different situations and their emotional fluctuations after the experiment, thus three core key variables are identified: "personal perception", "emotional commitment" and "patriotic passion", which are measured by questionnaires. The reliability test of the questionnaire was based on the questionnaire Cronbach's α requirement that the alpha value of the sub-questionnaires should generally be greater than 0.700 and at least not less than 0.600. The key variables and interpretations of each sub-questionnaire are as follows:

(1) Personal perception

The "personal perception" dimension was primarily adapted from established measurement scales in prior research. The questionnaire employs a five-point scoring system, with higher scores indicating a greater degree of perceived information at the time of the experience. The internal consistency of this scale in this study, the Clonbach coefficient α, is 0.822, which meets the experimental requirements. The variables and their interpretation are shown in Table 1.

Table 1. "Personal perception" variables and their explanations.

Variable name	Conceptual
Perceived expectations	The results or level of fulfilment expected by the individual during the period of participation in the experiment
Perceived informativeness	The amount of information or satisfaction that individuals expect to receive while participating in the experiment
Perceptual environment	Individuals' desired environment or level of fulfilment when participating in the experiment

(2) Emotional engagement

The "emotional engagement" dimension has received relatively limited attention in existing research. Therefore, this study adapted and developed the corresponding subscale based on established behavioural engagement frameworks from prior empirical work. This process ensured its alignment with the research context of red cultural immersive experience. The questionnaire is scored on a 5-point scale, with higher scores indicating richer content provided. The internal consistency of this scale in this study clombach coefficient α is 0.630, which meets the requirements of the experiment. The variables and their interpretation are shown in Table 2.

Table 2. "Emotional engagement" variables and interpretation.

Variable name	Conceptual
Sustainability	Individuals are able to engage in activities for longer periods of time when participating in experiments
Concentration	Individuals are not susceptible to external stimuli when participating in experiments
Acceptability	Individuals are happy to accept arrangements when participating in experiments

(3) Patriotic passion

The "patriotic passion" section was primarily adapted from the patriotic effect subscale of an established college students' moral sentiment questionnaire developed in prior research. On the basis of this sub-questionnaire, some questions were adjusted and supplemented based on the research purpose of this study. The questionnaire is scored on a 5-point scale, with higher scores indicating more intense fluctuations in patriotic feelings at the time. The internal

consistency Kronbach coefficient α of this scale in this study is 0.762, which meets the experimental requirements. The variables and their interpretations are shown in Table 3.

Table 3. Variables and explanations of "patriotic passion".

Variable name	Conceptual
National pride	A feeling of high recognition, confidence and optimism in the history, culture, traditional spirit, values, reality and future development of the nation.
Political	An emotional and conscious sense of belonging
Identity	arising from socio-political life.

Experimental results and discussion

(1) The experiment was statistically conducted by a one-sample bilateral t-test to measure the effect size in terms of Cohen's d and to give the specific effect size in terms of ES values, with Cohen's d values ranging strictly from 0.000 to 1.000. The description of the size of the value is as follows: The larger the value, the larger the magnitude of the difference; 0.000<Cohen's d≤0.200, indicating a small effect (small magnitude of difference); 0.200<Cohen's d≤0.800, i.e., around 0.500, indicating a medium effect (medium magnitude of difference); Cohen's d>0.800, indicating a large effect (large magnitude of difference).

Based on the results and preliminary analyses of the experimental data, we conducted a two-tailed paired t-test for each group to compare scores before and after the experiment. For the experimental group (E), the scores experimental effect (M=6.670, SD=4.472), showing statistical significance near the boundaries (t=1.217, p=0.024) for the last experiment as shown in Tables 4 - 5. Cohen's d=0.577, indicating medium effect, with an effect size of 0.274. Of the seven measurement time points, one Cohen's d result showed a small effect, the remaining six showed greater than 0.400, indicating a better experimental effect, and the effects and effect sizes for the seven times are shown in Table 6.

Table 4. Group statistics.

