

THE INFLUENCE OF VIRTUAL REALITY (VRT) ON EXPERIENCE QUALITY AND INTENTIONAL BEHAVIOUR IN ZHENGZHOU

WANG, H.^{1,2*} – SEGUMPAN, R. G.¹

¹ *Faculty of Business, City University College of Science And Technology, Selangor, Malaysia.*

² *School of Accountancy, Luoyang Institute of Science and Technology, Luoyang, China.*

**Corresponding author
e-mail: Oppo_Cathering[at]163.com*

(Received 28th April 2025; revised 11th June 2025; accepted 25th June 2025)

Abstract. The global tourism sector, a vital engine for economic development and cultural preservation, is increasingly integrating virtual reality technology (VRT) to enhance visitor engagement. However, its impact on ecotourism experiences and behavioural intentions remains insufficiently explored. This study investigates the influence of VRT on experience quality and intentional behaviour among university students in Zhengzhou, located in the Yellow River Basin. Anchored in the Stimulus-Organism-Response (S-O-R) framework and Pleasure-Arousal-Dominance (PAD) model, a mixed-methods approach was adopted. A structured evaluation framework encompassing 28 indicators was constructed, supported by 1,934 valid responses from 525 university students. Using partial least squares structural equation modeling (PLS-SEM), the study identifies immersion, ecological validity, and user engagement as significant predictors of visitors' emotional responses and behavioural intent. The results underscore the transformative role of VRT in influencing destination appeal, enhancing user satisfaction, and fostering social media interaction. These findings not only fill critical gaps in virtual ecotourism research but also offer practical strategies for post-pandemic recovery and sustainable destination branding in heritage-rich regions of China.

Keywords: *virtual reality technology, experience quality, intentional behavior, SOR-PAD, China Yellow River Basin*

Introduction

Tourism has historically played a significant role in nurturing CPI development as a social foundation enterprise that promotes the human satisfaction index, local economic benefits, and employment opportunities for urban residents. As of the time this study was conducted, the probability of city growth in each crisis was inextricably linked to city tourism, and the majority of rivers continue to be closely associated with great cities and have become an important tourism resource in the modern era. Rivers are an essential yet surprisingly overlooked aspect of international tourism. Current research on tourism development in the Yellow River basin, according to analytic reality, centres on the evaluation of tourism resources, inter-regional cooperation, and the relationship between tourism development and ecological conservation. Due to the large differences in the Yellow River's natural resources, different cultures between the East and West, uneven population density and economic development between cities, tourism brands in each city due to a lack of creative tourism brands and a poor sense of tourism experience, tourism consumers are willing to choose a tourist city destination, consumer trust, and consumer purchase willingness in terms of negative choices. These studies lack an examination of visitors' perceptions of the acceptability of new tourism models

and technology. However, the field of study has always been limited to a single municipal unit, and comparative urban studies between river regions are scarce.

Yellow River tourism is a multidisciplinary field that cannot rely on a single disciplinary theory. Therefore, the application of consumer psychology and behavioral theory is increasingly of interest to researchers. According to research, the application of virtual reality (VR) in tourism would be a suitable and long-term contributor to the transformation. Whether in education, marketing (Huang et al., 2016), cultural heritage (Dieck and Jung, 2018; Dueholm and Smed, 2014), or sustainability, the technology offers novel and interactive ways to spread information. In the pre-visit phase, however, the potential of VR has been highlighted. VR is uniquely positioned to communicate the intangible qualities of a predominantly experiential product within the context of tourism marketing. Wearing a virtual reality (VR) headset and having the ability to interact with and compare potential destinations can assist consumers in making more informed decisions (Cheong, 1995). Some research suggests that persuasion can be bolstered by providing travellers with comprehensive destination experiences (Huang et al., 2016). According to previous research, virtual reality can influence the attitudes and behaviours of consumers as if they existed in a virtual environment, thereby enhancing their comfort and enjoyment and increasing the likelihood those potential visitors will visit. On the basis of technical analysis, it asserts that the factors that determine the sense of immersion for virtual reality consumers can be roughly categorised into three variables: immersion, ecological validity, and engagement. Digital marketing can encourage tourists to visit, and virtual reality (VR) is an innovative marketing medium that has been shown to boost tourism.

Engagement is a notably significant predictor of visitor presence. The greater the sense of presence, the more the user thinks, feels, and acts in VR and the greater the suppression of extraneous stimuli in the real world. Engagement is defined as "the shifting of the centre of the user's experience into the fictional world of experiencing VE 'from the inside'." Interactivity is a key factor in generating interest. Giving the user an active role in the experience has been shown to increase presence. Even with simple devices, the majority of researchers have discovered that physical control and manipulation of the display environment enhances the sense of presence. High interactivity in control and manipulation of VR HMDs with haptic devices correlates with users' sense of presence, according to several studies (Bogicevic et al., 2019). A growing number of studies have investigated the impact of virtual reality on customers' purchase journeys, changes in attitudes and behaviours towards destinations, and the acceptance of VR technology for travel planning (Disztinger et al., 2017; Huang et al., 2016). Due to the limited number and exploratory nature of these empirical studies on virtual reality as a marketing tool in tourist destinations, there are gaps in the literature regarding various dimensions of consumer behaviour and VR experiences. Research discovered that not only is the term virtual reality (VR) overused in tourism research, but the theoretical discussion surrounding VR is still based on 1980s concepts, adding to calls for more substantive and theoretical research in the field (Huang et al., 2016). Numerous extensions and adaptations of the SOR model have been applied to various research contexts to date. Numerous tourism industry researchers have utilised the SOR model or its extensions to examine the preparedness of visitors to implement a new technology, such as virtual reality (VR). Virtual reality makes the information-seeking experience quicker, more interactive, and more detailed, making it ideal for tourism. The significance of implementing virtual reality and its benefits in tourism offers long-

