

Exploring Gen Z Tourists' Engagement in the Metaverse: A Stimulus-organism-response Approach with Cognitive Experiential Self-theory Integration

Pham Thanh Huyen¹, Nguyen Thi Thuy Duong², Nguyen Van Phuong^{3*},
Pham Minh Tien⁴

¹Faculty of Economics and Management, International School, Vietnam National University, Hanoi, Vietnam, ²Faculty of Marketing, Thuongmai University, Hanoi, Vietnam, ³School of Business Administration, VNU University of Economics and Business, Vietnam National University, Hanoi, Vietnam, ⁴Journal of Finance-Marketing Research, University of Finance - Marketing, Ho Chi Minh, Vietnam.

*Corresponding Author's Email: vanphuong@vnu.edu.vn

Abstract

This study investigates how experiential stimuli influence cognitive processing, tourist satisfaction and engagement in metaverse tourism among Generation Z. Integrating the Stimulus-Organism-Response (S-O-R) framework with Cognitive Experiential Self-Theory (CEST), the study distinguishes immersion, enjoyment and presence/telepresence as related but conceptually distinct experiential stimuli. Data were collected through an online survey of 158 Gen Z respondents with prior metaverse experience and analyzed using partial least squares structural equation modeling (PLS-SEM). The results show that enjoyment and presence/telepresence significantly enhance cognitive processing, whereas immersion has no significant effect. Cognitive processing positively influences metaverse tourist satisfaction ($\beta = 0.531$, $p < 0.001$) and metaverse engagement ($\beta = 0.308$, $p < 0.001$). Enjoyment and presence/telepresence exert significant indirect effects on satisfaction and engagement through cognitive processing, whereas immersion's indirect effects are not significant. Metaverse tourist involvement moderates the relationship between cognitive processing and tourist satisfaction, providing a boundary condition for this mechanism. These findings suggest that technological immersion alone may not be sufficient to stimulate elaborative cognitive evaluation among digitally experienced Gen Z users; rather, hedonic enjoyment and the perceived sense of presence may serve as more influential cues for cognitive appraisal. The study contributes to metaverse tourism research by integrating S-O-R and CEST, differentiating key experiential stimuli and identifying cognitive processing as an important mediating mechanism and tourist involvement as a boundary condition. Practically, the findings suggest that metaverse tourism experiences should combine immersive technologies with enjoyable, credible and meaningful interactions to strengthen satisfaction and sustained engagement.

Keywords: Generation Z, Immersive Marketing, Metaverse, Metaverse Tourist Involvement, Tourist Satisfaction.

Introduction

Metaverse technologies are reshaping tourism by extending destination experiences beyond physical travel through virtual reality (VR), augmented reality (AR), mixed reality, avatars and real-time social interaction (1-3). Unlike conventional digital promotion, metaverse tourism enables consumers to actively navigate virtual environments, interact with others and participate in experience creation, generating intertwined cognitive, emotional and behavioral responses. Accordingly, a central research issue is not simply whether metaverse environments are immersive, but how distinct experiential qualities translate into cognitive evaluation, satisfaction and sustained engagement. Prior tourism and VR research associate's immersion, enjoyment,

interaction and presence with favorable emotional responses, destination evaluations, satisfaction and engagement (4-6). However, the literature remains fragmented. Existing studies frequently emphasize VR advertising, specific technological devices, or short-term pre-visit experiences rather than socially interactive metaverse tourism. They also often aggregate generations, obscuring cohort-specific processes, while immersion, enjoyment and presence/ telepresence are sometimes treated as conceptually overlapping experiences (7-9). These limitations are particularly consequential for Generation Z, whose tourism information environments are increasingly visual, mobile, real-time and socially mediated (10, 11). This study addresses this gap

This is an Open Access article distributed under the terms of the Creative Commons Attribution CC BY license (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted reuse, distribution and reproduction in any medium, provided the original work is properly cited.

(Received 30th March 2026; Accepted 14th September 2026; Published 12th October 2026)

by integrating the Stimulus–Organism–Response (S-O-R) framework with Cognitive-Experiential Self-Theory (CEST). The model conceptualizes immersion, enjoyment and presence/telepresence as experiential stimuli, cognitive processing as the organismic mechanism and tourist satisfaction and metaverse engagement as consequential responses (12-14). It further examines the role of tourist involvement in these relationships. By distinguishing experiential stimuli and specifying their cognitive pathway, the study provides a more differentiated account of how Gen Z tourists transform metaverse experiences into evaluative and behavioral responses.

Metaverse and Tourism

The metaverse represents an evolving digital continuum in which users interact through avatars within immersive and socially connected environments (15, 16). Originating in Stephenson's Snow Crash, the concept has increasingly materialized through virtual reality (VR), augmented reality (AR) and mixed reality (XR), enabling users to transcend conventional physical boundaries and create new forms of social, economic and experiential value (17-20). Modern platforms support socialization, entertainment, collaboration and real-time interaction, thereby reshaping how information is consumed and value is created in digital environments (21, 22). In tourism, the metaverse enables virtual travel, experiential marketing and interactive storytelling, allowing consumers to explore destinations remotely or before physical travel (23, 24). Applications such as virtual flights, VR cultural exploration and interactive travel platforms illustrate this expanding potential (16, 20, 23).

Gen Z and Digital Engagement

Generation Z is often characterized as digitally oriented, although digital competence varies with access, education, technology use and prior experience (8, 9). Its relevance to metaverse tourism is therefore better understood through its contemporary information environment. Gen Z increasingly encounters tourism information through visual, short-form, social-media-based, real-time and mobile-oriented channels, whereas Gen Y relies relatively more on online reviews and Gen X on trustworthy information and detailed planning (20). Research on metaverse tourism further indicates that Gen Z represents an important segment for understanding tourists'

motivations and intentions to participate in virtual travel experiences (11). This evidence reinforces the relevance of Gen Z as a specific context for examining how experiential qualities shape cognitive and evaluative responses in metaverse tourism.

Theoretical Framework

This study integrates CEST and S-O-R. CEST distinguishes analytical, deliberate processing from intuitive and affect-laden experiential processing, emphasizing their complementary roles in decision making (14, 25). S-O-R conceptualizes environmental stimuli as antecedents of internal cognitive and emotional states and subsequent responses such as satisfaction and engagement (12, 26-28). Integrating the two perspectives, this study conceptualizes immersion, enjoyment and presence/telepresence as metaverse stimuli that activate cognitive processing and subsequently influence tourist satisfaction and metaverse engagement.

Conceptual Framework and Hypotheses

The conceptual framework integrates S-O-R and CEST to explain Gen Z tourists' responses to metaverse tourism. Within S-O-R, immersion, enjoyment and presence/telepresence constitute experiential stimuli. Immersion reflects absorption in the virtual activity, enjoyment captures hedonic pleasure and presence/telepresence represents the subjective sense of "being there" in a mediated environment (20, 23, 28). Although related, these constructs represent distinct experiential dimensions: attentional absorption, hedonic value and perceived spatial actuality (29, 30). They therefore warrant separate examination within the integrated framework.

The organismic stage is represented by cognitive processing, through which users interpret metaverse experiences analytically and experientially, incorporating reasoning, intuition and affect (14). This dual-processing perspective clarifies how experiential stimuli are translated into subsequent evaluations and responses. The response stage comprises metaverse tourist satisfaction and metaverse engagement, while tourist involvement is incorporated as a potential boundary condition linking cognitive processing with these outcomes.

Accordingly, H1 proposes that immersion positively influences cognitive processing. H2

proposes that presence/telepresence positively influences cognitive processing, given its capacity to enhance perceived realism and authenticity (20, 28). H3 proposes that enjoyment positively influences cognitive processing because pleasurable virtual experiences can stimulate engagement, motivation, learning and active information processing (1, 6, 29). H4 proposes that cognitive processing positively influences metaverse tourist satisfaction, as deeper evaluation can satisfy cognitive expectations and affective needs (6). H5 proposes that cognitive processing positively influences metaverse engagement because richer cognitive and affective processing encourages continued interaction (1, 6). H6 proposes that metaverse tourist satisfaction positively influences metaverse engagement, consistent with evidence that satisfying experiences foster repeated patronage, positive word-of-mouth and enduring

engagement (28, 31). Finally, H7a proposes that metaverse tourist involvement moderates the relationship between cognitive processing and satisfaction, while H7b proposes a moderating effect on the relationship between cognitive processing and engagement (1, 32).

