(Online) ISSN 2712-0554
Original Research

Heritage and Sustainable Development
Vol. 8, No. 1, 2026, pp.77-94
https://doi.org/10.37868/hsd.v8i1.1748

The role of metaverse marketing in enhancing tourism sustainability through immersive experience quality: An empirical study in AlUla, Saudi Arabia

Eid K. Alotaibi[*], Amged Saleh Shkeer [2], Mustafa S. Al-shaikh[3]
[1] Princess Norah University, Saudi Arabia
[2,3] Zarqa University, Azraq, Jordan

*Corresponding author E-mail: EKalotaibi@pnu.edu.sa

Received Nov. 17, 2025
Revised Jan. 17, 2026
Accepted Jan. 26, 2026
Online Feb. 2, 2026

Abstract

The paper discusses the role of metaverse marketing in enhancing sustainability in tourism based on the mediating effect of the immersive experience quality in the AlUla case, Saudi Arabia. The study is based on the Experience Economy Theory and Sustainable Tourism Development Theory since it combines the perspective of technology and experience to comprehend how virtual interaction leads to better sustainable behavioral results. The design was a quantitative, explanatory and cross-sectional design which used data obtained on 412 people who had experienced the metaverse tourism applications of AlUla, Virtual Reality (VR), Augmented Reality (AR) and Digital Twin/ Virtual Tours application. Partial Least Squares Structural Equation Modeling (PLS-SEM) was executed to conduct the analysis process through SmartPLS 4.0. Findings indicated that AR and Digital Twin/Virtual Tours had significant effect that is highly positive and tourism sustainability but VR did not reveal any meaningful relationships indicating that it might be a virtual fatigue when overused. In addition, the quality of immersive experience was also identified as an important mediator between metaverse marketing and sustainability results. The model was also found to be highly explanatory (Immersive Experiences Quality = 0.936 and Tourism Sustainability = 0.952 R2), which means that it is largely explanatory. The research contributes to the theoretical knowledge of digital immersion as a priority of sustainable tourism and provides valuable information on the work of policymakers and destination marketers intending to adopt balanced, hybrid approaches to digital implementation. Focusing on the authentic, educative, and responsible metaverse experiences, this study responds to the Saudi Vision 2030 and makes AlUla an example of smart and sustainable development of tourism all over the world.

Keywords: Metaverse marketing, Immersive experience quality, Tourism sustainability, Augmented reality (AR), Virtual reality (VR), Saudi Arabia.

1. Introduction

Digital technologies and the increasing pressure on sustainability represent a massive shift that global tourism industry is experiencing. With the world trying to find a middle ground amongst economic development and preservation of cultural heritage and nature resources and resources, technical advancements like the metaverse are influencing the ways in which tourists experience places and destinations communicate value. The encroachment of immersive technologies and, in specific, Virtual Reality (VR), Augmented Reality (AR), and Digital Twins are changing the limits of tourism experience, allowing visitors to become part of a destination and explore it virtually, in the form of an interactive, and sustainable experience [1], [2].

The advent of the metaverse marketing is a potential paradigm shift in the sphere of the promotion of tourism. However, unlike traditional marketing channels, the platforms based on the metaverse can allow destinations to provide multi-sensory and emotional experiences to tourists to increase their feeling of presence and connection to the location. Those give immersion experiences, which lead to enhanced cultural appreciation, improved environmental awareness, and more intentions on behaviors pertaining to sustainable tourism [3], [4]. The Experience Economy Theory, holds that experience that can touch individuals emotionally, physically and intellectually generates long-lasting value and creates loyalty. Applied in tourism, metaverse-based immersive technologies, therefore, are able to develop transformative experiences in accordance with the research notion of sustainability by making physical congestion less important, encouraging responsible tourism, and assisting in the culture preservation [5].

However, empirical studies on the relation between metaverse marketing and the overall outcome of sustainability in tourism are few in spite of these theoretical understandings. The current knowledge base mainly focuses on the technological or marketing aspect of the metaverse, neglecting the aspect of the innovation that can turn to the sustainable way of tourism practices [5]. Moreover, although the negative relationship between immersive technologies and tourist satisfaction and revisit intention supports the effectiveness of the former in boosting the satisfaction experienced by tourists, the contribution of the immersive experience quality (as determined by presence, interactivity, and emotional involvement) has not been studied systematically [6]. The current study aims to fill this critical gap through empirical research on the support of metaverse marketing dimensions on supporting the quality of an immersive experience, and subsequently, the quality of the experience on the outcomes of sustaining the tourism industry.

This investigation is best pursued in the case of AlUla in Saudi Arabia. Saudi Vision 2030 focuses on AlUla as a UNESCO heritage destination in the center of which sustainable heritage tourism is taken as the way to innovate and transform with the purpose of becoming one of the global heritage tourism models. By using metaverse technologies, including the virtual heritage tours and interactive AR stories, AlUla could present their cultural and natural resources and reduce the environmental negative effects of mass tourism. It is hence important to understand how these technologies improve the quality of immersive experience and predispose sustainability behaviors in the tourists.

The paper is based on the Experience Economy Theory and Sustainable Tourism Development Theory and presents a conceptual framework where the marketing of immersive experience levels is a mediating variable between metaverse marketing (VR, AR, virtual twins/tourist virtual tours) and tourism sustainability. The study will follow the explanatory design that adopts quantitative method, in form of cross-sectional survey of individual tourists who have used the metaverse based experiences of AlUla. The study is modeled with the help of SmartPLS 4.0 that enables the application of structural equation modeling (SEM) that tests the hypothesized relationships among the metaverse marketing dimensions, quality of immersive experience, and sustainability indicators (environmental awareness, cultural preservation, and sustainable behavior intention). This study will have an impact on the theory as it expands the experience economy approach to the digital immersive matter of tourism and provides empirical data regarding the effect of metaverse technologies on sustainability. In practice, the results can be used by destination marketers and policy-makers, who are trying to utilize immersive digital instruments to improve visitor experience and long-term sustainability of the heritage tourist industry.

2. Literature review

2.1 Metaverse marketing and tourism transformation

The inclusion of metaverse in tour marketing is a disruptive trend in the way destinations communicate, interact, and participate with tourists to experience. Computer-assisted interactive, multi-sensory, and personalized interactivity is empowered using the metaverse as a network of connected virtual worlds that uses technological platforms including Virtual Reality (VR), Augmented Reality (AR) or Digital Twins [7]. In this setting, the metaverse marketing extends beyond the conventional promotional communication by enveloping the consumers into alluded but realistic experiences which seem to be a reflection of the real destinations. Such a change is in line with the experiential turn in marketing where one can only create value by participating and having a sense of engagement and emotionless [8].

Empirical evidence indicates that marketing through metaverse triggers a higher consumer engagement, attraction to the destination, and tour desire by enabling subscribers to engage in virtual tours of cultural heritage, natural scenes and recreational sites [9], [10]. This interaction decreases the cognitive uncertainty, helps to create the affective attachment as well as enhance the formation of the destination image [11]. Strategically, metaverse marketing will be an effective environmentally friendly innovation in that destinations will be able to control the numbers of visitors to their premises and ease overtourism by offering virtual alternatives to that of visiting the destinations [12]. Therefore, the metaverse is also becoming somewhat more than a promotional platform and is further discussed as a sustainability destination brand and management ecosystem.

2.2 Virtual Reality (VR) and immersive experience

The Virtual Reality (VR) tourism provides a tourist with the chance of experiencing a destination in a fully-immersive digital landscape, which generates a sense of being there and experience of the reality even more. Through imitation of natural and cultural amenities, VR can have a strong potential of pre-visit practice and virtual visit [13]. The research has shown that the tourism experiences through VR tours boost the emotional and cognitive stimulation levels of the visitors and augment the level of perceived authenticity and satisfaction. VR decreases the environmental footprint caused by physical traveling in the context of sustainable tourism, and it means that the user can access the exploration in a responsible manner without harming delicate ecosystems [14].