Variable	Groups	N	Average value	Standard deviation	Standard error of the mean
Effect	E	10	6.670	4.472	1.491
	C	10	4.440	3.167	1.056

Table 5. Independent sample tests.

Variable		Levene's Test for variance equation		t-test for the mean equation						
		F	p	t	df	p	Mean value difference	Standard error value	95% confidence Interval for the difference	
									lower limit	limit
Effect	Assuming variances are equal	5.176	0.037	1.217	16.000	0.124	2.222	1.827	−1.650	6.094
Effect	Assuming that the variances are not equal	/	/	1.217	14.411	0.024	2.222	1.827	−1.685	6.129

Table 6. Effects and effect sizes for the 7 sub-effects.

Indicator	Effect of 1 time	Effects of 2 times	Effects of 3 times	Effects of 4 times	Effects of 5 times	Effects of 6 times	Effects of 7 times
VR group mean	8.470	7.800	5.330	7.800	9.000	6.400	5.140
VR group standard deviation	10.470	10.460	13.170	8.270	9.810	5.850	4.310
Meditation group average	12.400	7.600	9.200	12.000	9.200	7.600	7.000
Meditation group standard deviation	5.680	1.820	4.600	5.960	3.560	2.410	1.830
Cohen's d	0.457	0.826	0.650	0.280	0.637	0.589	0.577
Effect size(r)	0.290	0.162	0.247	0.202	0.131	0.299	0.274

(2) For the experimental data of the experimental group, Paired t-test was used to verify the correlation between the 7th experiment and the 1st experiment in order to check whether the intervention of the 7-day VR experiment has a sustained influence on the sense of personal experience and patriotic passion. It was found that the p-value of the two paired samples test was 0.033, which is less than 0.050, and therefore significant, i.e., the influence of the experimental group increased gradually and statistically as the experiment progressed. The relevant data are detailed in Tables 7 - 9.

Table 7. Statistics for paired samples.

Pair	Measure	Average value	N	Standard deviation	Standard error of the mean
Pair 1	Day1	45.444	10	5.790	1.930
	Day7	38.667	10	6.633	2.211

Table 8. Pairwise sample correlation coefficients.

Pair	Variables	N	Correlation coefficient	p
Pair 1	Day1 & Day7	10	0.093	0.812

Table 9. Paired samples test.

Pair		Paired differential					t	df	p
		Average value	Standard deviation	Standard error of the mean	95% confidence interval for the difference				
					Lower limit	Limit			
Pair 1	Day1 - Day7	6.778	7.934	2.645	0.679	12.876	2.563	8.000	0.033

(3) For the experimental data of the control group, a Paired t-test was used to verify the correlation between the 7th experiment and the 1st experiment, in order to check whether the intervention of the 7-day graphic experiment had a sustained influence on the sense of personal experience and patriotic passion. It was found that the p-value of the two paired-sample test was 0.407, which is greater than 0.050 and therefore not statistically significant, i.e., there was no significant change in the influence of the control group as the experiment gradually progressed. The relevant data are detailed in Tables 10-12.

Table 10. Statistics for paired samples.

Pair		Average value	N	Standard deviation	Standard error of the mean
Pair 1	Day 1	39.000	10	5.431	1.810
	Day 7	35.778	10	7.102	2.367

Table 11. Pairwise sample correlation coefficients.

Pair		N	correlation coefficient	p
Pair 1	Day1 & Day7	10	−0.548	0.127

Table 12. Paired samples test.

Pair	Paired differential					t	df	p
	Average value	Standard deviation	Standard error of the mean	95% confidence interval for the difference				
				Lower limit	Limit			
Pair 1	Day1 - Day7	3.222	11.054	3.685	−5.275	0.874	8.000	0.407

(4) In order to further verify whether the experimental group is more influential than the control group, the results after the 7th experiment were compared and analysed at the end of the experiment. The experimental data show that the p-value of assuming equal variance is 0.519, which is greater than 0.050, so the p-value of observing the first line of the t-test is 0.039 (see Tables 13 and 14), which is less than 0.050, so it can be assumed that the difference between the two is significant, i.e., after the 7th VR was better than the control group after the experiment and the difference between the two is statistically significant.