Overall, the framework specifies a parsimonious pathway from experiential stimuli → cognitive processing → satisfaction and engagement, with involvement defining the strength of these relationships.

Figure 1 presents the proposed research model developed based on the theoretical framework and the hypothesized relationships among the study constructs. The model illustrates how immersion, enjoyment and presence/telepresence are expected to influence cognitive processing and subsequent metaverse tourist outcomes, including satisfaction and engagement.

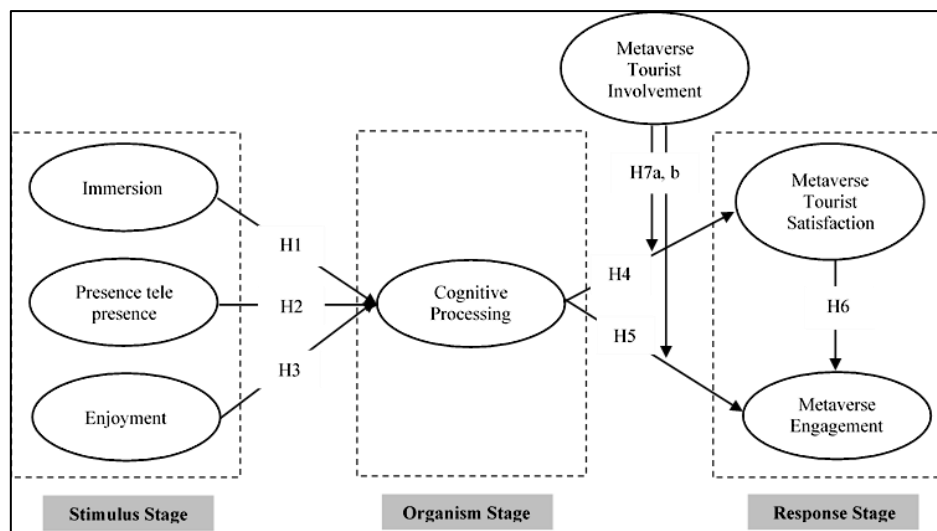


Figure 1: Research Model

Methodology

Data Collection

To empirically investigate the proposed conceptual framework, this study employed an online survey method targeting Generation Z users who actively engage with metaverse platforms such as Roblox, Decentral and and Horizon Worlds. This population was strategically selected given Gen Z's reputation for digital fluency and their significant presence within immersive digital environments (1, 6). Recruitment was conducted via social media networks, online communities dedicated to virtual and augmented reality and university mailing lists to obtain diverse respondents with varied metaverse usage patterns (33).

To optimize the validity and reliability of the findings, the survey was designed to screen for respondents' familiarity and regular engagement with metaverse technologies. Participants were required to meet specific eligibility criteria, including being aged 18–24 years and having self-reported experience with at least one major metaverse platform, to ensure alignment with the study's focus on digital-native behaviours (6, 33). This targeted approach allowed the study to capture rich insights into the attitudes and experiences of a demographic segment uniquely positioned at the forefront of metaverse adoption.

The data collection process yielded a total of 158 valid responses. Rigorous data cleaning procedures were implemented to remove incomplete, inconsistent, or duplicate submissions, thereby enhancing the integrity of the dataset (34). The final sample size is consistent with established methodological guidelines for quantitative research and is deemed sufficient to provide robust statistical power for structural equation modelling and hypothesis testing (35).

Overall, the sampling and data collection strategy was designed to maximize both the representativeness and quality of the Gen Z sample,

in line with best practices in digital behaviour and tourism research. By focusing on active metaverse users within Gen Z, the study ensures that its findings reflect the experiences and perspectives of a cohort poised to shape the future of digital tourism (1, 6).

Table 1 presents the demographic profile of the respondents. The sample consisted of 158 Gen Z participants aged 18–24, with a relatively balanced gender distribution. Most respondents were Bachelor's degree students, reflecting the predominantly young and student-oriented nature of the sample.

Table 1: Demographic Profile of Respondents

Characteristics		N	Percentage (%)
Gender	Male	91	57.59
	Female	67	42.41
Age	18–24 ages	158	100
Education level	Bachelor	114	72.15
	High School	25	15.82
	College	19	12.03
Monthly income	No answer	77	48.73
	Under \$250	64	40.51
	\$250 – 499	11	6.96
	\$500 – 999	4	2.53
	More than \$1000	2	1.27
Technology competency assessment	Very good	6	3.80
	Good	40	25.32
	Normal	107	67.72
	Poor	4	2.53
	Very poor	1	0.63
Time spent using the metaverse per week	Under 2 hours	90	56.96
	2 – 5 hours	41	25.95
	6 – 10 hours	24	15.19
	11 – 20 hours	2	1.27
	Over 20 hours	1	0.63

Note: N = Number of Respondents, Percentage = Percentage of respondents.

A total of 158 valid responses were collected from Generation Z participants aged 18 to 24 years residing in Vietnam. All participants reported prior experience with metaverse platforms.

Regarding gender distribution, 57.6% were male and 42.4% were female. This indicates a relatively balanced representation. In terms of educational background, the majority were Bachelor's degree students (72.15%). High school students comprised 15.82% and College 12.03%. The sample was predominantly composed of Gen Z learners-primarily students and young adults.

Concerning monthly income, nearly half of respondents (48.73%) chose not to disclose their income. Approximately 40.51% reported earning less than \$250 USD. A smaller proportion (10.76%)

reported higher income levels. This is consistent with the typical financial situation of students and young adults.

With respect to digital literacy, most respondents rated their skills as average (67.72%). About 25.32% considered themselves proficient. Only a minority rated themselves as very proficient (3.80%) or poor (2.53%). This distribution indicates that the sample possesses moderate to high levels of digital competency. Such competency is appropriate for engagement with metaverse environments and use of technologies such as VR, AR and XR.

In terms of metaverse usage, the majority (56.96%) reported spending less than 2 hours per week in metaverse environments. This was followed by 2–5

hours (25.95%) and 6–10 hours (15.19%). These figures suggest relatively low to moderate levels of engagement among Gen Z participants.

Measurement Development

In terms of metaverse usage, the majority (56.96%) reported spending less than 2 hours per week in metaverse environments. This was followed by 2–5 hours (25.95%) and 6–10 hours (15.19%). These figures suggest relatively low to moderate levels of engagement among Gen Z participants.).

The development of the survey instrument was guided by rigorous methodological standards to ensure the reliability and validity of measurements across all key constructs. All items were adapted from previously validated scales in the literature, reflecting best practices in research on virtual reality, technology acceptance and digital tourism experiences (26-27, 36). This approach enabled the study to leverage established measurement properties while tailoring item content to the unique context of metaverse-based tourism engagement among Generation Z.

The focal constructs were operationalized using multi-item Likert-type measures adapted from established research on virtual and metaverse tourism experiences (6, 37). The use of multi-item scales is widely recommended in social science research to enhance the robustness of empirical

findings and reduce the risk of measurement error (34).

To further ensure content validity, the preliminary survey instrument underwent pre-testing with a pilot group of Gen Z metaverse users. Participants were asked to complete the draft questionnaire and provide feedback on item clarity, relevance and interpretability (34). Insights from the pilot study led to minor refinements in question wording and scale anchors, ensuring that all items were well-understood and contextually appropriate for the target population (6).

Following pre-testing, the finalized measurement instrument demonstrated strong internal consistency and construct validity, providing a reliable foundation for empirical analysis. By anchoring the measurement strategy in prior literature and incorporating a rigorous pre-testing phase, this study enhances the credibility and generalizability of its findings within the broader domain of digital tourism and technology adoption research (38). Table 2 summarizes the measurement items used to operationalize the key constructs in the study. The items were adapted from previously validated scales and measured using a five-point Likert scale. The table also reports the sources from which the measurement items were adapted.