term benefits and can increase potential visits to tourist destinations; however, when people use a technology, they weigh the trade-off between the benefits (benefits) and costs (losses) of doing so.

This study will examine the impact of virtual reality technology on college students' consumption behaviour, ecotourism destination selection, and city reputation among high school students in the middle Yellow River reaches. The second objective is to examine the relationship between municipal reputation, university students' consumption patterns in the middle reaches of the Yellow River, and university students' selection of ecotourism destinations. Finally, examine the extent to which virtual reality technology has influenced changes in the consumption patterns and urban reputation of university students in the Yellow River region, as well as their future destination preferences for urban ecotourism. Numerous studies have demonstrated that COVID-19 and the energy crisis influence consumer attitudes and behaviours, and that tourism VR can provide multiple perspectives on the virtual reality tourism experience. Additionally, the quality of the experience and satisfaction with participation in VR tourism Ho influence consumer attitudes and behaviours. Therefore, virtual reality tourism can be an effective marketing and promotion instrument for destinations (Wang et al., 2022).

Tourism faces many problems if it is to continue to grow. In Chinese studies on VR technology and ecotourism, most respondents are younger or middle-aged, while older age groups are not well represented. Due to the limitations of objective conditions, most of the surveys could not reach city residents nationwide, and only some city residents could be taken as samples to be analysed; although the cities in central China are representative, China is vast and rich in resources, and the overall level of economy and values of city residents in different regions varies greatly, making the sample object slightly homogeneous. The main demographic group currently involved in VRT tourism is young people between the ages of 18 and 29. While this is consistent with the reality that young and middle-aged people use the Internet more frequently, other age groups can still be further modelled through offline research. Scholars found that by analysing the consumption behaviour of university student travellers in 2022, there are also differences in the characteristics of university student travellers' consumer behaviour, such as a diversity of motivations for consumption that are Mainly focusing on relaxation, innovation and entertainment, they prefer low-cost, economic and green ecological short-distance travel. College student tourists prefer natural scenery tourism brands with beautiful scenery and prominent themes. When college student tourists obtain tourism information, they are more inclined to obtain information and book corresponding services through information channels (Zhang, 2022). The main characteristics of this group are that they are generally highly educated, their incomes are relatively at the beginning stage, and a large proportion of them have monthly incomes of less than 10,000 yuan, with young males predominating. In terms of motivation, diversified motives play a decisive role in consumers' final consumption intention. Throughout the travelling decision-making process, one aspect of motivation may not only influence consumers, but also various stimuli may affect them at the same time.

Virtual reality technology has the characteristics of visualization, immersion, and interactivity, which can quickly reproduce real tourist attractions and bring a new revolution to the tourism experience. Existing research on virtual tourism experiences mainly focuses on sensory enjoyment and emotional experience (Disztinger et al., 2017;

Huang et al., 2016). Existence and presence are often used to measure the sensory enjoyment of virtual tourism users. Previous research on virtual reality technology and ecotourism was mostly limited to tourism promotion, and currently virtual tourism is still unable to meet the needs of consumers. It is necessary to analyze the quality of consumer experience and provide some suggestions for the development of virtual tourism functions. At the same time, it is possible to analyze the impact of consumer cognitive level and income level on consumer willingness to pay, and provide some suggestions for the development of virtual tourism. It involves participating in tourism, leisure, destinations, and consumption, all of which are real physical spaces in traditional situations. It is also used for participation in film tourism and music tourism. However, there is currently a lack of exploration for participating in virtual reality tourism (Wang, 2011). A few scholars' studies on ecotourism and VRT have explored the relationship between tourism participation and location attachment from a human geography perspective, focusing on people's interactions with real physical spaces. However, it is unclear whether people develop location attachment as a result of virtual reality tourism experiences (Wang, 2011).