Table 13. Independent Sample Tests.

Variable		Levene's Test for variance equation		t-test for the mean equation						
		F	p	t	df	p	Mean value difference	Standard error value	95% confidence interval for the difference	
									Lower limit	Limit
Effect	Assuming variances are equal	0.434	0.519	0.892	16.000	0.039	2.889	3.239	−3.978	9.756
	Assuming that the variances are not equal	/	/	0.892	15.926	0.039	2.889	3.239	−3.980	9.759

Table 14. Group statistics.

Group	N	Average value	Standard deviation	Standard error of the mean
E	10	38.667	6.633	2.211
C	10	35.778	7.102	2.367

Countermeasures and recommendations for the inheritance of red culture

Through comparative experiments, it is found that the application of VR technology has a positive influence effect on the dissemination and inheritance of red culture, and the experimental effect is better than the dissemination in the form of graphics and text, for the experimental results and analyses, the countermeasures are proposed as follows.

Establishing a sound all-media communication system to expand the coverage of red culture communication

With the rapid development of information technology and the diversification of media forms, the construction of an all-media communication system has become an important means of cultural transmission and propaganda. Red culture is an important cultural heritage and an important content for patriotic education and revolutionary tradition education. In order to better disseminate red culture and promote the inheritance and development of revolutionary spirit, it is of great significance to establish a sound all-media communication system.

By building an all-media communication system, we can integrate all kinds of media resources, including newspapers, television, radio, the Internet and so on, to form diversified communication channels and expand the coverage of red culture. At the same time, we can also make use of modern information technology means, such as big data and artificial intelligence, to accurately assess and optimise the communication effect and improve the quality and effect of communication.

In the construction of an all-media communication system, a variety of measures can be taken. Firstly, we can strengthen in-depth cooperation with traditional media and make use of their authority and credibility to improve the communication effect of red culture. Secondly, we can broaden the new media communication channels by opening special websites and social media platforms to attract the attention and participation of more young audiences. In addition, we can also make use of new media forms such as short videos and live broadcasts to innovate communication methods and contents and improve the attractiveness and infectiousness of red culture.

Establishment of a red cultural pavilion with VR technology to increase the channels of red cultural experience

The integration and development with modern science and technology is a major embodiment of red cultural heritage and innovation, and an inevitable trend for future development. Historical facts are rooted in historical experience, whose core lies in memory experience. Modern technologies represented by the new generation of information technology, such as artificial intelligence, virtual reality and big data, empower the construction of intelligent culture. These technologies can digitize historical texts to form new communication modes, realize digital transformation and content customization, and pursue innovative development on the premise of respecting historical facts. By exploring red historical resources, we can continuously enrich and refine contemporary red classics and historical events, revitalize red resources, and fully restore historical scenes for participants, who can even immerse themselves in corresponding virtual scenarios. Participants can even walk directly into the virtual scene to experience the historical events that have happened, this process is not only the process of historical reconstruction, but also the process of memory reconstruction, and red culture also becomes rich and vivid in this process. At the same time, the application of a new generation of information technology can also help participants break through the limitations of time and space, immersive experience of historical events experienced by those who lived through them, thus triggering a stronger emotional resonance.

In order to display red culture more vividly and imaginatively, so that visitors can immerse themselves in the atmosphere of revolutionary history, the opening of red culture VR experience hall has become an important initiative. In the VR experience hall, visitors can enter a virtual three-dimensional scene through head-mounted equipment, all-round, multi-angle feel the charm of red culture. Through the use of advanced VR technology, historical scenes can be restored, and revolutionary events can be reproduced, so that visitors can feel as if they were in that era and have close contact with historical figures and events.