Table 2: Summary of Measurement Items and Sources

Construct	Sample Items	Scale Type	References
Immersion	I feel fully absorbed in the metaverse experience. The metaverse created a new environment that suddenly disappeared at the end of the show. At times, I was unaware of my surroundings. I am completely immersed in what I am doing in the metaverse. I lost track of the reality of the outside world throughout the metaverse tour. My focus does not easily stray when I am on metaverse.	5-point Likert	(5, 6, 34)
Enjoyment	I find using the metaverse enjoyable. Interacting with the metaverse is enjoyable for me. I have a lot of fun in the metaverse. Using metaverse was captivating. Using metaverse did not bore me.	5-point Likert	(5, 6, 26)
Presence/ Telepresence	I feel as if I am really present in the virtual world.	5-point Likert	(30, 34)
Cognitive Processing	I analyze information carefully when using the metaverse. While using the metaverse platform made me think more about it. I thought a lot about the metaverse platform while I visited it.	5-point Likert	(6, 36-37)

	Visiting this metaverse stimulated my interest in knowing more about it.		
Satisfaction	I am satisfied with the metaverse tour. I have enjoyed myself from the metaverse tour. I am positive in participating in the metaverse tour in the future.	5-point Likert	(6, 34, 31)
Engagement	I am actively involved when using metaverse platforms.	5-point Likert	(6, 31)
Involvement	I have a strong interest in visiting tourist destinations in the metaverse. I feel attached when I visit tourist destinations in the metaverse. I got pleasure from visiting the destinations in the metaverse. It is very special for me to visit tourist destinations in the metaverse.	5-point Likert	(39)

Analytical Techniques

To rigorously test the hypothesized relationships in the conceptual framework, this study employed Partial Least Squares Structural Equation Modeling (PLS-SEM) as the primary analytical technique. PLS-SEM is particularly well-suited for research that investigates complex models with multiple constructs, both reflective and formative and is recognized for its flexibility regarding sample size and data distribution assumptions (34, 40). The variance-based approach of PLS-SEM allows for the simultaneous estimation of measurement (outer) and structural (inner)

models, thereby enabling the comprehensive assessment of the theoretical structure underlying metaverse engagement among Gen Z users.

Within the PLS-SEM framework, the study evaluated the psychometric properties of all measurement scales by assessing construct reliability (using Cronbach's alpha and composite reliability), convergent validity (using Average Variance Extracted, AVE) and discriminant validity (using the Fornell-Larcker criterion and cross-loadings) (34). The structural model was then examined to estimate path coefficients, statistical significance and explained variance (R^2) for endogenous constructs.

The core structural equation can be expressed as Equation [1]:

$$H = B\eta + \Gamma\xi + \zeta \quad [1]$$

Where, η represents endogenous latent variables, ξ denotes exogenous latent variables, B and Γ are coefficient matrices and ζ is the error term (35).

To investigate mediation and moderation effects within the model, additional analyses were performed using multiple regression and bootstrapping procedures. For mediation analysis, the indirect effect of a predictor (X) on an outcome (Y) through a mediator (M) was evaluated using the following decomposition Equation [2]:

$$\text{Total Effect (c)} = \text{Direct Effect (c')} + \text{Indirect Effect (a} \times \text{b)} \quad [2]$$

Where, "a" is the effect of X on M , "b" is the effect of M on Y and "c'" is the direct effect of X on Y controlling for M (41). Significance of indirect effects was established using bias-corrected bootstrap confidence intervals.

Moderation analysis assessed whether metaverse tourist involvement altered the strength of the relationship between cognitive processing and the two outcome variables. Interaction terms (e.g., cognitive processing $\times$ digital literacy) were entered into hierarchical regression models to detect significant moderating influences (42). The

moderation effect was supported if the interaction term yielded a significant coefficient, demonstrating that the strength or direction of the primary relationship varied by the moderator.

All statistical analyses were conducted using the SmartPLS software package for PLS-SEM and SmartPls for multiple regression and

bootstrapping procedures. These tools were chosen for their widespread use in social science research and their advanced capabilities for handling complex mediation and moderation models (34, 40). Model fit, effect sizes (f^2 , q^2) and predictive relevance (Q^2) were also evaluated to ensure the robustness and generalizability of the findings.

By employing this rigorous analytical strategy, the study ensured comprehensive examination of the conceptual model and hypotheses, yielding

insights that are methodologically sound and consistent with the highest standards in technology adoption and digital tourism research (34, 35, 40).

Table 3 summarizes the analytical procedures used to examine the measurement and structural models. The analysis included data screening, measurement model assessment, structural model assessment, mediation and moderation analysis and evaluation of predictive relevance and effect sizes.

Table 3: Summary of Analytical Steps

Step	Description	Software Used	Key Outputs / Tests
Data Screening & Cleaning	Removal of incomplete, inconsistent and duplicate responses; verification of eligibility criteria (age, metaverse use)	SmartPLS	Clean dataset, descriptive statistics
Measurement Model Assessment	Evaluation of reliability and validity (Cronbach's alpha, composite reliability, AVE, Fornell-Larcker criterion, cross-loadings)	SmartPLS	Internal consistency, convergent & discriminant validity
Structural Model Assessment	Estimation of path coefficients and explained variance (R^2); significance testing using bootstrapping	SmartPLS	Path coefficients, R^2 values, model fit indices
Mediation Analysis	Examination of indirect effects using the product-of-coefficients approach and bootstrapping	SmartPLS	Direct/indirect effects, confidence intervals
Moderation Analysis	Introduction of interaction terms (e.g., cognitive processing $\times$ digital literacy) in regression models; significance testing of interaction terms	SmartPLS	Moderation coefficients, significance levels
Predictive Relevance & Effect Size	Assessment of model's predictive power (Q^2) and effect sizes (f^2 , q^2)	SmartPLS	Q^2 , f^2 , q^2 statistics
Reporting & Interpretation	Synthesis of findings, interpretation of hypothesis testing, model fit and theoretical implications	Word/Excel	Results tables, figures and narrative summary

Note: AVE = Average Variance Extracted, PLS-SEM = Partial Least Squares Structural Equation Modeling, R^2 = Coefficient of Determination, Q^2 = Predictive Relevance, f^2 = Effect Size.

Results

Assessment of Measurement Model

The measurement model was assessed using Partial Least Squares Structural Equation Modeling (PLS-SEM) in SmartPLS 3.2.9 following an established two-step assessment procedure

(34). Table 4 presents the results of construct reliability and convergent validity assessment. All factor loadings, Cronbach's alpha, composite reliability and AVE values are reported to evaluate the measurement quality of the constructs.

Table 4: Reliability and Convergent Validity

Constructs	Items	Factor loadings	α	ρ_a	CR	AVE
Cognitive Processing	CP1	0.895	0.938	0.939	0.957	0.847
	CP2	0.929				
	CP3	0.929				
	CP4	0.904				
Metaverse Engagement	ME1	0.876	0.938	0.940	0.951	0.795
	ME2	0.885				
	ME3	0.905				
	ME4	0.897				

Enjoyment	ME5	0.908				
	E1	0.914	0.896	0.897	0.932	0.820
	E2	0.908				
	E3	0.894				
Immersion	I1	0.839	0.830	0.832	0.897	0.745
	I2	0.839				
	I3	0.872				
Presence/Telepresence	PT1	0.942	0.928	0.929	0.953	0.871
	PT2	0.944				
	PT3	0.930				
Metaverse Tourist Satisfaction	MTS1	0.930	0.952	0.955	0.967	0.882
	MTS2	0.956				
	MTS3	0.944				
	MTS4	0.901				
Metaverse Tourist Involvement	MTI1	0.917	0.947	0.949	0.964	0.856
	MTI2	0.920				
	MTI3	0.932				
	MTI4	0.929				

Note: AVE = Average Variance Extracted, CR = Composite Reliability, α = Cronbach's alpha, ρ_a = Dijkstra-Henseler's rho_A. Factor loadings, Cronbach's alpha, CR and AVE are reported to assess the reliability and convergent validity of the measurement model.