Virtual reality tourism can create a connection between tourists and destinations and play an important role in guiding tourists to better appreciate destination attractions and elicit behavioural intentions. Most previous studies have explored the relationship between tourism participation, location attachment and behavioural intentions in traditional settings, and the impact of virtual reality tourism marketing on destination choice and decision-making. However, few researchers have focused on attitudes and behavioural intentions in virtual reality environments, especially decision-making through the mediating role of location attachment in virtual reality tourism (Wang, 2011). Due to the current stage of virtual tourism development, survey questionnaire results show that consumers have limited understanding of the existence of virtual tourism and their understanding of the quality of services provided. Consumers are in a Knight's uncertain decision-making environment. In this environment, consumers' price perception level has increased, and they prefer to use Willingness to pay as a reference point to judge market prices. Examine the differences and similarities between those who visited the destinations displayed in VR tourism and those who did not. In addition, future research may use the personality characteristics of prospective visitors as control variables (such as the five main personality traits and attachment patterns). This can be a valuable extension for analysing the behaviour of prospective visitors according to their individual characteristics. In addition, future research can use this theoretical research model to compare the behaviour of consumers using augmented reality (AR) and virtual reality (VR) in order for tourism-related businesses to utilise AR, VR, and MR technologies. The literature has demonstrated the validity of the attitude-behavior relationship theory and research on virtual reality tourism can apply the attitude-behavior context theory to better understand the experiences and behaviours of consumers in the context of virtual reality tourism.

The majority of studies on virtual tourism have employed functional perspectives to examine the intention of continued utilisation. Despite their significance, however, the effects of affective factors such as pleasure, arousal, and dominance on intention to engage in virtual tourism were ambiguous (Lee et al., 2020). Prior research has examined the effective application of virtual reality (VR) in tourism from a variety of perspectives and contexts; however, no exhaustive empirical research has examined the impact on visitors' consumption behaviour and destination choice outcomes. This study

will be constructing a framework to explain how VRT affects people's attitudes and behavioural intentions. Previous studies have used the TAM, S-O-R and AIDA models as well as the VRTI model (Wang et al., 2022), and future research may need to apply the SOR theory with PAD to other scenarios to determine if there are geographical or cultural differences. Future research could also apply multi-group analysis to investigate behavioural differences between two different consumer groups, such as how male and female consumer groups differ in their behavioural tendencies, and also investigate the similarities and differences between consumers who have experienced virtual tours and those who have not. In addition, future research could use the model to compare the behaviours of consumers who use augmented reality (AR) and those who use virtual reality (VR), enabling tourism-related businesses to make full use of AR, VR and MR technologies to improve the satisfaction and happiness of tourists experiencing virtual tours.

On the basis of extensive Field research, this paper uses a variety of qualitative research and analysis methods to conduct a comprehensive study of this problem for the first time. It examined the development of green eco-tourism brand between the national level and the ecological construction of three cities, and solved four problems: (1) In the face of COVID-19 and the Energy crisis, how can urban eco-tourism use virtual reality technology to help improve the reputation of urban eco-tourism and attract the attention of university students? (2) Under the influence of COVID-19 and the Energy crisis, what changes have taken place in college students' Consumer behaviour, and how do these changes affect college students' tendency to choose tourism destinations? (3) Why do 20-35 year old college students in the Yellow River Basin become more and more interested in brands related to green ecology, and what changes have taken place in college students' tourism Consumer behaviour due to urban ecotourism and virtual reality technology? (4) In the Big data model, more and more urban ecotourism has led to the decline of city reputation due to the same type. What are the factors that affect ecotourism cities in the middle reaches of the Yellow River to attract college students' attention and promote Consumer behaviour in many aspects with the help of virtual reality technology? Based on these research questions, the research objectives are as follows: (1) Analyse the relationship between immersion and experience quality when using VRT from the consumer perspective of university students. (2) Determine the impact of university student travellers' acceptance of VRT ecotourism on the quality of their ecotourism experience. (3) Analyse the relationship between engagement with VRT and consumer experience quality. (4) Examine the effect of VRT on consumers' virtual tourism participation intentions. (5) Examine the significance of VRT for social media engagement in Yellow River ecotourism development. Therefore, this study attempts to fill the gap in urban ecotourism development by answering the following research questions.

Central & related research question

Facing the emergency, what are the effects of VRT on the quality of experience and behaviour of university student tourism consumers in the middle Yellow River reaches of China? RQ1: In its application, the combination of Yellow River Ecotourism and VRT has demonstrated considerable appeal. How does the immersive experience of VRT appeal to university students' purchasing habits? RQ2: Under the influence of COVID-19 and the Energy crisis, What VRT green ecology-related policies have been implemented by the government to promote the growth of ecotourism communities, and

to what effect? RQ3: Why are 20-35 year old college students in the Yellow River Basin increasingly paying attention to tourism information related to green ecology? In the process of improving the integration of urban eco-tourism and virtual reality Technological convergence, how to improve the enthusiasm of university student tourists to actively participate in the development of urban eco-tourism? What factors may affect the positive feelings of university students on virtual reality technology? RQ4: College students will have many ideas in the process of participating in ecological virtual reality tourism. The PAD model will use big data analysis to investigate how the quality of university students' VRT experiences influences their intent to visit the Yellow River ecotourism city. RQ5: What are the interactions between the quality of consumer experience and social media engagement of university student visitors under the influence of VRT?