In the design of the VR experience hall, the scene can be reproduced according to the historical information and the actual situation. For example, the streets, battle scenes, meeting scenes, etc. of the revolutionary period can be simulated so that visitors can feel the atmosphere and historical background of that era. At the same time, the immersion and realism of the visitors can be enhanced through diversified sensory experiences such as sound, light and vibration.

By opening red culture VR experience hall, it can provide visitors with an immersive experience opportunity, allowing them to more deeply understand

the connotation and value of red culture. At the same time, the VR experience hall can also inject new vitality into the local tourism industry, attract more tourists to visit and experience, and promote the development of the local economy.

Creating red cultural industry brands and improving the red cultural industry chain

In today's competitive cultural market, brand building is crucial to the development of industry. In order to better promote the red cultural industry and increase its visibility and influence, it is necessary to carefully create a brand with recognition and value [10]. The red cultural resources represented by the red tourism zones in some areas are quite well-known locally, but they are less well-known outside the province, especially compared with first-tier cities such as Beijing, Shanghai, Yan'an and other old revolutionary zones, which makes it difficult to form its own unique competitiveness. Therefore, the city's red cultural brand awareness should be made.

Firstly, the name and logo of the brand should reflect the characteristics and connotations of the regional red culture. Consideration can be given to using words and images related to revolution, heroes, or designing them in conjunction with local natural and cultural landscapes. At the same time, the colours and fonts of the brand should be in line with the brand image, combining with new-generation information technology to form a unique visual recognition system.

Secondly, the brand should have unique stories and values. It can show the deep heritage and contemporary value of regional red culture by mining historical events and character stories. At the same time, the brand can also be combined with modern social values to convey the spiritual connotation of positivity and struggle. Brand communication can be promoted using a variety of channels and platforms. For example, it can be promoted online through social media, advertisements, public relations activities. It can also be promoted offline in cooperation with tourism, education and other institutions. At the same time, art forms such as film and television productions and cultural performances can also be used to enhance the brand's popularity and reputation.

Finally, brand building requires continuous innovation and optimisation. It should constantly pay attention to market dynamics and consumer needs, and launch cultural products and services that meet the trend of the times and consumer preferences. At the same time, it is also necessary to strengthen the protection of intellectual property rights and brand maintenance to ensure the long-term development and stable growth of the brand. From the perspective of industrial integration, it is essential to identify the boundaries of integration between red culture industry and other industrial sectors. This can be achieved through the design, development and innovative creation of derivative and peripheral products, as well as red-themed catering, accommodation and related physical spaces. Such efforts help construct an efficient and integrated red culture industrial chain, thereby enhancing public experience and extending consumption duration.

Developing multiple application modes to avoid programming of VR technology applications

Care needs to be taken in the use of VR technology to avoid the programming of its application, i.e., over-reliance on established experiences and processes and lack of innovation and flexibility.

Firstly, innovative thinking is emphasised in the design and development process. Although it is possible to refer to and learn from the experiences and practices of other successful cases, each project has its own unique needs and characteristics, which require customised design and development according to the actual situation. Through innovative thinking, new application scenarios and possibilities can be explored to make the application of VR technology richer and more diverse.

Secondly, it should focus on user experience and feedback. Users are the ultimate beneficiaries of VR technology applications, and their needs and feedback are the key to optimising and improving the applications. Therefore, close communication and cooperation should be maintained with users to understand their needs and expectations, and timely adjust and improve the design and functions of the application. Through the continuous optimisation of user experience and feedback, the application effect and quality of VR technology can be continuously improved.

In addition, emphasis should be placed on the continuous updating and development of technology. Virtual reality technology is a rapidly developing field,

and new technologies and methods are constantly emerging. Attention should be paid to the latest progress and trends in technology, and new technologies and methods should be introduced and applied in a timely manner, so that the application of VR technology is always smooth with the development trend of the times and science and technology.