Figure 2 presents the final PLS-SEM path model with the latent constructs and standardized loadings. The model illustrates the estimated

relationships among the constructs and provides an overview of the structural paths examined in the empirical analysis.

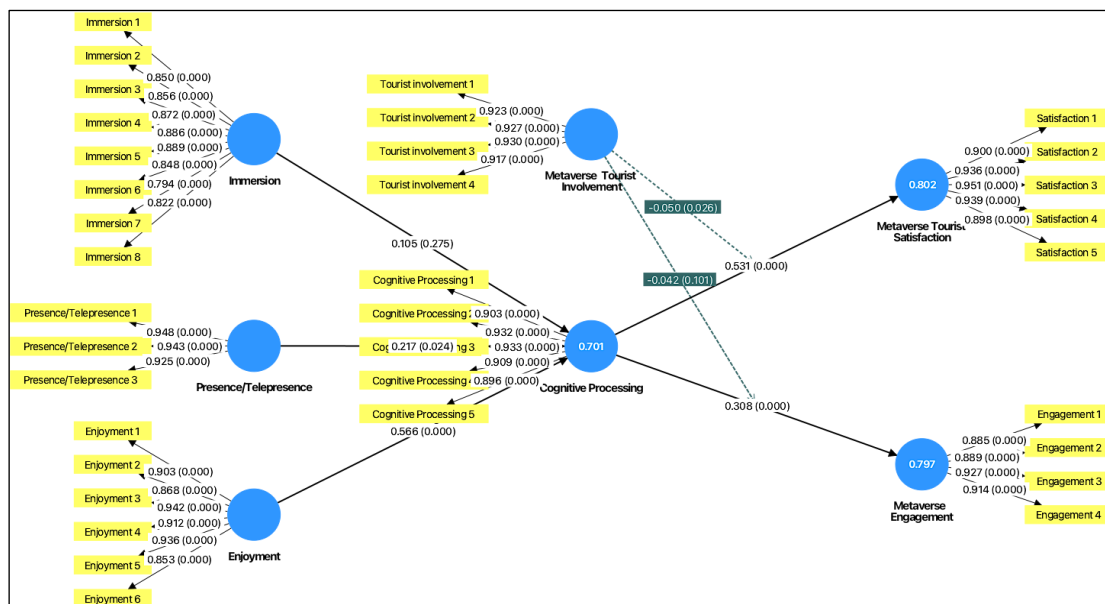


Figure 2: Model Diagram

These initial results support the adequacy of the measurement model and provide a foundation for subsequent analysis of reliability and validity, which are detailed in the following sections.

Construct Reliability and Validity

Table 4 provides the results of internal consistency and convergent validity. All factor loadings exceeded the recommended threshold value of 0.70 (34), ranging from 0.839 to 0.956, indicating that all indicators strongly represent their underlying constructs. The results demonstrate

that each construct exhibits substantial item reliability, with particularly high loadings observed for Cognitive Processing (0.895-0.929), Engagement (0.876-0.905), Enjoyment (0.894-0.914) and Tourist Satisfaction (0.901-0.956). These findings confirm that all measurement items contribute significantly to explaining the variance of their corresponding latent variables. No indicators were removed, as all met acceptable loading criteria and enhanced the overall reliability and validity of the constructs.

The internal consistency reliability of the constructs was assessed using both Cronbach's Alpha coefficient (α) and Composite Reliability (CR). Reliability is considered acceptable when α and CR values exceed 0.70, while values above 0.90 indicate high reliability (34). As shown in Table 4, Cronbach's Alpha values ranged from 0.830 (Immersion) to 0.928 (Presence/Telepresence), while CR values ranged from 0.897 to 0.952. These results confirm the high internal consistency of the measurement items and indicate that the constructs are measured with precision and stability. The high reliability coefficients demonstrate that all observed indicators effectively capture the theoretical dimensions of the multidimensional tourism experience constructs.

Convergent validity was assessed through Average Variance Extracted (AVE), which reflects the

proportion of variance captured by a construct relative to measurement error. An AVE value greater than 0.50 is considered indicative of adequate convergent validity (43). The AVE values obtained in this study ranged from 0.820 (Enjoyment) to 0.882 (Satisfaction), all exceeding the minimum threshold. These results indicate that each construct explains more than half of the variance in its indicators, confirming that the observed variables effectively represent their underlying latent dimensions. Consequently, the constructs in this study—Cognitive Processing, Metaverse Engagement, Enjoyment, Immersion, Presence/Telepresence, Metaverse Tourist Satisfaction and Metaverse Tourist Involvement—demonstrate high convergent validity and measurement precision.

Table 5: Fornell–Larcker Criterion

	CP	E	I	ME	MTI	MTS	PT
CP	0.915						
E	0.817	0.903					
I	0.726	0.778	0.853				
ME	0.818	0.816	0.774	0.904			
MTI	0.810	0.808	0.823	0.870	0.924		
MTS	0.865	0.848	0.776	0.900	0.832	0.925	
PT	0.745	0.779	0.832	0.760	0.853	0.786	0.939

Note: CP = Cognitive Processing, E = Enjoyment, I = Immersion, ME = Metaverse Engagement, MTI = Metaverse Tourist Involvement, MTS = Metaverse Tourist Satisfaction, PT = Presence/Telepresence.

Discriminant Validity

Discriminant validity was examined using the Fornell–Larcker criterion. This criterion compares the square root of the Average Variance Extracted (AVE) for each construct (displayed on the diagonal) with its correlations with other constructs (off-diagonal values). As presented in Table 5, all diagonal values exceeded the correlations between corresponding constructs. This indicates that each construct shares more variance with its own indicators than with any other construct (43).

For instance, the square root of AVE for Cognitive Processing [0.915] surpassed its correlations with Enjoyment [0.817], Immersion [0.726], Metaverse Engagement [0.818], Metaverse Tourist Involvement [0.810], Metaverse Tourist Satisfaction [0.865] and Presence/Telepresence [0.745]. Similarly, Enjoyment [0.903], Immersion [0.853], Metaverse Tourist Involvement [0.924] and Presence/Telepresence [0.939] demonstrated

higher diagonal values compared to their respective correlations with other constructs. These results confirm strong discriminant validity across all latent constructs. Each construct is empirically distinct. Each measures a unique aspect of the metaverse tourism experience. Furthermore, inter-construct correlations were moderate in magnitude. They ranged from 0.73 to 0.90. This suggests meaningful yet non-overlapping relationships. These relationships are consistent with theoretical expectations. Therefore, the measurement model satisfies the Fornell–Larcker criterion. It supports the distinctiveness of Cognitive Processing, Enjoyment, Immersion, Metaverse Engagement, Metaverse Tourist Involvement, Metaverse Tourist Satisfaction and Presence/Telepresence within the conceptual framework. Discriminant validity was further assessed using the Heterotrait-Monotrait Ratio (HTMT). Table 6 presents the HTMT matrix for the study constructs. Most HTMT values were

below the recommended thresholds, supporting adequate discriminant validity. Although several

construct pairs slightly exceeded the 0.90 criterion, all values remained below 1.0.

Table 6: Heterotrait-monotrait ratio (HTMT) - Matrix

	CP	E	I	ME	MTI	MTS	PT
CP							
E	0.857						
I	0.757	0.807					
ME	0.871	0.869	0.820				
MTI	0.854	0.850	0.867	0.931			
MTS	0.906	0.888	0.807	0.956	0.874		
PT	0.791	0.825	0.884	0.817	0.909	0.831	

Note: CP = Cognitive Processing, E = Enjoyment, I = Immersion, ME = Metaverse Engagement, MTI = Metaverse Tourist Involvement, MTS = Metaverse Tourist Satisfaction, PT = Presence/Telepresence.

In addition, discriminant validity was further assessed using the Heterotrait-Monotrait ratio (HTMT). This provides a more stringent evaluation of construct distinctiveness (44). The HTMT test offers a more rigorous criterion than the traditional Fornell-Larcker approach by evaluating the average correlations between indicators of different constructs. HTMT values below 0.85 under the conservative criterion or 0.90 under the liberal criterion are considered indicative of acceptable discriminant validity (44). Values below 1.0 may still be considered acceptable depending on the theoretical foundation and model complexity (45).