Mehrabian and Russel's S-O-R model is regarded as a relevant underpinning theory in human actions and behavioural studies. Empirically, most researchers employ the extended S-O-R model as the underpinning theory to examine the cause and effects among three main variables in their studies' structured conceptual framework. The S-O-R model is widely used to evaluate consumers' perceptions and behavioural intentions within a single integrated framework. The existing studies also prove the model's flexibility, allowing a range of variables to be incorporated and examined in research. Overall, the S-O-R model has proven to be a useful and flexible theoretical framework for investigating the complex interplay between stimuli, organisms, and responses in human behaviour. Its widespread use and adaptability highlight its value as a foundational theory for research in various fields. Virtual Reality (VR) technology is rebuilding travelers' perceptions of the tourist landscape, offering innovative ways to experience natural environments without a physical presence. Due to the varying academic backgrounds of the researchers, the definitions of ecotourism and virtual reality technology have been analysed differently. College tourists examined the decision-making process of their tourism selections, including the relationship between personal psychological and social factors and ecotourism. Notably, most researchers have modified the S-O-R model's application to suit their own study context and incorporated diverse factors into the integrated framework.

In the extended SOR model, numerous researchers have studied virtual reality tourism in different fields by constructing different variables. The compatibility or avoidance of negative experiences from consumer participation in virtual reality technology. But other scholars suggest that the use of virtual reality technology effectively enhances another structure of tourist visit intention as the ultimate response. In addition, the study also investigated favorable responses, such as specific settings of positive behavior models for tourism enterprises to provide a good immersive experience, and participation in accepting effective ecological validity, which help to increase visit intention and enhance social media engagement. Studies present VR as a new technology that is immersive and interactive, where individuals choose and tailor travel experiences and in which VR tourism positively moderates the tourist experience (Bogicevic et al., 2019). To better understand the relationship between university students' consumption behaviour and ecotourism, as well as tourists' intention to visit and engagement with virtual reality technology, the PAD model can be used to analyse the impact of tourists' consumption behaviour on ecotourism. The focus of the literature review in this study is on the application of VR technology in Yellow River tourism in China, targeting college student tourists. By integrating theoretical frameworks such as

Stimulus-Organism Response (S-O-R) theory, Pleasure-Arousal Dominance (PAD) model, and focusing on the concepts of immersion, ecological validity, engagement, intention to visit, and social media participation. This literature review highlights how VR technology can be effectively utilized in river tourism within China, particularly for university students. By employing theoretical frameworks like S-O-R and PAD, along with analyzing concepts such as immersion, ecological validity, and engagement, the review underscores VR's potential to transform educational tourism and promote environmental consciousness. Continued research is necessary to further explore the specific impacts of VR on different demographic groups within the university student population and to optimize VR content for educational and engagement purposes.

Tourism is regarded by the World Tourism Organisation as an essential means of achieving the third millennium objective; 80 percent of the 56 countries that have adopted poverty reduction strategies use tourism as a means of achieving economic growth, employment, and poverty reduction. According to Chinese government statistics in December 2021, tourism and affiliated industries will account for more than 4% of GDP between 2014 and 2020. Ecotourism is now widely accepted, and research indicates that accessing natural environments does not necessitate travelling to remote, natural ecological areas. Many intact ecological environments exist in urban locations and are readily accessible by public transport. Because COVID-19 and the energy crisis have not been completely eradicated at the time of this study, urban tourism has become a part of urban life and a means of satisfying the demand for tourism in the context of changing travel behaviours (Lin et al., 2022).

China's urban tourism research reveals a phase imbalance. The distinctions in municipal resource conditions are a result of the various urban development conditions. At various phases of sustainable urban development, different forms of development patterns emerge; consequently, different patterns of ecotourism city development and planning arise, and the corresponding patterns of construction and development change. In the absence of theoretical guidance, methodologies are in their infancy, and thus quantitative studies and mathematical methods of urban tourism are rarely employed. Similarly, the academic and tourism sectors have not yet conducted in-depth research on the development of urban tourism disciplines, the development of theoretical and methodological systems for urban tourism, the integrated management of urban tourism, the socio-cultural and ecological impacts of urban tourism, the differences in urban tourism phenomena and activities between regions, and the growth of tourism in regional town systems, city clusters. The research on urban tourism in China has been expanded from traditional landscape cities, historical capitals, and cultural cities such as Guilin, Xi'an, Quanzhou, Beijing, Nanjing, etc. to various cities, primarily regional central cities such as Hong Kong, Macau, Shanghai, Guangzhou, Wuhan, Xiamen, Kunming, Changsha, and Shantou, etc., indicating that the significance of urban tourism to the national economy has been widely acknowledged. Urban tourism research has a promising future despite the fact that it is presently limited to individual cities and not regional urban agglomerations.

The Yellow River Basin is situated in central China. The Yellow River Basin, which begins in the BayanHar Mountains of Qinghai province in western China, empties into the Bohai Sea Gulf in Shandong province. The Yellow River Basin spans approximately 1900 km east to west and 1100 km north to south. The Yellow River Basin has a highly variable topography, and its elevation progressively decreases from west to east. Complex are the natural conditions of topography, climate, hydrology, and vegetation.