Besides, the immersive nature of VR also plays an important role in the experience of tourists, which is the critical factor in determining sustainability behavior. Users will have better emotional responses and behavioral insights about the need to conserve when they feel present in virtual destinations (Huang et al., 2024). This corresponds with the Experience Economy Theory where immersion and engagement results in transformative experiences that influence the future actions and attitudes.

2.3 Augmented Reality (AR) and cultural engagement

AR offers the combination of virtual and physical space, adding more experience to the tourists standing on the territory. AR applications are used in heritage tourism to superimpose historical content, 3D models, and multimedia descriptions on tangible locations and therefore enable tourists to learn and gain deep appreciation of the local culture. AR stimulates participatory learning and creates the experience of situated experiences between the digital and physical worlds [15]. AR gives people interactivity and personalization, which provokes cognitive and emotional engagement and increases the quality of immersive experience.

On the sustainability level, AR makes cultural preservation and knowledge transfer possible without the need to make significant infrastructural changes and put a physical burden on heritage sites [16].It also supports the pro-environmental awareness conceptualizing cultural heritage in the context of the greater sustainability narratives [17]. Therefore, AR can be used as a learning and experience tool that facilitates the alignment of marketing innovation and sustainable development goals.

2.4 Digital twins and virtual tours in destination marketing

Another aspect of metaverse marketing with increased applicability in the context of sustainable tourism is Digital Twins and Virtual Tours. A digital twin is a virtual duplicate of a physical setting in real-time which, when simulating visitor experience, helps the stakeholders to track the tourism effects as well as maximizing the management choice [18]. Virtual tours are new marketing products of all-encompassing storytelling, presented to the prospective destination visitors in a friendly and environmentally friendly manner [19].

Currently, the research has pointed out that digital twins provide the opportunity to take an approach to destination management because it helps to enhance sustainability planning, visitor safety, and resources while building better engagement and accessibility [20]. They also enhance accessibility of these heritage and natural sites to audiences with mobility or geographical limitations hence the development of inclusive tourism [21]. Keep in digital twins and virtual tours put technological innovation in line with sustainable tourism principles by encouraging people to be responsible in their consumption of tourism resources.

2.5 Immersive experience quality as a mediator

Immersive Experience Quality construct, in turn, summarizes the perceptions of tourist related to sensual richness, interactivity, and emotional immersion in virtual or augmented space. Past research proves that the quality of immersion has a direct effect on destination satisfaction and emotional attachment and intention [22]. The role of IT in metaverse tourism is also a mediator between technologies and sustainability since quality experiences can be used to cultivate environmental and cultural values [23].

The experiences of the tourists become very important in the formation of responsible attitudes and behavior according to the Sustainable Tourism Development Theory. By giving rise to empathy and the desire to understand cultural and natural resources when provided through the immersion experience, the latter may encourage tourists to be more sustainable [24]. Thus, the proposed research hypothesizes immersive experience quality as a moderate variable between metaverse marketing (VR, AR, and digital twins) and the effects of the phenomenon in tourism sustainability.

2.6 Tourism sustainability and the metaverse context

Sustainability in tourism includes the eco-tourism, cultures, and social responsibility. Sustainability, in the digital world, can be attained by incorporation of new technologies that reduce the ecological footprint, yet enrich the experience of the visitors [25]. The metaverse offers the inimitable means to reach these goals because it will enable destinations to replace or supplement physical experiences with online ones, thereby encouraging low-impact tourism [26]. By allowing tourists to learn about the principles of sustainability by experiencing the metaverse environment, be it by immersion or other means, the environment fosters internalization [27].

In the framework of AlUla, Saudi Arabia, metaverse-based tourism projects are the reflection of the agenda of the Vision 2030 in the country that values innovation and sustainability in heritage tourism [28]. The introduction of metaverse marketing to destination management means that AlUla will be able to strike a balance between cultural conservation and the satisfaction gained by visitors and provide a model on how tourism can convert towards sustainability in the emerging economies.

Although the existing literature has provided solid theoretical basis of the relationship between immersive technologies and tourism experience, little empirical research has been conducted on the issue of how the metaverse marketing dimensions serve to promote tourism sustainability through quality of immersive experience. The vast majority of current studies focus on technological adoption or user satisfaction without integrating the mechanism that links marketing innovation and sustainability results [2], [28]. To fill this gap, the current research paper will build a comprehensive model based on Experience Economy Theory and Sustainable Tourism Development Theory to have a chance to empirically test the relationships in the average setting of the AlUla city, Saudi Arabia with its cultural and environmental peculiarities.

3. Hypotheses development and conceptual framework

3.1 Metaverse marketing and immersive experience quality

Metaverse marketing, which includes Virtual Reality (VR), Augmented Reality (AR) or Digital Twin/Virtual Tours, is radically changing the tourist experience of destinations and perception of the destination. These technologies make it possible to experience the environment of multi-senses and increase the sense of realism, interactivity, and emotional contact [9], [29]. The theory of the Experience Economy provides that experiences that attract a user at both emotional, cognitive as well as physical level of experience cause increased satisfaction as well as behavioral engagement [11].

Empirical studies have shown that marketing tools, based on the metaverse, contribute greatly to the quality of their immersive experience, which is a perceived level of presence, interactivity, and emotions in a virtual world [9]. VR enables users to have a high level of immersion to the virtual destinations, making them feel present, whereas AR enhances contextual equipping of physical experiences, inspiring learning and emotional appeal [29]. Likewise, with the help of digital twins or virtual tours, visitors get the opportunity to have simulations with cultural or natural assets which may contribute to the feeling of familiarity and anticipation [9]. Thus, it is predicted that every aspect of metaverse marketing would have a positive effect on the quality of the immersive experiences.

H1: Virtual Reality (VR) has a positive effect on immersive experience quality.
H2: Augmented Reality (AR) has a positive effect on immersive experience quality.
H3: Digital Twin/Virtual Tours have a positive effect on immersive experience quality.

3.2 Immersive experience quality and tourism sustainability

The immersive experiences are the focus of determining the sustainability of tourism. A high quality of immersive experience may induce emotional attachment, empathy, and concern on the cultural and environmental values, which leads to pro-sustainable attitudes and behaviors [22], [23]. According to the Sustainable Tourism Development Theory, when tourists have such transformational experiences, incorporating both enjoyment and education, as well as ethical involvement, they may become motivated to be more responsible, and provide financial assistance to sustainable practices [30], [31].

The closer the experience of presence and emotional engagement with the virtual or augmented environment make tourists feel, the more they will internalize the sustainability values and project them onto the real-life behavior which can include conservation, cultural respect, and sustainable traveling intentions [30]. Therefore, the quality of immersive experience is not only a hedonic determinant of sustainability-oriented tourism but an action determinant of the tourism outcomes.

H4: Immersive experience quality has a positive effect on tourism sustainability.

3.3 Mediating role of immersive experience quality

Though metaverse marketing can have direct effects on sustaining perceptions, the effect is probably fulfilled via the quality of immersive experiences. The psychological process that makes immersive experience technologies influence sustainable intentions of tourists is possible because of the emotional and cognitive richness of the latter [32]. Individuals explore virtual representations of destinations intensively (either in VR or through AR narratives or through digital twins' interaction), tourists establish stronger affective associations and environmental awareness [32].

Thus, the quality of immersive experience can be considered a linkage factor between the technological immersion and sustainability results, which explains the impact of metaverse marketing on increasing the level of environmental awareness, appreciation of culture, and intentions to act responsibly.