As shown in Table 6, most HTMT values in this study fall below the recommended thresholds. These results provide generally acceptable evidence of discriminant validity between the constructs. For example, HTMT ratios between Cognitive Processing and Immersion [0.757], Cognitive Processing and Presence/Telepresence [0.791] and Enjoyment and Immersion [0.807] are substantially lower than the conservative threshold. Although several construct pairs, including Cognitive Processing–Metaverse Tourist Satisfaction [0.906], Metaverse Engagement–Metaverse Tourist Satisfaction [0.956] and Metaverse Tourist Involvement–Metaverse Engagement [0.931], slightly exceed the conventional 0.90 threshold, all HTMT values remain below 1.0. Values below 1.0 may still be considered acceptable when supported by the theoretical context and model characteristics (46). These elevated values indicate strong conceptual and empirical relationships between these constructs. This can be justified theoretically as they represent interrelated cognitive-affective

dimensions of user engagement in metaverse tourism experiences. Moreover, discriminant validity remains acceptable due to the conceptual overlap and complementary nature of these variables within the Stimulus-Organism-Response (S-O-R) framework (47).

Overall, the HTMT results, when interpreted alongside the Fornell–Larcker criterion, demonstrate that the measurement model exhibits adequate discriminant validity. This confirms that each construct captures a distinct aspect.

Structural Model and Hypotheses Testing

Explanatory power (R²)

The coefficient of determination (R²) reflects the extent to which independent variables explain dependent variables in the structural model. R² values of 0.75, 0.50 and 0.25 are commonly interpreted as high, moderate and low levels of explanatory power, respectively (48).

Table 7 presents the coefficient of determination (R²) for the endogenous constructs. The results show that Cognitive Processing, Metaverse Engagement and Metaverse Tourist Satisfaction achieved R² values of 0.701, 0.797 and 0.802, respectively, indicating strong explanatory power. All three endogenous variables - Cognitive Processing, Metaverse Engagement and Metaverse Tourist Satisfaction - exhibited high R² values. This demonstrates the strong explanatory power of the proposed model. The model's robust explanatory capacity highlights its theoretical soundness and predictive accuracy in understanding Gen Z users' behavioral responses in virtual tourism environments.

Table 7: Coefficient of Determination (R^2) for the Endogenous Constructs

	R Square (R^2)	R Square Adjusted	Explanatory power
Cognitive Processing	0.701	0.695	Strong
Metaverse Engagement	0.797	0.793	Strong
Metaverse Tourist Satisfaction	0.802	0.798	Strong

Relevance of Coefficients: Effect Size (f-square) and Predictive Power (Q-square)

Table 8 presents the structural path coefficients, significance levels, confidence intervals, effect sizes and hypothesis-testing decisions. The results indicate that Enjoyment and Presence/Telepresence significantly influence Cognitive Processing, whereas the direct effect of Immersion on Cognitive Processing is not statistically significant.

The table also reports the indirect effects used to assess the proposed mediation relationships. Effect size (f^2) was used to evaluate the contribution of each exogenous construct to its corresponding endogenous variable. Effect sizes (f^2) of 0.02, 0.15 and 0.35 are commonly interpreted as small, medium and large, respectively (34). As shown in Table 8, several relationships exhibited large effect sizes. This indicates strong explanatory contributions within the structural model.

Table 8: Structural Model and Hypothesis Testing Results

	Beta	T-value	P-value	CI	Decision	f^2
Direct Effects						
H1: I → CP	0.106	1.091	0.276	[-0.078, 0.300]	Rejected	0.010
H2: PT → CP	0.217	2.252	0.024	[0.017, 0.393]	Supported	0.041
H3: E → CP	0.566	6.737	< 0.001	[0.399, 0.733]	Supported	0.363
H4: CP → MTS	0.531	7.800	< 0.001	[0.396, 0.663]	Supported	0.458
H5: CP → ME	0.308	4.643	< 0.001	[0.182, 0.444]	Supported	0.151
H6: MTS → ME	0.561	7.479	0	[0.422;0.704]	Supported	5.039
Moderation Effects						
MTI × CP → ME	-0.042	1.642	0.101	[-0.095, 0.004]	Rejected	0.012
MTI × CP → MTS	-0.050	2.221	0.026	[-0.094, -0.007]	Supported	0.017
Indirect Effects (via CP)						
E → CP → ME	0.174	3.671	< 0.001	[0.091, 0.277]	Supported	
E → CP → MTS	0.301	5.358	< 0.001	[0.194, 0.412]	Supported	
I → CP → ME	0.032	1.016	0.310	[-0.023, 0.103]	Not Supported	
I → CP → MTS	0.056	1.054	0.292	[-0.040, 0.168]	Not Supported	
PT → CP → ME	0.067	2.083	0.037	[0.005, 0.133]	Supported	
PT → CP → MTS	0.115	2.169	0.030	[0.009, 0.218]	Supported	
Conditional Direct Effects (MTI as Moderator)						
CP → ME at MTI+1SD	0.266	3.604	< 0.001	[0.120, 0.412]		
CP → ME at MTI Mean	0.308	4.643	< 0.001	[0.182, 0.444]		
CP → ME at MTI-1SD	0.350	5.130	< 0.001	[0.218, 0.487]		
CP → MTS at MTI+1SD	0.481	6.403	< 0.001	[0.337, 0.630]		
CP → MTS at MTI Mean	0.531	7.800	< 0.001	[0.396, 0.663]		
CP → MTS at MTI-1SD	0.581	8.535	< 0.001	[0.438, 0.706]		

Note: β = Standardized Path Coefficient, T = T-statistic, p = p-value, CI = 95% confidence interval, f^2 = Cohen's effect, size, CP = Cognitive Processing, E = Enjoyment, I = Immersion, ME = Metaverse Engagement, MTI = Metaverse Tourist Involvement, MTS = Metaverse Tourist Satisfaction, PT = Presence/Telepresence.

Specifically, Metaverse Tourist Involvement → Metaverse Engagement ($f^2 = 0.626$) demonstrated a large effect size, reflecting its dominant role as a direct predictor of engagement. Metaverse Tourist Involvement → Metaverse Tourist Satisfaction ($f^2 = 0.261$) showed medium effect and Cognitive

Processing → Metaverse Tourist Satisfaction ($f^2 = 0.458$) also showed large effects, underscoring the pivotal roles of involvement and cognitive processing in determining satisfaction. Enjoyment → Cognitive Processing ($f^2 = 0.363$) exhibited a large effect, highlighting the

importance of hedonic stimulation in driving cognitive engagement. Cognitive Processing → Metaverse Engagement ($f^2 = 0.151$) showed a medium effect. In contrast, Presence/Telepresence → Cognitive Processing ($f^2 = 0.041$) and Immersion → Cognitive Processing ($f^2 = 0.010$) demonstrated small effect sizes, indicating more limited direct contributions.

Overall, the f^2 values confirm that the proposed model possesses strong explanatory power, with metaverse tourist involvement and cognitive

processing emerging as the most influential predictors of the outcome variables. Enjoyment also plays a critical role as the primary driver of cognitive processing, which serves as the central mediating mechanism linking experiential stimuli to satisfaction and engagement.

Table 9 presents the Q^2 values used to assess the predictive relevance of the structural model. All endogenous constructs show Q^2 values substantially above zero and above the 0.35 threshold, indicating strong predictive relevance.

Table 9: Predictive Relevance (Q^2) of the Structural Model

Construct	Q^2
Cognitive Processing	0.742
Enjoyment	0.734
Immersion	0.638
Metaverse Engagement	0.672
Metaverse Tourist Satisfaction	0.77
Presence/Telepresence	0.71

Note: Q^2 = Stone-Geisser predictive relevance.