Moreover, the social and economic development of the Yellow River Basin differs significantly. The eastern sections of the basin have a more evolved economy than the western parts. In Yellow River Basin, in addition to Han culture, there are Tibetan culture, Muslim culture, Mongolian culture, and other minority cultures, and the distinctions between their religions and folk customs are evident. The Yellow River is one of China's two most significant rivers. The Yellow River travels through nine provinces and thirty-three communities, thirteen of which are renowned tourist destinations. Existing research on China is limited to the Yangtze River Basin, as relatively few studies have been conducted on the scope of river basins. In contrast, the Yellow River Basin's complex development is the result of its unique natural geographical conditions. In response to the Chinese government's strategy for watershed ecological preservation and qualitative development, it is crucial to conduct research on urban ecotourism development in the Yellow River Basin.

Due to COVID-19 and energy shortage, the number of visitors has decreased in recent years, which has had a significant impact on the growth of local urban ecotourism and ecotourism brands. Numerous experts and academics from around the world have therefore investigated development competitiveness from ten perspectives, including ecological factor, environmental factor, cultural factor, educational factor, scientific factor, civil factor, brand factor, economic factor, market factor, and development potential factor. The ecological and landscape values constituting a substantial portion of their endogenous capital could stimulate their socioeconomic development, in which urban green tourism would play a crucial role. Shi examines the primary determinants of the per capita ecological footprint and city classification of sixteen of China's most popular tourist destinations from 2000 to 2017 (Shi et al., 2020). Due to the diverse types of tourist cities and varying levels of local culture and economic development, the majority of green eco-tourism brands in different cities are of varying quality, there is no unified measurement standard, and all parties lack a clear understanding of green eco-tourism brands, resulting in uneven green eco-tourism brands and stifled development. In the past three years, the majority of people have altered their travel habits, opting for brief city excursions to adapt to the impact of rising prices caused by the energy crisis and to remain healthy in the face of the epidemic, while also meeting their own travel requirements. People, for instance, typically plan trips to locations close to their residences, choose family and friends as travel companions, select ecological and open natural landscapes, and avoid public transport and peak holiday travel periods.

As personal, social, and biophysical factors are the subjects of virtual technology applications in urban ecotourism systems as well as the drivers of urban ecovirtual tourism brands, research must centre on people's attitudes, values, decisions, and lived experiences. Interviews with participating urban ecotourists were used to examine the viability of urban ecotourism branding and virtual technology use sites, as well as the relationship between college student tourists' consumption behaviour, psychological traits, and urban ecotourism. This is an effective method for answering research questions requiring additional evidence to disclose emotional dimensions and provide context reflecting how participants construct meaning and make decisions. Research instruments: In this study, questionnaire creation serves as the primary data collection method. Three comprehensive questionnaires will be chosen through in-depth interviews with experts and professors in order to test the research instrument. Subsequently, pilot testing were conducted to ensure the questionnaire's clarity and

suitability. This research employed a qualitative methodology. According to previous study, "qualitative research is oriented towards analysing concrete cases in their temporal and local particularity and starting from people's expressions and activities in their local contexts". In general, it can be stated that the goals of qualitative research include an investigation that: seeks to build an understanding of phenomena (i.e., human behaviour, cultural or social organisation); often focuses on meaning (i.e., how do people make sense of their lives, experiences, and understanding of the world?); may be descriptive: the research describes complex phenomena such as social or cultural differences; and may be interpretive: the results of the investigation are

These characteristics apply to qualitative research. This type of research will be able to capture a vast array of qualitative information with detailed descriptions and a wealth of nuances that are more valuable than a simple statement of quantity or frequency.

Materials and Methods

Method for collecting data: The analysis of multi-sample data guided the selection of the sample and aggregation of the data. This study obtained data from college student visitors in two tourist communities located in the middle Yellow River reaches. The questionnaires were distributed at random to 525 college student visitors in each city. They were instructed to complete the survey and return it to the interviewer (*Figure 1*).

Hypothesis 1: Immersive VRT will have a positive effect on the quality of ecotourism experiences for university students.

Hypothesis 2: The ecological validity of VRT leads to improved quality of ecotourism experience for university students.

Hypothesis 3: The involvement of VRT provides a good tourism experience for university students.

Hypothesis 4: Increased quality of experience is positively related to the number of college students' intention to visit ecotourism destinations.

Hypothesis 5: Improved quality of ecotourism experience attracts social media attention.

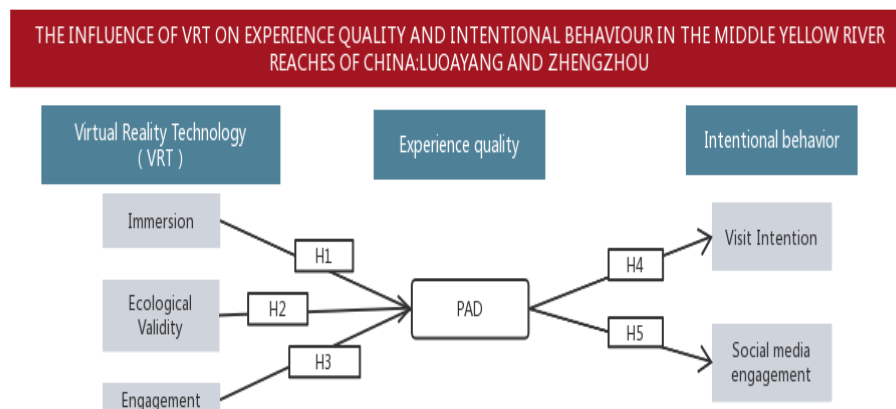


Figure 1. Research hypotheses.