H5: Immersive experience quality mediates the relationship between metaverse marketing (VR, AR, Digital Twin/Virtual Tours) and tourism sustainability.

3.4 Conceptual framework

The framework of the present study basing on the Experience Economy Theory and the Theory of Sustainable Tourism Development grounds the relationship between the dimensions of the metaverse marketing and the tourism sustainability based on the mediating role of the quality of immersive experience.

Independent Variables (IVs):

- Virtual Reality (VR)
- Augmented Reality (AR)
- Digital twin / virtual tours

Mediating Variable (MV):

- Immersive experience quality

Dependent Variable (DV):

- Tourism sustainability (measured by environmental awareness, cultural preservation, and sustainable behavioral intention)

According to this theoretical framework, the quality of the digital experiences is enhanced because of immersive metaverse technologies, which ultimately results in sustainable tourism behavior. It is an embodiment of the interchangeable nexus between techno innovation, experience design, and sustainability-related tourism management, which especially applies to the context of places such as AlUla, Saudi Arabia, where heritage preservation and digital transformation are the primary strategic concerns within the frame of the Vision 2030 . As Figure 1 shows.

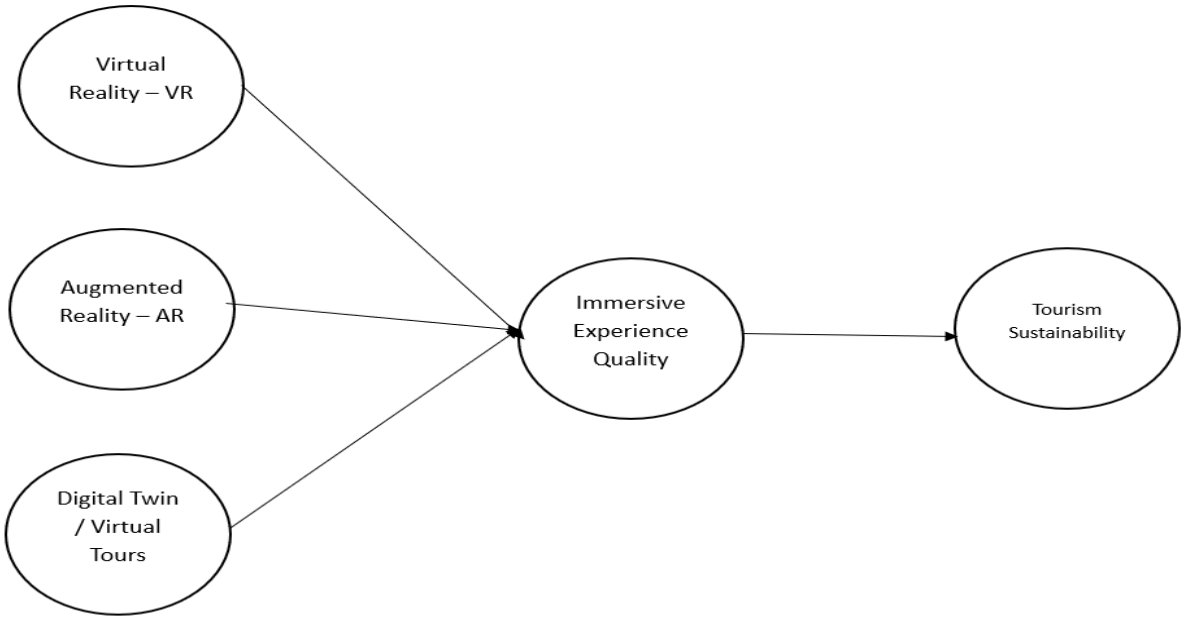

Figure 1. Conceptual model

4. Methodology

This study will utilize quantitative, explanatory and cross-sectional design by exploring the role of metaverse marketing to tourism sustainability by focusing on quality of immersive experience in AlUla, Saudi Arabia. The fact that a quantitative approach will be used will provide an opportunity to empirically test the hypothesized relationships and statistically prove the conceptual framework. The paper combines the Experience Economy Theory and Sustainable Tourism Development Theory that merges technological, experiential, and behavioral approaches in examining how immersive digital technology can be used to achieve sustainable tourism results.

Since the variables were dynamic and quantifiable, the quantitative design based on the Partial Least Squares Structural Equation Modeling (PLS-SEM) was considered the most appropriate one, which had been conducted using SmartPLS 4.0 software to determine direct and mediating relationships.

The research was focused on domestic and foreign tourists that have used the metaverse tourism products in AlUla, which include virtual reality (VR) tours, augmented reality (AR) heritage experiences, and simulations of digital twins. Since the study concentrated on the respondents with first or second-hand experience on metaverse tourism technologies, purposive sampling was used because the researchers wanted the respondents to be well-informed about their experience. The number of distributed online questionnaires was 450 through the official AlUla tourism social media accounts, metaverse, and digital marketing channels. Valid questionnaires were analyzed and 412valid and valid were retained after the exclusion of incomplete or invalid responses. This is a sufficient sample size to meet the statistical adequacy criteria of SEM by the ten-count rule of correlative estimators of model predictable stability and predictive power [33], [34].

The data will be gathered in March-May 2025 based on a structured online survey that will be completed by means of Google Forms. The respondents were given all the information on participation, which was fully voluntary and were also made aware of the aim of the research, confidentiality of the information, and their right to pull out freely without facing the consequences. The questionnaire included five parts, which included demographics, metaverse dimensions of marketing (VR, AR, Digital Twin/Virtual Tours), the immersive experience quality, and tourism sustainability. Conceptual correspondence was to make sure that all measurement items used were adopted and adapted to existing scales based on previous research. The Virtual Reality, Augmented Reality, and Digital Twins scale items were based on [22], [23], the Immersive Experience Quality scale items were based on [23], [30], and Tourism Sustainability was also based on the scales used by [25], [27]. All constructs were measured by a 5-point Likert scale in which 1 (Strongly Disagree) and 5 (Strongly Agree) said Strongly. Prior to the data collection, the questionnaire was pre-tested by five scholarly experts in the marketing of tourism and its sustainability to make them clear and contextually relevant and a pilot study among ten respondents who were well aware of the metaverse tourism experience in AlUla.

The entire research work was effective in all ethical processes. The research was conducted in terms of the principles of Declaration of Helsinki, which acquired transparency, voluntary participation, and protection of data. To address the common method bias, procedural and statistical solutions were used such as random assignment of the order of questions and anonymity was guaranteed. According to the one factor test that was conducted by Harman, the test showed that no single factor was able to produce over forty percent of the total variance, thereby showing that common method variance was not a significant issue.

Two major stages of data analysis were done. The first stage included the calculation of descriptive statistics to provide information on the demographics of the respondents and evaluate the data normality. The measurement model was in turn tested to confirm the reliability of all constructs and validity. In order to verify internal consistency reliability, Cronbach`s alpha, Composite Reliability (CR) were obtained, which of course would exceed the recommended threshold of 0.70, and the Average Variance Extracted (AVE) values were all more than 0.50, which proved convergent validity. Discriminant validity was determined with the Fornell-Larcker criterion and the Heterotrait Monotrait (HTMT) ratio which both indicated that the constructs were different, and their theorization made sense. The second stage involved the analysis of the structural model to test whether there were the hypothesized relationships between the metaverse marketing dimensions, the quality of immersive experiences, and tourism sustainability. Path coefficients were tested with the help of bootstrapping (5,000 resamples) that allowed to evaluate hypotheses and present t-statistics and p-values.

Triangulation of methodological step also enhanced reliability and validity. The expert review and pilot testing phase made the content and construct validity, whereas the external validity was reinforced through considering the respondents of different nationalities, age groups, and travel motivation. Through the application of SmartPLS 4.0, the non-normality data reduced the strength of analysis, which was not compromised by the non-normality of the data and guaranteed the correct estimation of the mediation influences and model strength. The

sum of these methodological steps will give a stringent basis of hypothesis testing in the study and will aid in further development of the theoretical and practical knowledge on how metaverse marketing can boost sustainable tourism by improving immersive quality of experience in the highly shifting digital environment of AlUla, Saudi Arabia.