Joint promotion by multiple subjects to form a multi-point development of red culture

In order to effectively promote the dissemination and development of red culture, it is necessary to clarify the rights and responsibilities of all relevant parties, and the formation of multi-party synergy is the key to promoting the dissemination of red culture. The joint participation of governments, enterprises, social organizations, media institutions, and individuals can facilitate the extensive dissemination and sustainable development of red culture across broader fields. This multi-stakeholder collaboration enables more people to understand, attach importance to, and recognize this valuable cultural heritage, thereby collectively boosting its prosperous inheritance and development.

Firstly, the government, as the leading force in the development of cultural industry, should take up the important responsibility of promoting the dissemination of red culture. The government can formulate and introduce relevant policies and plans while providing financial and technical support for the red cultural industry. In particular, it can fund the introduction of emerging technologies such as VR and the construction of supporting infrastructure, as well as cultivating professional talents to guarantee the daily operation and maintenance of relevant equipment. At the same time, enterprises and social capital are encouraged to enter this field to form a joint effort to build together. On the other hand, the government can also co-operate with universities and research institutes to strengthen red culture research and talent team building, providing strong intellectual support for industrial development. The government should also actively promote the combination of red culture with tourism, education and other industries, develop more cultural products and services with local characteristics, and improve the dissemination effect and market competitiveness of red culture.

Secondly, enterprises and social groups should also play an important role in the dissemination of red culture. Enterprises can launch more products and services featuring red culture through innovation and research and development to meet consumers' needs while contributing to the inheritance and development of red culture. Social groups, on the other hand, can organise and participate in various forms of red cultural activities, such as cultural performances, exhibitions and lectures, to expand the influence and coverage of red culture. In addition, enterprises and social groups can support the protection, inheritance and innovation of red culture through donations and investments, making positive contributions to the prosperity of this cultural heritage.

Finally, in addition to the important role that the media and social media platforms, also play in the dissemination of red culture, as mentioned earlier, individuals should also play their own role in the dissemination of red culture. They can improve their cultural literacy and cognitive level by learning and understanding red culture. At the same time, they can also experience and feel the charm of red culture by participating in various forms of Red Cultural activities and travelling. In addition, the value and significance of red culture can be conveyed through communication and sharing with others, influencing and infecting those around us. Through individual participation and contribution, we can jointly promote the dissemination and development of red culture in a wider social field.

Conclusion

The inheritance of red culture is closely related to our lives, and scientific research on it can enrich the relevant theories and be used to guide the practice. While the development and application of new technologies represented by VR technology will continuously give new elements to the culture. Therefore, we should increase the investment in relevant research, and at the same time, we should continue to try, innovate and breakthrough in practice, integrate multiple perspectives, multiple theories, and establish a synergistic evolution mechanism between the two, so that we can better realise red culture "into the brain into the heart" and "into the genes". Passed on from generation to generation. Unlike prior studies that merely explore the in-depth connotation and denotation of red culture, this research adopts a management perspective. It conducts empirical research via a

comparative experiment to examine the effects of VR technology on the dissemination and inheritance of red culture and further obtains statistically significant differential results. Proposing targeted optimization countermeasures based on empirical findings constitutes the core innovation of this study.

Due to the limitations of research time and objective conditions, this study only sets up one reference group for the experimental comparison of red cultural heritage effects. In addition, the experimental period is relatively short, and the research lacks verification support from a larger sample size and a longer time span. In future follow-up research, the sample size will be appropriately expanded. Moreover, AMOS structural equation modelling will be adopted to further explore and deeply analyse the correlation and influence mechanism among various influencing factors. More scientific and rigorous testing methods will also be employed to optimise and supplement relevant research, which is an important direction for future academic exploration.

Funding

This work was supported by Shandong Provincial Association for Science of Arts & Culture (Grant No. L2025Z05160820), and the Dongying Science Development Fund (Grant No. DJB2021009).

Acknowledgements

The authors would like to show sincere thanks to those techniques who have contributed to this research.

Conflicts of Interest

The authors declare no conflict of interest.

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