This research will make use of an exploratory sequential mixed methods technique that was developed in order to gain a comprehensive understanding of the quality of

experience and expected conduct of tourists when virtual reality technology is utilised in ecotourism. The application of this approach will begin by placing an emphasis on the collecting and examination of qualitative data. Following this, the quantitative phase will be utilised to validate and verify the conclusions obtained in the qualitative phase. Two rounds of in-depth interviews are used to explore how tourists feel about the tourism experience and intention to visit in VRT. The data generated is then used to identify relevant variables, build a framework of hypotheses, and identify further questions to better refine consumer attitudes towards VRT. The second step will involve administering the questionnaire to people who have indicated that they had travelled with VRT. The purpose is to provide an overview of the research design, the instruments, the determination of the sample size, the data collecting and analysis, as well as the ethical problems involved. The goal of this study was to gather and analyse data in order to support or deny the following hypotheses: the variance reduction technique (VRT), experience quality, mediation theory SOR, and the association between PAD and purposeful activity (*Figure 2*).

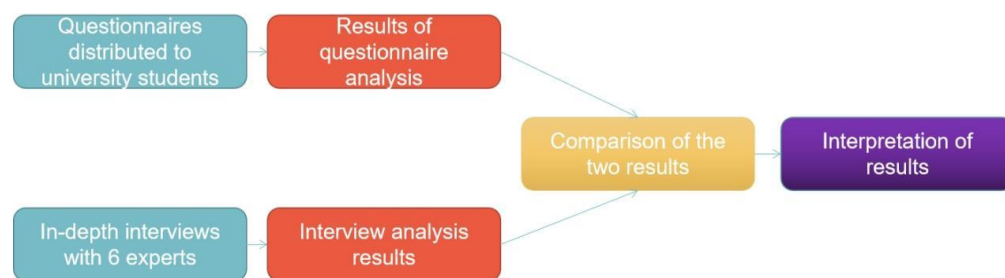


Figure 2. Mixed methods approach.

Results and Discussion

Independent sample t-test

The sample size required in the study was analyzed using the pwr package in R. Drawing on the findings, the independent samples t-test for analysis of variance was prespecified to have an effect size of $d=0.67$ (Cohen, 1988), and prespecified to have a statistical test power of $1-\beta=0.8$ and a significance level of $\alpha=0.05$, which indicated that a minimum of 28 subjects were needed in each group (*Figure 3*). The reliability analysis conducted in this study confirms that the measurement scales used to assess the different constructs-Immersion, Ecological Validity, Engagement, PAD (Pleasure-Arousal-Dominance), Visit Intention, and Social Media Engagement-exhibit strong internal consistency across all dimensions. This is evident from the high Cronbach's α coefficients observed for each scale, all of which exceed 0.9, indicating a high level of reliability. For example, the Cronbach's α coefficient for the Immersion scale is 0.975, with Corrected Item-Total Correlation (CITC) values ranging from 0.911 to 0.941, suggesting that each item within the scale consistently contributes to the overall reliability. This high internal consistency implies that the scales are robust and reliable, making them suitable for use in subsequent statistical analyses. A similar pattern of results was observed across the other scales. For instance, the Cronbach's α coefficients for the Ecological Validity and Engagement scales were also above 0.9, reinforcing the conclusion that the questionnaire is reliable in assessing the intended constructs.

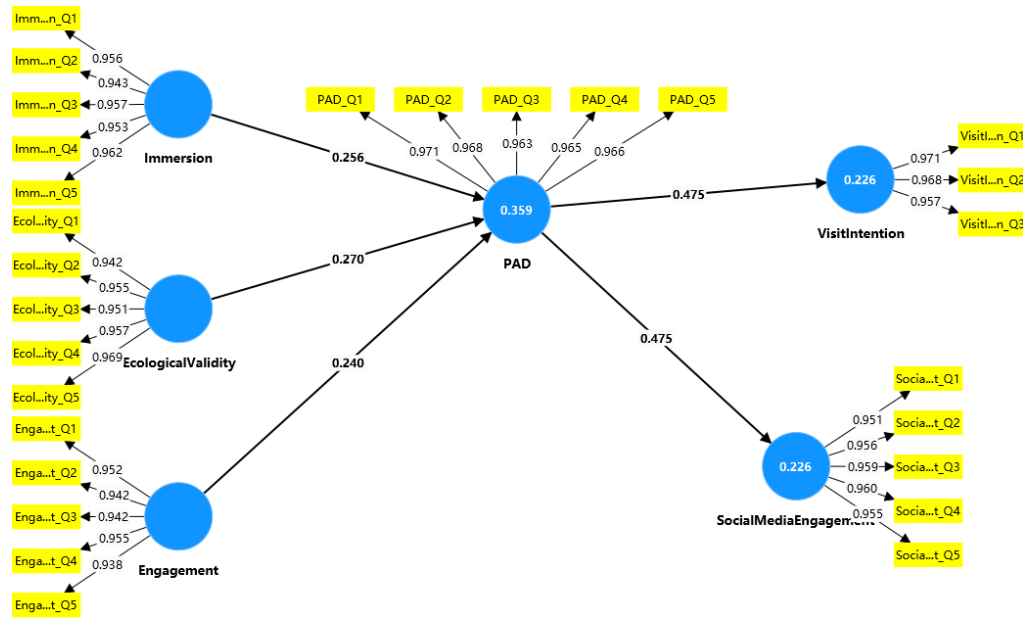


Figure 3. Structural Equation Model (SEM).