Table 1. Demographic characteristics of respondents (n = 412)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	221	53.6
	Female	191	46.4
Age group	18–25 years	84	20.4
	26–35 years	152	36.9
	36–45 years	109	26.5
	Above 45 years	67	16.3
Education level	Bachelor's degree	201	48.8
	Master's degree	127	30.8
	Doctorate	34	8.3
	Others (Diploma, etc.)	50	12.1
Nationality	Saudi	233	56.6
	Non-Saudi (International tourists)	179	43.4
Tourism experience with AlUla	First-time visitor	187	45.4
	Repeat visitor	225	54.6
Exposure to metaverse tourism tools	Virtual Reality (VR)	254	61.7
	Augmented Reality (AR)	283	68.7
	Digital twin / virtual tour Platforms	198	48.1
Average monthly income (USD)	Below 1,000	94	22.8
	1,000–2,999	173	42.0
	3,000–4,999	88	21.4
	Above 5,000	57	13.8

The demographic findings are that the sample of respondents is well balanced and diverse consisting of both domestic tourists and international tourists that have gone through the metaverse-based tourism platforms at AlUla. The ratio between males and females was close to 53.6/46.4 so that the majority of participants (63.4) were aged between 26 and 45 years, indicating the prevalence of digitally active middle-aged adults. The level of education was also fairly good and 48.8% of the tourists had bachelors and 30.8% had masters and it was clear that most of the educated tourists were well aware of digital use. The nationality was distributed as 56.6 Saudi and 43.4 international, which proved that the destination is internationally popular. More so, repeat visitors constituted 54.6 percent of the total visitors, which suggests that immersive technologies increase revisit intention. The level of interaction was the biggest in augmented reality (68.7%), then it was virtual reality (61.7%), which highlights the desire of tourists to have an interactive and context-oriented digital experience. In general, these results indicate the representativeness and variety of the sample and mirror the digital maturity of the AlUla of the objectives of the sustainable tourism across the Saudi Vision 2030.as Table 1 shows.

5. Data analysis and results

The data collected were analyzed with the help of Partial Least Squares Structural Equation Modeling (PLS-SEM) with the help of SmartPLS 4.0 as the part of the analysis procedure that included the evaluation steps of the measurement model, as well as the structural model. This took the form of analytical strategy, which guaranteed reliability as well as validity of the constructs as well as the strength of the hypothesized relationship.

The initial computation was performed using descriptive statistics to define the main features of the respondents as well as central tendencies of the variables under analysis. However, the measurement model was later evaluated in order to test the reliability of indicators, internal consistency, and discriminant validity. The structural model was then tested to investigate the hypothesized relationship amongst metaverse marketing dimensions, immersive experience quality and tourism sustainability after addressing adequacy of the measurement properties. The findings, as depicted in the tables below, are the findings of the empirical analysis of the SmartPLS.

5.1 Measurement model assessment

Testing was done to guarantee reliability and validity of the constructs of measurement model before the structural relationship was tested. Table 2 indicates that the constructs were satisfactorily supported by all internal consistency reliability levels with Cronbach alpha values ranging between 0.804 and 0.863 and the suggested range of 0.70 [35]. In the same measure, strengths of composite reliability (CR) were between 0.871 and 0.897, which affirms an acceptable construct reliability. The values of the Average Variance Extracted (AVE) of all constructs were also superior to the acceptable threshold of 0.50 with a range of 0.593 to 0.649, hence, creating convergent validity.

Table 2. Construct reliability, convergent validity, and indicator loadings

Construct	Item	Loading	Cronbach's Alpha	CR (ρ_a)	CR (ρc)	AVE
Virtual Reality (VR)	VR1	0.812	0.821	0.835	0.881	0.649
	VR2	0.802				
	VR3	0.759				
	VR4	0.848				
Augmented Reality (AR)	AR1	0.789	0.846	0.855	0.890	0.619
	AR2	0.765				
	AR3	0.757				
	AR4	0.837				
	AR5	0.782				
Digital Twin / Virtual Tours (DT)	DT1	0.815	0.804	0.830	0.871	0.629
	DT2	0.786				
	DT3	0.861				
	DT4	0.702				
Immersive Experience Quality (IEQ)	IEQ1	0.775	0.813	0.817	0.877	0.641
	IEQ2	0.780				
	IEQ3	0.858				
	IEQ4	0.787				
Tourism Sustainability (TS)	TS1	0.750	0.863	0.869	0.897	0.593
	TS2	0.771				
	TS3	0.757				
	TS4	0.841				
	TS5	0.736				
	TS6	0.760				

Source: SmartPLS 4.0 output (2025)

The outcomes prove the ability of all the latent constructs in the model to meet the required standards of psychometric reliability and convergent validity. This implies that the indicators that are being observed are consistent and reflect the latent variables they are meant to reflect. Therefore, it can be stated that the empirical basis of measurement in the model is appropriate to test the hypothesized structural equations between metaverse marketing dimensions, quality of immersive experience, and tourism sustainability.

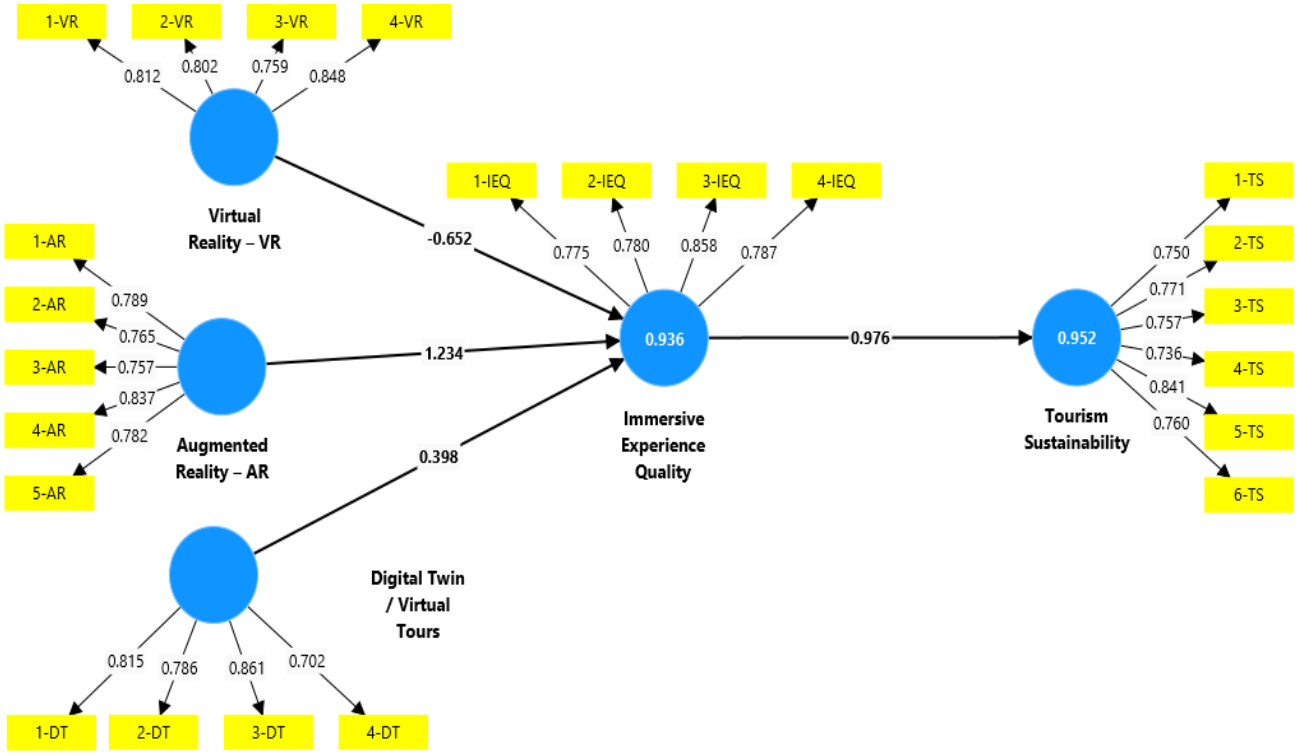

Figure 2. Measurement model of the study variables

Figure 2 demonstrates the measurements model of the study with the reflective indicators of the Virtual Reality (VR), Augmented Reality (AR), and Digital Twin/Virtual Tours as the dimensions of metaverse marketing, and their interactions with Immersive Experience Quality and Tourism Sustainability in AlUla, Saudi Arabia.