The Stone-Geisser Q^2 test was applied to assess the predictive relevance of the structural model using the blindfolding procedure in SmartPLS. Q^2 values greater than 0 indicate predictive relevance, while values above 0.35 suggest strong predictive capability (34). As shown in Table 9, all constructs achieved Q^2 values significantly higher than this threshold, ranging from 0.638 (Immersion) to 0.77 (Metaverse Tourist Satisfaction).

These high Q^2 values demonstrate that the model possesses excellent predictive accuracy. This confirms its robustness in explaining and predicting the cognitive, affective and behavioral responses of Gen Z tourists in metaverse environments. Therefore, the structural model not only explains substantial variance (high R^2 values) but also exhibits strong predictive value. This reinforces the overall quality and reliability of the research framework.

Direct Effects

As shown in Table 8, Immersion → Cognitive Processing ($\beta = 0.106$, $t = 1.091$, $p = 0.276$) was not statistically significant. This suggests that immersion alone does not exert a direct effect on cognitive engagement in the metaverse context. Given its small effect size ($f^2 = 0.010$), the finding suggests that immersion alone may be insufficient to stimulate cognitive processing in the present context.

In contrast, Enjoyment → Cognitive Processing demonstrated a strong and significant effect

($\beta = 0.566$, $t = 6.737$, $p < 0.001$). The effect size was $f^2 = 0.363$, indicating a medium-to-large contribution. This finding indicates that users' positive affect and pleasure in the metaverse substantially enhance their cognitive engagement. It reinforces the role of hedonic experience as a key driver of mental involvement.

Similarly, Presence/Telepresence → Cognitive Processing was statistically significant ($\beta = 0.217$, $t = 2.252$, $p = 0.024$). It showed a small effect size ($f^2 = 0.041$). This confirms that a stronger sense of virtual presence enhances users' attention and cognitive absorption.

Beyond the stimulus-to-CP paths, cognitive processing directly and significantly predicts metaverse tourist satisfaction (H4: $\beta = 0.531$, $t = 7.800$, $p < 0.001$, $f^2 = 0.458$) and metaverse engagement (H5: $\beta = 0.308$, $t = 4.643$, $p < 0.001$, $f^2 = 0.151$). Metaverse tourist satisfaction also significantly predicts metaverse engagement (H6: $\beta = 0.611$, $t = 9.366$, $p < 0.001$, $f^2 = 0.626$). Overall, these results indicate that enjoyment and presence/telepresence play critical roles in stimulating cognitive processing, whereas immersion does not contribute directly. Cognitive processing and metaverse tourist involvement jointly determine satisfaction and engagement.

Mediation Analysis

The study also examined the mediating role of Cognitive Processing in conveying the effects of experiential stimuli (Enjoyment, Immersion and

Presence/Telepresence) on outcome variables (Metaverse Tourist Satisfaction and Metaverse Engagement). Bootstrapping with 5,000 subsamples in SmartPLS was used. As shown in Table 8, the indirect path Enjoyment → Cognitive Processing → Metaverse Engagement was statistically significant ($\beta = 0.174$, $t = 3.671$, $p < 0.001$, 95% CI [0.091, 0.277]). Similarly, Enjoyment → Cognitive Processing → Metaverse Tourist Satisfaction was also significant ($\beta = 0.301$, $t = 5.358$, $p < 0.001$, 95% CI [0.194, 0.412]). These results indicate that cognitive processing mediates the effect of enjoyment on metaverse engagement and tourist satisfaction. Presence/Telepresence also exerts significant indirect effects via Cognitive Processing on Metaverse Engagement ($\beta = 0.067$, $t = 2.083$, $p = 0.037$, 95% CI [0.005, 0.133]) and Metaverse Tourist Satisfaction ($\beta = 0.115$, $t = 2.169$, $p = 0.030$, 95% CI [0.009, 0.218]).

In contrast, the indirect effects of Immersion via Cognitive Processing were not statistically significant. The path Immersion → Cognitive Processing → Metaverse Engagement yielded $\beta = 0.032$, $t = 1.016$, $p = 0.310$ with a 95% CI [-0.023, 0.103] that included zero. Similarly, Immersion → Cognitive Processing → Metaverse Tourist Satisfaction was also non-significant ($\beta = 0.056$, $t = 1.054$, $p = 0.292$, 95% CI [-0.040, 0.168]). These results indicate that immersion's influence on outcomes does not operate through the cognitive processing pathway and may instead depend on direct affective or emotional mechanisms.

Overall, these results confirm that cognitive processing serves as a critical mediating mechanism in the S-O-R pathway for enjoyment and presence/telepresence, but not for immersion. Enjoyment and presence/telepresence significantly activate cognitive processing, which in turn drives both metaverse engagement and satisfaction, establishing a robust indirect pathway from hedonic stimuli to behavioural and affective outcomes.

Summary of Hypothesis Testing

The hypothesis testing results provide strong evidence for the theoretical framework. They confirm that affective and cognitive experiences play central roles in shaping users' cognitive and behavioural responses in metaverse tourism. The findings reveal that enjoyment ($\beta = 0.566$, $t = 6.737$,

$p < 0.001$) and presence/telepresence ($\beta = 0.217$, $t = 2.252$, $p = 0.024$) significantly enhance users' cognitive processing, whereas immersion ($\beta = 0.106$, $t = 1.091$, $p = 0.276$) does not demonstrate a significant direct effect. This suggests that when users feel pleasure and a realistic sense of 'being there,' they engage more deeply with virtual tourism activities.

In contrast, immersion alone is insufficient to activate higher cognitive engagement. This implies that deep environmental absorption must be accompanied by affective stimulation or meaningful interaction to impact thought processes.

Furthermore, cognitive processing was demonstrated to positively influence both metaverse tourist satisfaction (H4: $\beta = 0.531$, $p < 0.001$) and metaverse engagement (H5: $\beta = 0.308$, $p < 0.001$). Metaverse tourist satisfaction also positively influences metaverse engagement (H6: $\beta = 0.611$, $p < 0.001$). Regarding moderation, metaverse tourist involvement does not significantly moderate the cognitive processing-engagement relationship (H7b: $\beta = -0.042$, $p = 0.101$), but it significantly moderates the cognitive processing-satisfaction relationship (H7a: $\beta = -0.050$, $p = 0.026$).

The mediation results further highlight the role of Cognitive Processing as a central pathway connecting experiential stimuli to outcomes. Users whose enjoyment and sense of presence activate deeper cognitive engagement tend to achieve higher levels of both satisfaction and behavioural engagement. This reflects the importance of designing metaverse environments that foster not only immersive sensations but also meaningful cognitive elaboration.

Overall, the findings suggest that enjoyment, telepresence, metaverse tourist involvement and cognitive processing are key drivers of holistic metaverse tourism experiences. Metaverse tourist involvement significantly moderates the relationship between cognitive processing and tourist satisfaction, but not the relationship between cognitive processing and metaverse engagement. These results underscore the importance of designing metaverse experiences that balance affective enjoyment, realistic presence, meaningful user participation and cognitive stimulation. Such design fosters sustained engagement.

Discussion

Overview of Key Findings

This study examined how immersion, enjoyment and presence/telepresence influence cognitive processing, satisfaction and engagement among Gen Z users in metaverse tourism. The findings show that enjoyment and presence/telepresence significantly enhance cognitive processing, whereas immersion has no significant direct effect. This suggests that positive affect and the perceived sense of being present may be more important than technological immersion alone in stimulating cognitive engagement.

Cognitive processing directly and significantly influences both metaverse tourist satisfaction and metaverse engagement. The mediation analysis further confirms that cognitive processing serves as a critical pathway through which enjoyment and presence/telepresence exert their indirect effects on both outcomes, whereas immersion does not demonstrate significant indirect effects through this route. Metaverse tourist involvement emerges as both a strong direct predictor of satisfaction and engagement and as a significant moderator of the cognitive processing–satisfaction relationship. These findings highlight the complex interplay between cognitive mechanisms, hedonic stimuli and user involvement in shaping responses to metaverse tourism.

Comparison with Previous Research

The findings are consistent with prior research emphasizing the importance of enjoyment and presence in virtual reality and online tourism environments (49). The significant effects of enjoyment and presence/telepresence suggest that affective and experiential qualities may be stronger drivers of cognitive processing than technological immersion alone.