In addition to reliability, the validity analysis further supports the robustness of the measurement instruments. Validity in this context refers to the degree to which the scales accurately measure the constructs they are intended to measure. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, calculated at 0.955, and the Bartlett's test of sphericity, which yielded a significant result ($p < 0.05$), demonstrate that the data are appropriate for factor analysis. These results indicate that the dataset possesses the necessary correlations between variables, a requirement for conducting exploratory factor analysis (EFA). The EFA revealed that the first six principal components together account for a substantial proportion of the total variance, with the eigenvalue of the first principal component being 4.617, which explains 16.488% of the total variance. Furthermore, each factor loading exceeds 0.8, and the commonality for all items is above 0.881, confirming the structural validity of the questionnaire. These results suggest that the questionnaire effectively captures the underlying constructs it was designed to measure. The confirmatory factor analysis (CFA) results provide additional evidence for the convergent and discriminant validity of the scales. Convergent validity refers to the degree to which items within a scale are correlated, while discriminant validity assesses whether the constructs are sufficiently distinct from one another. The Average Variance Extracted (AVE) values for all six factors exceed 0.5, and the Composite Reliability (CR) values are above 0.7, indicating strong convergent validity. This means that the items within each factor converge well to measure the same underlying construct. In terms of discriminant validity, the square root of the AVE for each factor was greater than the maximum correlation with any other factor, confirming that the constructs are distinct from one another and not measuring the same underlying phenomenon. These findings support the robustness of the model and the distinctiveness of the constructs assessed.

The correlation analysis further emphasizes the relationships between the various dimensions of the study. Significant positive correlations were observed between different factors, indicating interrelatedness. Notably, strong correlations were found between Social Media Engagement and PAD ($r = 0.475^{***}$) and between Immersion and Visit Intention ($r = 0.456^{***}$). These correlations suggest that emotional experiences and

immersion play crucial roles in shaping tourists' intentions to visit a destination and their likelihood of engaging with tourism content on social media platforms. The emotional dimension of the PAD model-which encapsulates pleasure, arousal, and dominance-was particularly influential in both visit intentions and social media engagement. Finally, the structural equation modeling (SEM) analysis demonstrated that Immersion, Ecological Validity, and Engagement significantly predicted PAD, with a combined explanatory power of 35.9% ($R^2=0.359$). This indicates that these three variables together explain 35.9% of the variance in PAD, suggesting that they have a substantial impact on tourists' emotional experiences. Additionally, PAD was found to significantly influence both Visit Intention and Social Media Engagement, with path coefficients of 0.475 for both relationships. This suggests that the emotional states experienced by users of virtual reality technology (as captured by the PAD model) are critical drivers of their intentions to visit the destinations in real life and their engagement with related content on social media.

In summary, the results of the reliability and validity analyses indicate that the measurement instruments used in the study are both reliable and valid. The CFA and SEM analyses provide strong evidence for the hypothesized relationships in the model, highlighting the importance of immersion, ecological validity, and engagement in shaping tourists' emotional experiences, which, in turn, significantly influence their visit intentions and social media engagement. These findings underscore the critical role that virtual reality technology plays in modern tourism, particularly in enhancing user engagement and influencing behavioral outcomes in the context of tourism marketing. The current research explores the role of VR technology in improving experience quality and intentional behavior in tourism in the middle reaches of the Yellow River. From the perspective of users, when they experience a good quality of experience from VR technology, their intention to visit and social media engagement will significantly increase (H4, H5). New forms of virtual reality technology can effectively enhance the quality of ecological tourism experience for college students and attract their interest (Bogicevic et al., 2019), one of which is to elaborate that it focuses on visitors' stimulation and level of participation in VR. Another is quality, emphasizing the stimulation of tourists' feelings and emotions. Good VR technology production provides users with a great travel experience, leading to significant visit intentions and social participation. This study also explores the impact of immersive, ecologically effective, and participatory virtual reality on user visit intention and social media from the perspective of VR technology content. This finding suggests that when users receive good stimulation from virtual reality technology, their travel experience and intention behavior significantly improve (H1, H3). This conclusion confirms previous research based on immersive VR. Past studies believe that virtual reality technology is an important prerequisite for tourist presence. The current research provides evidence that this discovery also applies to the virtual reality tourism experience of the Yellow River. Finally, an interdisciplinary approach is recommended for future research. Collaborating with information technology experts would enable a deeper understanding of the technical aspects and key terms related to VR and AR in tourism. Such collaboration could also ensure that the practical application of these technologies is optimized without increasing the complexity of information retrieval for users. By bringing together expertise from fields such as computer science, tourism studies, and consumer psychology, future research could develop more comprehensive frameworks for analyzing and implementing VR and AR in tourism. This approach would not only

enhance the theoretical foundations but also offer more practical solutions for tourism managers seeking to integrate immersive technologies into their marketing strategies and tourist experiences.