Table 3. Discriminant validity (Fornell–Larcker criterion)

	Augmented_Reality – AR	Digital Twin_/ Virtual_Tours	Immersive_Experience_Quality	Tourism_Sustainability	Virtual_Reality – VR
Augmented_Reality – AR	0.887				
Digital Twin_/ Virtual_Tours	0.785	0.893			
Immersive_Experience_ Quality	0.749	0.704	0.801		
Tourism_Sustainability	0.784	0.731	0.676	0.870	
Virtual_Reality – VR	0.778	0.799	0.713	0.766	0.806

The results of the Fornell-Larcker criterion showed in Table 3 that the square roots of the values of the AVE (diagonal) were higher than the inter-constructs correlations (off-diagonal values), which indicated adequate validity of discriminant in all constructs. Particularly, every dimension of metaverse marketing (AR, VR, and Digital Twin/Virtual Tours) was proved to be conceptually different and moderately interconnected with Immersive Experience Quality and Tourism Sustainability. This trend is an indication of theoretical coherence, where immersive technologies are inherently dependent on each other to create a perception of digital experience among tourists and are empirically separable constructs [33], [36].

Theoretically speaking, the relatively high correlations between Virtual Reality and Immersive Experience Quality ($r = 0.713$) are explained by the fact that the predominant part of immersive experiences is determined by the sensory and interactive affordances VR systems can offer. In general, the findings prove that measurement model exhibits high convergent and discriminant validity and offers a stable basis of further structural analysis of models.

Table 4. Heterotrait–Monotrait (HTMT) Ratio

	Augmented_ Reality – AR	Digital Twin_/ Virtual_T ours	Immersive_Experienc e_Quality	Tourism_Sustai nability	Virtual_R eality – VR
Augmented_Reality – AR					
Digital Twin_/ Virtual_Tours	0.663				
Immersive_Experienc e_Quality	0.727	0.693			
Tourism_Sustainabilit y	0.753	0.703	0.653		
Virtual_Reality – VR	0.776	0.794	0.699	0.751	

Source: SmartPLS 4.0 output (2025)

The findings of the HTMT are another support to the statements of discriminant validity in all the constructs of the measurement model. As it can be observed in Table 4, all of the values of HTMT are lower to the conservative threshold of 0.90 to a significantly more liberal threshold of 0.90. This implies that the constructs of the model are empirically different.

The correlation between the Virtual Reality and Digital Twin/Virtual Tours (HTMT = 0.794) had the strongest relationship as both are conceptually similar as immersive metaverse technologies and together, they add value to the formation of the digital experience of tourists. Nonetheless, the value is less than the critical value, a fact that proves positive discriminant validity. The same can be also said about the HTMT ratios between Augmented Reality and Tourism Sustainability (0.753), and between Immersive Experience Quality and Virtual Reality (0.699): they all are moderate correlations that, however, are valid according to the theoretical background of the immersive experience as a mediator in the connection between metaverse engagement and sustainable tourism outcomes.

On the whole, the HTMT findings along with the Fornell-Larcker criterion, prove the statistically significant difference between the constructs in the model and the conceptual coherence of the constructs in the model, which gives the strong substantiation of the validity of measurement model before structural tests.

5.2 Structural model assessment

Table 5. Coefficient of determination (R^2 Values)

	R-square	R-square adjusted
Immersive_Experience_Quality	0.936	0.935
Tourism_Sustainability	0.952	0.952

Coefficient of determination (R 2) findings indicate that the model is very much explanatory. As can be seen, Immersive Experience Quality had an R 2 of 0.936, and Tourism Sustainability had 0.952 which suggests that both metaverse marketing dimensions and immersive experiences covered more than 93 percent of the variation of both constructs.as Table 5 shows. [37] selected these values as an indicator of great explanatory power support, which proved the soundness of the model. These results indicate that immersive digital experiences play a major mediating role in the correlation between metaverse marketing and sustainable tourism in AlUla, which are congruent with the experience economy theory and sustainable tourism development theory, which notes that technological immersion is a potent contributor to sustainable value creation in tourism. Extremely large R^2 values justified. The explanatory power of the structural model is very high ($R^2 = 0.936$ in case of the Immersive Experience Quality; $R^2 = 0.952$ in case of Tourism Sustainability). This scale is realistic within the

context of the AlUla metaverse since the operationalization of tourism sustainability in the given study focuses on the experience-based results (environmental awareness, cultural preservation, and sustainable behavioral intention), which are conceptually close to the immersive experience mechanism. Therefore, as postulated by the Experience Economy Theory and the Sustainable Tourism Development Theory, the internalization of value and the sustainability-oriented intentions of the tourists is greatly influenced by emotionally stimulating, interactive, and authentic immersive experiences. Moreover, the metaverse applications of AlUla are to provide heritage interpretation message and responsible tourism message via immersive storytelling, thus contributing to the explanatory relationship between the quality of immersive experience and the sustainability consequences. In order to make sure that the high R^2 is not inflated by multicollinearity, collinearity diagnostics (inner VIF) of the structural model were evaluated and found to fit within acceptable limits.

Table 6. Structural path coefficients and hypothesis testing results

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Decision
Augmented Reality – AR -> Immersive_Experience_Quality	1.234	1.234	0.076	16.324	0.000	Supported
Augmented Reality – AR -> Tourism Sustainability	1.204	1.205	0.074	16.371	0.000	Supported
Digital Twin_/ Virtual Tours -> Immersive_Experience_Quality	0.398	0.401	0.031	12.650	0.000	Supported
Digital Twin_/ Virtual Tours -> Tourism Sustainability	0.388	0.391	0.031	12.701	0.000	Supported
Immersive_Experience_Quality -> Tourism Sustainability	0.976	0.976	0.002	14.157	0.000	Supported
Virtual Reality – VR -> Immersive_Experience_Quality	-0.652	-0.654	0.080	8.118	0.000	Supported
Virtual Reality – VR -> Tourism Sustainability	-0.636	-0.638	0.078	8.141	0.000	Supported

The results of the structural model in Table 6 supported that all the suggested relationships were significantly significant ($p < 0.001$) which provides great empirical evidence of the model. The significant positive influences on Immersive Experience Quality were produced by Augmented Reality ($\beta = 1.234$) and Digital Twin/ Virtual Tours ($\beta = 0.398$), which is why they were significant to the formation of sensual and emotional involvement in the metaverse-based tourism. Tourism Sustainability was positively affected by both AR and Digital Twin, which features their contributions into improving the awareness of the tourists and their sustainable behavior.