However, the non-significant direct effect of immersion contrasts with earlier research that identified immersion as a major factor in activating cognitive processing (25). This difference suggests that immersion may be insufficient by itself and may require complementary affective or experiential stimuli, such as enjoyment and presence, to influence users' cognitive responses. The significant mediating role of satisfaction is also consistent with previous findings showing that satisfaction can translate immersive experiences into behavioral intentions and platform engagement (46). The present study extends this

perspective to metaverse tourism by demonstrating that cognitive and affective evaluations jointly contribute to satisfaction and subsequent engagement.

Theoretical Implications

The findings extend the Stimulus–Organism–Response (S–O–R) framework by showing how experiential stimuli—particularly enjoyment and presence/telepresence—activate cognitive processing and subsequently contribute to satisfaction and engagement. They also support the application of Cognitive Experiential Self-Theory (CEST) by highlighting the importance of experiential and affective processing alongside rational evaluation in Gen Z users' metaverse tourism experiences.

A further contribution is the identification of Metaverse Tourist Involvement as both a direct predictor of and a moderating factor on the cognitive processing–satisfaction relationship. The mediation findings further establish cognitive processing as the central mechanism through which hedonic stimuli (enjoyment and presence/telepresence) exert their effects on outcomes. This provides a more differentiated explanation of how users transform experiential stimuli into cognitive evaluations and ultimately into behavioural and affective responses within immersive digital tourism environments.

Practical Implications

The findings suggest that tourism marketers, platform developers and destination managers should focus not only on technological immersion but also on creating enjoyable and credible senses of presence. Gamified storytelling, interactive features, realistic avatars, responsive environments and aesthetic customization can enhance users' cognitive and emotional involvement.

The strong relationship between satisfaction and engagement also highlights the importance of post-experience strategies, including personalized feedback, social sharing and engagement mechanisms. In addition, cognitive processing and usage frequency should be considered when designing user experiences, with tutorials and onboarding support helping less experienced users benefit from metaverse tourism features. Finally, experiences should be tailored to Gen Z preferences for interactivity, authenticity, autonomy and social connection.

Theoretical Contributions

Model Advancement and Validation

This research advances theoretical understanding of digital tourism behavior by validating an integrated framework combining two foundational models: the Stimulus-Organism-Response (S-O-R) model and Cognitive Experiential Self-Theory (CEST) in the rapidly evolving metaverse context. By conceptualizing immersion, enjoyment and presence/telepresence as environmental stimuli, the study empirically demonstrates their capacity to activate cognitive and affective responses (organism). These responses subsequently lead to behavioral outcomes such as satisfaction and engagement (response). These findings provide empirical support for the hypothesized structural relationships proposed by the S-O-R model in immersive digital environments.

The research also reinforces the dual-system perspective of CEST. It shows that user behavior in the metaverse is shaped by interaction between the rational system-manifested through cognitive processing and the experiential system-manifested through positive emotions such as enjoyment and presence. Demonstrating the simultaneous roles of both systems in driving satisfaction and engagement expands CEST's application scope from traditional digital environments to highly immersive metaverse spaces.

Through this theoretical integration, the research not only validates existing models but also adapts and extends them to fit a new technological ecosystem. In this ecosystem, psychological and sensory stimuli coexist and interact in real time. This indicates that user engagement in the metaverse is not merely a result of advanced technology. It is a product of the interplay between reflexive cognition and positive emotion. Therefore, the proposed theoretical model holds value beyond explaining current digital tourism behavior. It provides a solid foundation for developing new theoretical frameworks in research on immersive technology and digital-native consumer behavior.

Novelty in Segmentation and Context

A prominent theoretical contribution of this research lies in establishing Generation Z as a distinct and significant segment in metaverse tourism behavior research. As digital natives, Gen Z users bring specific expectations regarding

interactivity, authenticity and self-expression in virtual environments. The sample reported predominantly average levels of self-assessed technological competence 18 – 24 ages. This study provides empirical evidence on metaverse tourism engagement within a Gen Z sample and clarifies how cognitive processing and metaverse tourist involvement shape relationships between experiential stimuli and behavioral outcomes. Results show that cognitive processing mediates the effects of experiential stimuli on metaverse tourist satisfaction and engagement. This emphasizes the importance of psychological readiness and technological competence in optimizing digital tourism experiences.

By focusing on Gen Z, this research fills a significant gap in digital tourism and human-computer interaction literature. Previous research primarily relied on behavioral models of mature or multigenerational consumers. These findings reveal that Gen Z engagement in the metaverse is not merely entertainment consumption or escapism. It is a meaningful form of cognitive and emotional connection. It reflects personal investment in digital experiences. This provides a new theoretical perspective on how digital natives approach, evaluate and restructure tourism experiences in immersive technological environments.

Consequently, this research not only expands the application scope of behavioral theories in new technological contexts. It also proposes a user segmentation approach based on generational characteristics and digital competence. This factor is increasingly important in designing experiences and marketing strategies in the metaverse era.

Synthesis with Existing Literature

The most theoretically informative result is the non-significant path from immersion to cognitive processing ($\beta = 0.106$, $t = 1.091$, $p = 0.276$, $f^2 = 0.010$). This result concerns cognitive processing, not a direct immersion-to-behavioral-engagement path, which the model did not test. It indicates that perceived absorption or envelopment, by itself, did not explain additional variation in how respondents analyzed, evaluated, or interpreted the metaverse-tourism experience. By contrast, enjoyment ($\beta = 0.566$, $t = 6.737$, $p < 0.001$) and presence/telepresence ($\beta = 0.217$, $t = 2.252$, $p = 0.024$) were significant predictors,

showing that the three experiential stimuli are not functionally interchangeable.

Evidence consistent with this boundary is indirect but informative. No significant differences between high- and low-immersion conditions were observed across the general VR-tourism model, although substantive experience pathways remained important (50). A more immersive VR delivery mode did not uniformly improve cognitive and psychological outcomes and could also be accompanied by greater processing demands (51). Evidence from repeated VR sessions suggests that both moderate and high levels of immersion can support motivation, engagement and learning, without establishing a simple linear advantage for the highest immersion level (52). These findings do not replicate the present structural path or population but support the cautious interpretation that immersion may be enabling without being sufficient.

The present result nevertheless contrasts with research reporting positive immersion effects. Immersion was found to mediate the effects of person-environment interaction on satisfaction and engagement (4). Immersion and enjoyment independently predicted the intention to discover a destination following a VR marketing experience (29). More directly, in metaverse travel contexts, immersive experience was found to predict engagement both directly and indirectly through hedonic and utilitarian value (53). The present finding should therefore not be interpreted as evidence that immersion is generally ineffective; rather, it identifies a boundary condition specifically for the pathway from immersion to cognitive processing.

Practical Recommendations

Strategies for Tourism Marketers and Managers

Tourism marketers and managers can apply findings from this research to design metaverse experiences that optimize user interaction and engagement, particularly for Gen Z. First, priority should be given to enhancing vividness, interactivity and enjoyment through elements such as gamification, immersive storytelling and high aesthetic quality. These elements not only create visual appeal but also evoke positive emotions. This subsequently drives cognitive participation and behavioural commitment.

Metaverse experiences should be designed to balance pleasure and meaningful depth. This creates conditions for users to both entertain themselves and reflect. Evoking emotional resonance and stimulating reflective cognition will enhance user satisfaction and perceived value. Particularly for Gen Z—a generation that values personalization and social connection—experiences must allow users to customize interfaces, participate in content co-creation and share experiences across social media platforms. These features not only meet self-expression needs but also create a sense of ownership and deep attachment to virtual destinations.

Managers should also pay attention to users' technology accessibility. Integrating user-friendly tutorials, engaging onboarding experiences and timely technical support will help expand reach to less tech-savvy users. This enhances the comprehensiveness and effectiveness of implementation strategies. In an increasingly competitive digital tourism platform landscape, designing metaverse experiences aligned with Gen Z expectations and behaviours will be critical for building long-term engagement.