Conclusion

In conclusion, the present research has made significant strides in illuminating the role of virtual reality (VR) and augmented reality (AR) within the context of Yellow River tourism. By investigating the influence of these technologies on visitor experience and behavioral intentions, this study offers valuable theoretical and practical insights. The findings contribute to a better understanding of how VR and AR can be leveraged to enhance the attractiveness of tourism destinations in the Yellow River Basin, especially in the face of challenges such as the post-COVID-19 recoveries and evolving tourist preferences. However, this research is just the beginning, and numerous opportunities for further exploration remain. Firstly, future studies could delve deeper into novel psychological factors. For instance, the concept of "tourist flow," which refers to the state of complete immersion and enjoyment during travel, has not been fully explored in relation to VR/AR applications. Understanding how VR and AR can induce and enhance this flow experience among tourists could provide a more comprehensive view of their impact on tourist satisfaction and revisit intentions. Technologically, there is a vast expanse to cover. The integration of VR/AR with emerging technologies such as 5G, which offers faster data transfer speeds, could revolutionize the real-time interactivity of virtual tours. Additionally, the potential of using haptic feedback devices in conjunction with VR/AR to create more immersive tactile experiences for tourists exploring the Yellow River's landscapes and cultural heritage sites remains largely uncharted.

Methodologically, future research should consider adopting more experimental approaches. Controlled laboratory experiments can help isolate the specific effects of VR/AR on tourist behavior, eliminating the confounding variables present in real-world settings. This would allow for more precise causal inferences and a better understanding of the underlying mechanisms. Finally, interdisciplinary collaboration is crucial for the future development of VR/AR in tourism. Bringing together experts from fields such as tourism management, psychology, computer science, and cultural heritage preservation can lead to more innovative and practical solutions. For example, psychologists can contribute to understanding the emotional and cognitive responses of tourists, while computer scientists can develop more advanced VR/AR algorithms and interfaces. Through such collaborative efforts, both the theoretical knowledge and practical applications of VR and AR in the Yellow River tourism industry can be significantly advanced, ensuring its sustainable growth in an increasingly digital world.

Acknowledgement

This research is self-funded.

Conflict of interest

The authors confirm that there is no conflict of interest involve with any parties in this research study.

REFERENCES

- [1] Bogicevic, V., Seo, S., Kandampully, J.A. (2019): Virtual reality presence as a preamble of tourism experience: The role of mental imagery. – *Tourism Management* 74(5): 55-64.
- [2] Cheong, R. (1995): The virtual threat to travel and tourism. – *Tourism Management* 16(6): 417-422.
- [3] Dieck, M.C., Jung, T. (2018): A theoretical model of mobile augmented reality acceptance in urban heritage tourism. – *Current Issues in tourism* 21(2): 154-174.
- [4] Disztinger, P., Schl, S., Groth, A. (2017): Technology acceptance of virtual reality for travel planning. – *Information and Communication Technologies in Tourism*, NewYork: Springer International Publishing 13p.
- [5] Dueholm, J., Smed, K.M. (2014): Heritage authenticities-A case study of authenticity perceptions at a Danish Heritage Site. – *Journal of Heritage Tourism* 9(4): 285-298.
- [6] Huang, T., Xi, J.C., Ge, Q.S. (2016): Spatial differences in rural tourism opportunities of residents in the Yangtze River Delta and their impact mechanisms. – *Resour. Sci.* 38: 2168-2180.
- [7] Lee, M., Lee, S.A., Jeong, M., Oh, H. (2020): Quality of virtual reality and its impacts on behavioral intention. – *International Journal of Hospitality Management* 90: 9p.
- [8] Lin, S.W., Wang, K.F., Chiu, Y.H. (2022): Effects of tourists' psychological perceptions and travel choice behaviors on the nonmarket value of urban ecotourism during the COVID-19 pandemic: Case study of the Maokong region in Taiwan. – *Cogent Social Sciences* 8(1): 1-35.
- [9] Shi, Y., Shao, C., Zhang, Z. (2020): Efficiency and driving factors of green development of tourist cities based on ecological footprint. – *Sustainability* 12(20): 23p.
- [10] Wang, F., Huang, S., Morrison, A.M., Wu, B. (2022): The effects of virtual reality tourism involvement on place attachment and behavioral intentions: Virtual reality tourism of the Yellow Crane Tower in Wuhan. – *Asia Pacific Journal of Tourism Research* 32(7): 274-289.
- [11] Wang, S. (2011): The model of tourism sustainable development in Jiaozuo. – In *Proceedings of the 2011 2nd International Conference on Artificial Intelligence, Management Science and Electronic Commerce (AIMSEC)* 4p.
- [12] Zhang, L. (2022): Characteristics of college students' tourism consumption behavior and market development strategies. – *Huasheng Online* 3p.