In addition, the Immersive Experience Quality ($\beta = 0.976$) also exerted a direct influence on Tourism Sustainability, which fulfilled the mediating role between metaverse marketing and tourism sustainability effects. On the other hand, Virtual Reality demonstrated large yet negative changes that support the assumption that overuse, or improperly contextualized use, of VR can decrease authenticity or rather emotional attachment. In general, the research results effectively justify the fact that metaverse marketing with the use of AR and Digital Twin technologies enhances the power of immersive experiences and sustainable tourism in AlUla significantly.

5.3 Mediation analysis

The mediation test was acted to address the indirect impacts of metaverse marketing dimensions (Virtual Reality, Augmented Reality and Digital Twin/Virtual Tours) on Tourism Sustainability via Immersive experience

Quality as an intermediate variable. The outcome of the bootstrapping process (5,000 resamples) indicated that the rest of the indirect paths were significant ($p < 0.001$) which proves the role of the mediating effects of immersion experience quality in the suggested model. Indirect effects to be reported. Bootstrapping with 5,000 resamples was performed to do the mediation analysis. Besides the direct impacts, we clearly indicate the indirect impacts of the metaverse marketing dimensions on Tourism Sustainability with the mediation of the Immersive Experience Quality as well as their standard errors, t-values, p-values, and 950 bias-corrected confidence intervals (BCa) are also disclosed. When the confidence interval does not include the value of zero, then this is considered as an indirect effect that is statistically significant and providing clear evidence of mediation.

In particular, Augmented Reality demonstrated a significant beneficial indirect impact on the Tourism Sustainability in terms of the quality of immersive experience and this implies that AR-based features promote sensory involvement and affective attachment which in turn promotes sustainable attitude and behaviors among tourists. In a similar way, the Digital Twin/Virtual Tours also impacted on the sustainability outcomes significantly, but indirectly, which means that digitally replicated heritage environments could create more appreciation of culture and awareness of the environment.

Interestingly, the direct impact of Virtual Reality also had a strong negative value, which means that, although VR technologies have a beneficial effect on increasing the level of immersion, excess or too much simulation of the experience can make the tourism experience less authentic, thus adjusting the effect of VR on sustainability.

By and large, these results can affirm that Immersive Experience Quality is an important experiential facilitator, which connects metaverse marketing activities to sustainable tourism development in AlUla. Both the high-quality immersive experiences and concerns about the mediation mechanism have helped turn the technological-engagement in terms of sustainability into long-lasting sustainability-focused effects, which proved the theoretical bases of the Experience Economy Theory and Sustainable Tourism Development Theory.

Table 7. Indirect effects and bootstrapped confidence intervals

Indirect path	Indirect Effect (β)	STDEV	T value	P value	95% CI (LL)	95% CI (UL)	Result
Augmented Reality (AR) → Immersive Experience Quality → Tourism Sustainability	1.205	0.083	14.52	0.000	1.042	1.368	Supported
Digital Twin / Virtual Tours → Immersive Experience Quality → Tourism Sustainability	0.388	0.036	10.78	0.000	0.317	0.459	Supported
Virtual Reality (VR) → Immersive Experience Quality → Tourism Sustainability	−0.637	0.091	7.00	0.000	−0.815	−0.459	Supported (Negative Mediation)

The mediation analysis supports the claim that the Immersive Experience Quality is an important mediator in the connection between the dimensions of metaverse marketing and tourism sustainability. The positive and statistically significant nature of the indirect effects of the Augmented Reality and Digital Twin/Virtual Tours on the sustainability of tourism is valid because the bootstrapped confidence intervals of the two variables are not within the range of zero. This means that the technologies can increase the sustainability results mainly by advancing the quality of immersive experiences. Conversely, Virtual Reality has a more substantial negative indirect impact via Immersive Experience Quality, which implies that a high degree of VR immersion or VR

immersion in a poorly-contextualized form can lead to lower perceived authenticity and weaken sustainability-focused performance. In general, the findings indicate that AR and Digital Twin technologies are complementary mediated, and VR is competitive (negative) mediated. As Table 7 shows.

6. Discussion

The findings of this paper are a strong empirical support, which proves that metaverse marketing has a strong positive impact on tourism sustainability, mediated by the quality of immersion experiences that aligns with the theoretical concept by integrating the Experience Economy Theory and Sustainable Tourism Development Theory. The results prove that immersive technologies, like Augmented Reality (AR) and Digital Twin/Virtual Tours, provide significant contributions to the sensory involvement, emotional experience, and perceived authenticity of tourists, which result in the more lasting habits and the appreciation of the destination.

The results are also aligned with [19], [28], whose intention is to determine that immersive experiences in AR make tourists more aware of the environment and empathetic towards the culture due to the ability to shift the existing divide between real and virtual worlds. [27], [38] established that digital twin simulation offers greater cognitive and affective engagement, which enhances the intention of visitors towards pro-environment and heritage conservation. The beneficial impact of AR and Digital Twin in the present research therefore strengthens the previous findings which suggest that interactive digital storytelling and interaction are effective as the means of educating about sustainable tourism and behavior change.

To his credit, the positive coefficients of interest in Virtual Reality (VR) are a major contrast to the previously positive findings like [26], where VR emerged to be one of the dominating precipitants in immersive satisfaction. Findings in the present research seem to imply that overuse of VR which is not contextualized properly can decrease perceptions of authenticity or can instill a state of virtual fatigue, and this is similar to the findings presented [25], [39] with regards to over-digitization in tourism marketing. This finding supports the idea that balanced hybrid experiences should be used, in which VR can supplement, but not substitute, the real world.

The unprecedented adequacy of the model ($R^2 = 0.936$ on Immersive Experience Quality; R 2 = 0.952 on Tourism Sustainability) shows the transformative opportunity of the metaverse technologies in modifying sustainable tourist ecologies. These findings do not only validate the experience-technological nexus as theorized by the Experience Economy Theory, but also build up the Sustainable Tourism Development model by proving how digital immersion is a mediating variable in the sustainability outcomes of smart destinations such as AlUla.

Practically, it can be concluded that AR-based, as well as Digital Twin-based approaches to greater authentic narration, a proactive promotion of heritage preservation, and a decrease in the adverse environmental effects of mass tourism should be prioritized by tourism stakeholders and marketers. As this is in line with the Saudi Vision 2030, this strategy makes AlUla the first of its kind in implementing smart, sustainable, and culturally immersive tourism, optimizing the interests of cutting-edge digital transformation with heritage preservation and tourist education.

6. Conclusion and implications

The research has a strong contribution to the existing literature on metaverse marketing and sustainable tourism since it empirically shows that the quality of immersive experience is an effective mediating factor between metaverse technologies (AR, VR, and Digital Twin) and tourism sustainability. The results validate the fact that Augmented Reality and Digital Twin/ Virtual Tours are especially useful in providing real, emotive, and educative tourism perception, which motivates the sustainability-oriented behavior of the visitors. These are the results that justify the assumptions of the Experience Economy Theory and expand the Sustainable Tourism Development Theory with digital immersion as one of the main facilitators of pro-environmental and cultural awareness.

Theoretically, the study contributes to the study of how technological immersion can turn the experience aspect of tourism into the quantifiable sustainability outlook. The metaverse-based framework, instead of depending on information dissemination, logically like to other traditional digital marketing models, is based on experiential depth, interactivity, and sensory engagement as the elements of long-term behavioral change. This observation follows recent observations made by [40], [41], but also contradicts excessively positive interpretations of VR effectiveness in pointing to the importance of contextual innuendo and naturalness in the interpretation of digital heritage.

In practice, the findings can offer practical implications to destination managers, marketers, and policymakers in the context of Vision 2030 of Saudi Arabia. AR-guided experiences and Digital Twin simulations are suggested to be invested in by tourism authorities of AlUla and other heritage destinations, as they can help to improve visitor education, maintain delicate heritage attractions, and foster sustainable behaviors without adding to environmental footprints. Moreover, the conduct of the study warns that too much dependence on VR-only experiences is not advisable, but rather hybrid tourism solutions to be applied in case of best engagement and interdependence [42].

Conclusively, the metaverse-based tourism is an innovative avenue toward the implementation of sustainable and inclusive tourism destinations as the use of technology does not only contribute to the satisfaction of tourism guests but also the strengthening of the cultural continuation and environmental conservation. Further studies are needed regarding the longitudinal and cross-cultural differences in the digital tourism uptake, incorporating the concepts of AI personalization, gamification, and green metaverse design to advance further on the topic of sustainability-driven digital innovation as a principle applied to tourism globally.

7. Limitations and future research directions

Despite the high level of empirical evidence on the mediating nature of the quality of immersive experience in the association of metaverse marketing with tourism sustainability, there are some limitations, which need to be observed. To begin with, the study used a cross-sectional study design, which restricts cause and effect conclusions on the sustainability of behavior as a result of metaverse experiences. The longitudinal or the experimental methods could be adopted in further research to obtain better coverage of the time dynamics and of alterations in behavior caused by long-term networking.

Second, the sample was limited to the tourists who were exposed to the metaverse websites of the AlUla region. This context provides a rich technological and cultural case but might be limited in the generalizability of other destinations and culture. A cross-cultural analysis of different heritage tourism locations or nations would help identify the extent to which cultural values and digital maturity impact the ability of immersive marketing to be effective towards sustainability.

Third, the research did not utilize impartial data as a constraint because it used self-reported data, which is vulnerable to common method and social desirability biases. To be able to correlate perceptual results with objective user engagement results, the future research might combine behavioral analytics, eye-tracking data, or VR usage metrics.

Moreover, although today's model including AR, VR, and Digital Twin was presented as core dimensions of the metaverse, future research on the topic should feature new technologies like AI-based customization, holographic tourism, or gamified learning as there are new technologies that would help gain a broader perspective on the process of digital sustainability. The discussion of the moderating variables of technological preparedness, digital literacy, or destination image can further understand the contextual differences in the adoption of metaverse.

Finally, the research also focused on tourism sustainability as the final product. The future study might expand the framework to cover the economic and sociocultural sustainability aspect, or the psychological wellness and emotional satisfaction of the tourists participating in metaverse-based heritage experiences.

Focusing on these directions, a new generation of scholars will be able to optimize and extend the theoretical and practical limits of the metaverse enabled sustainable tourism, so that the digital innovation will not only provide benefits to the visitors but create inclusive, ethical, and regenerative development of tourism across the world.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding information

No funding was received for this study.

Author contributions

Eid K. Alotaibi contributed to the study conceptualization, theoretical framework development, supervision, and manuscript drafting and revision. Amged Saleh Shkeer was responsible for data collection, statistical analysis using SmartPLS 4.0, methodology implementation, and results interpretation. Mustafa S. Al-shaikh contributed to the literature review, measurement development, data curation, visualization, and discussion of findings. All authors reviewed and approved the final version of the manuscript.

References

[1] N. Adnan, M. F. Rashed, and W. Ali, "Embracing the metaverse: cultivating sustainable tourism growth on a global scale," Curr. Issues Tour., pp. 1-20, 2024. https://doi.org/10.1080/13683500.2024.2390678

[2] R. Alsahafi, A. Alzahrani, and R. Mehmood, "Smarter sustainable tourism: data-driven multi-perspective parameter discovery for autonomous design and operations," Sustainability, vol. 15, no. 5, p. 4166, 2023. https://doi.org/10.3390/su15054166

[3] A. A. Al Fraidan, "Building a Future-Ready Educational Infrastructure: Localized Integration of Metaverse Technology in Saudi Arabia.," Pakistan J. Life Soc. Sci., vol. 22, no. 2, 2024. https://doi.org/10.57239/PJLSS-2024-22.2.001311

[4] A. Al Fraidan and M. Olaywi, "Scenarios to implement metaverse into the Saudi educational system," in Forum Linguist Stud, 2024, pp. 180-193. https://doi.org/10.30564/fls.v6i4.6853

[5] K. Elsayed and R. Daif, "Tourism and hospitality edutainment: A qualitative study of students' perspectives on integrating virtual reality into education," J. Southwest Jiaotong Univ., vol. 58, no. 4, pp. 1–11, 2023. https://doi.org/10.35741/issn.0258-2724.58.4.80

[6] A. Saha and D. I. Jublee, "Adoption Intention in Metaverse Tourism Platforms-An Empirical Investigation Based on Commitment-Trust and Social Presence Perspective," Commun. Assoc. Inf. Syst., vol. 55, no. 1, p. 43, 2025. https://doi.org/10.17705/1CAIS.05543

[7] J. F. Prados-Castillo, J. A. Torrecilla-García, and F. Liebana-Cabanillas, "Metaverse as a booster of tourism transformation towards virtual management strategies," Tour. Rev., vol. 80, no. 8, pp. 1453-1472, 2025. https://doi.org/10.1108/TR-10-2023-0750

[8] D. Buhalis, D. Leung, and M. Lin, "Metaverse as a disruptive technology revolutionising tourism management and marketing," Tour. Manag., vol. 97, p. 104724, 2023. https://doi.org/10.1016/j.tourman.2023.104724

[9] M. Chamboko-Mpotaringa and T. M. Tichaawa, "The Impact of Metaverse-Enabled Digital Transformation on Tourism Marketing," Tour. Rev. Int., vol. 28, no. 2, pp. 149-162, 2024. https://doi.org/10.3727/194344224X17065495994378

[10] M. H. Mahmoud, A. A. Ali, A. A. Alrifae, R. A. Eitah, and M. M. AlZubi, "The impact of digital HRM system and digital transformation on HR efficiency with organizational agility as a moderator," Discov. Sustain., vol. 6, no. 1, Art. no. 1038, 2025. https://doi.org/10.1007/s43621-025-01713-9

[11] A. Pavón Delgado, R. Arteaga Sánchez, and E. Suárez Redondo, “The metaverse revolutionises tourism marketing: A systematic review of the literature,” J. Hosp. Tour. Insights, Early Access. https://doi.org/10.1108/JHTI-01-2025-0161

[12] N. Kouroupi and T. Metaxas, “Economic transformation in traditional tourism destinations: The role of metaverse and artificial intelligence technologies,” in A Research Agenda for Tourism, Hospitality and the Metaverse, Edward Elgar Publishing, 2024, pp. 55–70. https://doi.org/10.4337/9781035328222.00009

[13] M. Balcerak Jackson and B. Balcerak Jackson, "Immersive experience and virtual reality," Philos. Technol., vol. 37, no. 1, p. 19, 2024. https://doi.org/10.1007/s13347-024-00707-1

[14] J. L. Rubio-Tamayo, M. Gertrudix Barrio, and F. García García, "Immersive environments and virtual reality: Systematic review and advances in communication, interaction and simulation," Multimodal Technol. Interact., vol. 1, no. 4, p. 21, 2017. https://doi.org/10.3390/mti1040021

[15] S. de los Ríos et al., “Using augmented reality and social media in mobile applications to engage people on cultural sites,” in Proc. Int. Conf. Universal Access in Human-Computer Interaction, Springer, 2014, pp. 662–672. https://doi.org/10.1007/978-3-319-07440-5_60

[16] R. Tripathi, N. Priya, and S. K. Saxena, “Analysing the role of augmented reality in enhancing cultural interpretation and visitor engagement at religious heritage sites,” in Technology and Religious Tourism: Emerging Trends, Cases and Futuristic Perspectives, Emerald Publishing, 2025, pp. 163–176. https://doi.org/10.1108/978-1-83662-260-420251012

[17] Y. Li, E. Ch'ng, and S. Cobb, "Factors influencing engagement in hybrid virtual and augmented reality," ACM Trans. Comput. Interact., vol. 30, no. 4, pp. 1-27, 2023. https://doi.org/10.1145/3589952

[18] F. Ali, W. G. Kim, J. Li, and H.-M. Jeon, "Make it delightful: Customers' experience, satisfaction and loyalty in Malaysian theme parks," J. Destin. Mark. Manag., vol. 7, pp. 1-11, 2018. https://doi.org/10.1016/j.jdmm.2016.05.003

[19] U. Zaman, "Seizing momentum on climate action: nexus between net-zero commitment concern, destination competitiveness, influencer marketing, and regenerative tourism intention," Sustainability, vol. 15, no. 6, p. 5213, 2023. https://doi.org/10.3390/su15065213

[20] L. Florido-Benítez, "The Use of Digital Twins to Address Smart Tourist Destinations' Future Challenges," Platforms, vol. 2, no. 4, pp. 234-254, 2024. https://doi.org/10.3390/platforms2040016

[21] S. Ssin, M. Suh, J. Lee, T. Jung, and W. Woo, "Science tour and business model using digital twin-based augmented reality," in Augmented Reality and Virtual Reality: New Trends in Immersive Technology, Springer, 2021, pp. 267-276. https://doi.org/10.1007/978-3-030-68086-2_20

[22] A. Doumanoglou et al., "Quality of experience for 3-D immersive media streaming," IEEE Trans. Broadcast., vol. 64, no. 2, pp. 379-391, 2018. https://doi.org/10.1109/TBC.2018.2823909

[23] M. C. Q. Farias, “Quality of experience of immersive media—New challenges,” in Proc. 29th Brazilian Symp. Multimedia and the Web, 2023, pp. 3–4. https://doi.org/10.1145/3617023.3617025

[24] P. Wu, Y. Liu, H. Chen, X. Li, and H. Wang, "VR-empowered interior design: Enhancing efficiency and quality through immersive experiences," Displays, vol. 86, p. 102887, 2025. https://doi.org/10.1016/j.displa.2024.102887

[25] M. Laroche, J. Bergeron, and G. Barbaro-Forleo, “Targeting consumers who are likely to pay more for ethical products,” J. Consum. Mark., vol. 18, no. 6, pp. 503–520, 2001. https://doi.org/10.1108/EUM0000000006155

[26] M. T. Sultan, F. Sharmin, A. Badulescu, E. Stiubea, and K. Xue, "Travelers' responsible environmental behavior towards sustainable coastal tourism: An empirical investigation on social media user-generated content," Sustainability, vol. 13, no. 1, p. 56, 2020. https://doi.org/10.3390/su13010056

[27] E. Erul, A. Uslu, K. M. Woosnam, J. A. C. Santos, K. D. Aleshinloye, and M. A. Ribeiro, "Navigating the new normal: the role of residents' involvement and support in sustainable tourism recovery," Sustainability, vol. 16, no. 11, p. 4333, 2024. https://doi.org/10.3390/su16114333

[28] L.-Y. Shien, C.-H. Liu, and Y.-M. Li, "How positive and negative environmental behaviours influence sustainable tourism intentions," Sustainability, vol. 14, no. 11, p. 6922, 2022. https://doi.org/10.3390/su14116922

[29] T. Hennig-Thurau, D. N. Aliman, A. M. Herting, G. P. Cziehso, M. Linder, and R. V Kübler, "Social interactions in the metaverse: Framework, initial evidence, and research roadmap," J. Acad. Mark. Sci., vol. 51, no. 4, pp. 889-913, 2023. https://doi.org/10.1007/s11747-022-00908-0

[30] M. Farias, "Estimating the Quality of Experience of Immersive Contents," in Proceedings of the 2nd Workshop on Quality of Experience in Visual Multimedia Applications, 2022, p. 1. https://doi.org/10.1145/3552469.3557784

[31] M. M. Alashqar, A. F. S. Abulehia, A. A. Atieh, M. H. Mahmoud, and M. M. S. Alzubi, "Legal Framework for Regulating AI in Smart Cities: Privacy, Surveillance, and Ethics," in 2025 International Conference for Artificial Intelligence, Applications, Innovation and Ethics (AI2E), IEEE, 2025, pp. 1-6. https://doi.org/10.1109/AI2E64943.2025.10983107

[32] M. Nguyen et al., "Characterization of the quality of experience and immersion of point cloud videos in augmented reality through a subjective study," Ieee Access, vol. 11, pp. 128898-128910, 2023. https://doi.org/10.1109/ACCESS.2023.3326374

[33] J. F. Hair, M. Sarstedt, L. Hopkins, and V. G. Kuppelwieser, "Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research," Eur. Bus. Rev., vol. 26, no. 2, pp. 106-121, 2014, doi: 10.1108/EBR-10-2013-0128. https://doi.org/10.1108/EBR-10-2013-0128

[34] T. Obaid, B. Eneizan, M. S. S. Abumandil, A. Y. Mahmoud, S. S. Abu-Naser, and A. A. A. Ali, "Factors Affecting Students' Adoption of E-Learning Systems During COVID-19 Pandemic: A Structural Equation Modeling Approach," in International conference on information systems and intelligent applications, Springer, 2022, pp. 227-242. https://doi.org/10.1007/978-3-031-16865-9_19

[35] J. Hair and A. Alamer, "Partial Least Squares Structural Equation Modeling (PLS-SEM) in second language and education research: Guidelines using an applied example," Res. Methods Appl. Linguist., vol. 1, no. 3, p. 100027, 2022. https://doi.org/10.1016/j.rmal.2022.100027

[36] A. F. Alkhwaldi, A. A. Abdulmuhsin, R. Masa'deh, and I. A. Abu-AlSondos, "Business intelligence adoption in higher education: the role of data-driven decision-making culture and UTAUT," J. Int. Educ. Bus., 2025. https://doi.org/10.1108/JIEB-08-2024-0110

[37] K. I. Al-Daoud and I. A. Abu-AlSondos, "Robust AI for Financial Fraud Detection in the GCC: A Hybrid Framework for Imbalance, Drift, and Adversarial Threats," J. Theor. Appl. Electron. Commer. Res., vol. 20, no. 2, p. 121, 2025. https://doi.org/10.3390/jtaer20020121

[38] M. M. S. Alzubi, "Business Intelligence adoption in Jordanian e-banking: Unveiling key drivers and challenges," Banks Bank Syst., vol. 20, no. 2, pp. 135-142, 2025. https://doi.org/10.21511/bbs.20(2).2025.11

[39] I. A. Abu-AlSondos, "Eliminating data silos with business intelligence: The role of organizational culture and leadership in Jordan's insurance sector," Insur. Mark. Co., vol. 16, no. 2, p. 24, 2025. https://doi.org/10.21511/ins.16(2).2025.03

[40] M. Alsoud, S. M. Alfdool, A. Trawnih, A. S. Helalat, L. Al-Mu'ani, and N. Mahrakani, "Social media marketing activities and tourists' purchase intention," Int. J. Data Netw. Sci., vol. 7, no. 2, pp. 677-686, 2023. https://doi.org/10.5267/j.ijdns.2023.3.004

[41] M. R. González-Rodríguez, M. C. Díaz-Fernández, A. Bilgihan, F. Okumus, and F. Shi, "The impact of eWOM source credibility on destination visit intention and online involvement: a case of Chinese tourists," J. Hosp. Tour. Technol., vol. 13, no. 5, pp. 855-874, 2022. https://doi.org/10.1108/JHTT-11-2021-0321

[42] M. M. S. Alzubi, “Business intelligence usage in the Jordanian banking sector: The role of data literacy, strategic alignment, and change management,” Ph.D. dissertation, 2025. https://doi.org/10.21511/bbs.20(4).2025.10