Addressing Cognitive Processing

Because cognitive processing plays a central mediating role in the research model, managers and metaverse tourism platform developers must consider user segmentation based on technological proficiency. Identifying different levels of cognitive processing allows for designing appropriate experience strategies. This ensures inclusivity and optimizes interaction across the entire user spectrum.

For users with low cognitive processing or limited experience with immersive technology, guided tutorials, structured onboarding pathways and streamlined interfaces should be provided. These elements reduce cognitive load. They enable users to access and experience platforms easily. This enhances confidence and satisfaction levels.

Conversely, for advanced users, particularly those with high technological competence and expectations for more complex experiences—platforms should offer advanced customization options, creative toolkits and co-creation features. These functions not only maintain interest but also drive active participation. They reflect Gen Z's needs for self-expression and exploration.

Adjusting experiences according to cognitive processing not only enhances interaction effectiveness. It also contributes to building an inclusive digital tourism environment. In such environments, all users—regardless of technological competence—can participate, perceive and connect meaningfully. This is a critical factor for expanding reach and sustainably developing metaverse tourism platforms in the future.

Enhancing Engagement and Loyalty

To build long-term engagement and nurture brand loyalty in metaverse environments, digital tourism platforms must integrate experiential design elements capable of sustaining continuous participation and creating emotional value for users. Elements such as gamification, community building and user co-creation play critical roles in transforming immediate satisfaction into sustained behavioural commitment.

Implementing reward systems, virtual badges and collaborative missions not only creates participation motivation but also encourages users to return to platforms regularly. These mechanisms transform virtual tourism experiences into journeys of personal and social development. Users feel recognized, challenged and connected.

Social features such as group chat, group destination exploration, or real-time experience sharing will promote interaction among individuals. This strengthens emotional attachment. These interactions not only enrich tourism experiences but also create a sense of community belonging. This is an important factor in building brand loyalty.

More importantly, engagement in metaverse environments is not limited to virtual space. It can extend to actual tourism activities. When users feel deeply connected to a destination or brand through digital experiences, they tend to convert that attachment into real consumption behavior. Therefore, designing multidimensional experiences—combining emotion, cognition and social interaction—will be key to maintaining Gen Z tourist engagement in both worlds: real and virtual.

Policy and Industry Recommendations

For policymakers and stakeholders in the tourism industry, this research highlights the urgent need to establish ethical, technological and experiential standards. These standards should guide the sustainable development of metaverse tourism.

Immersive technology is becoming increasingly widespread. Gen Z actively participates in these environments. Clear regulatory frameworks are essential. They protect data privacy, ensure equitable access and safeguard users' psychological well-being.

Policies must prioritize the protection of young users. They are vulnerable to emotional and social influences in virtual environments. This includes content moderation, algorithm transparency and preventing platforms from exploiting user behaviour without oversight. Ensuring accessibility for users with varying levels of digital competence is also critical. It promotes inclusivity and equity in metaverse tourism experiences.

Cross-sector collaboration among tourism authorities, technology developers and educational institutions plays a pivotal role. It builds digital capacity for users and the future workforce. Training programs should focus on digital skills, privacy awareness and interaction capabilities in immersive environments. These initiatives enhance participation capacity. They reduce risks during the digital transformation of the tourism sector.

Promoting policy initiatives that support innovation, consumer protection and technology infrastructure development will establish a foundation for a sustainable metaverse tourism ecosystem. Digital experiences should be engaging. They must also be safe, equitable and provide long-term societal value.

Conclusion

Main Contributions and Summary

This research was conducted to explore how experiential and cognitive processes interact to influence satisfaction and behavioural engagement in metaverse tourism contexts. The focus is on Gen Z users. They are digital natives with high technological competence and specific expectations for digital experiences. By implementing an integrated theoretical model combining Stimulus–Organism–Response (S–O–R) and Cognitive Experiential Self-Theory (CEST), the study provides a comprehensive analytical framework. It explains how affective stimuli—specifically enjoyment and presence—activate cognitive processing. This subsequently leads to satisfaction and engagement behaviours in immersive environments.

Empirical results reveal that enjoyment and presence/telepresence are powerful stimuli. They stimulate cognitive processing. Immersion did not have a statistically significant direct effect on cognitive processing in the present sample. This finding clarifies the interplay between the rational and experiential systems in shaping Gen Z users' behavioral responses.

Model validation through PLS-SEM technique provides robust empirical evidence for the complex psychological dynamics governing user behaviour in metaverse tourism. The model achieves high reliability and discriminant validity. It also demonstrates strong explanatory power for outcome variables such as satisfaction and engagement. The research contributes to expanding consumer behaviour theory in immersive digital environments. It also provides a practical foundation for designing digital tourism experiences aligned with generational characteristics and modern users' technological expectations.

Theoretical and Practical Implications

Theoretically, this research refines and extends the S-O-R and CEST frameworks. It demonstrates their applicability in fully immersive digital environments such as the metaverse. The study clarifies the roles of affective stimuli, particularly enjoyment and presence, as well as cognitive processing and satisfaction in shaping metaverse engagement. It clarifies how two processing systems, experiential and rational, interact to shape user behaviour in digital tourism contexts. The proposed theoretical model not only validates foundational hypotheses but also adapts them to fit Gen Z characteristics and the evolving immersive technology environment.

From a practical perspective, these findings provide clear direction for designing engaging metaverse tourism experiences. They emphasize affective stimulation, cognitive engagement promotion and experience journey personalization. Integrating elements such as gamification, customization capabilities and social interaction will enhance satisfaction. These elements strengthen engagement and build brand loyalty in digital environments. Tourism marketers and platform developers can apply these insights to create digital destinations. They should be visually appealing. They must also be emotionally valuable.

They should reflect new generation users' needs for connection, self-expression and exploration.

Overall, this research contributes meaningfully to both theory and practice. It provides a solid foundation for developing digital tourism experience models in the metaverse era. It also opens new directions for research and application of immersive technology in the global tourism industry.

Limitations

First, the sample comprises 158 Gen Z respondents. While this focus provides a relevant context for examining metaverse tourism, it limits the generalizability of the findings and does not support claims that the observed relationships are generation-specific. Differences in life stage, education, income, digital access and prior metaverse experience may also contribute to variation within the cohort. In addition, the use of non-probability recruitment through social media networks, virtual reality communities and university mailing lists may introduce self-selection bias. Individuals who are more interested in metaverse technologies may have been more likely to participate, which could limit the representativeness of the sample and potentially overestimate engagement-related responses. Future research could therefore adopt cross-generational designs and probability-based or more diverse recruitment strategies to directly examine whether the proposed relationships differ across Gen Z, Gen Y and older cohorts.

Second, the cross-sectional and self-reported design limits causal interpretation and may be subject to common-method effects, recall bias and differences in respondents' understanding of metaverse experiences. In addition, the study incorporates users of platforms such as Roblox, Decentral and and Horizon Worlds, which differ in technological requirements, interaction modes, social features and content. Aggregating these experiences may consequently mask platform- or device-specific effects, particularly for immersion and presence. Longitudinal, experimental, or platform-specific studies could provide stronger evidence regarding these relationships.

Third, immersion, presence and enjoyment are conceptually related and have been operationalized inconsistently across prior studies. Although the present study distinguishes these constructs theoretically, potential overlap in measurement

may influence their estimated structural effects. Accordingly, the non-significant relationship between immersion and cognitive processing should be interpreted within the boundaries of the current measures, sample and model specification rather than as evidence that immersion is universally inconsequential. Future research should replicate the model using alternative measures and conduct rigorous assessments of discriminant validity to further establish the distinctiveness and robustness of these experiential constructs.

Future Research Directions

Future research should pursue four priorities. First, cross-generational studies should compare Gen Z, Gen Y and Gen X, with measurement invariance established before multi-group analysis. Second, longitudinal and experimental designs should examine causal effects and whether immersion varies by repeated exposure, device, platform, prior experience and digital literacy. Third, research should investigate alternative mechanisms linking immersion with cognitive processing, satisfaction and engagement, while ensuring clear construct definitions and discriminant validity. Finally, cross-cultural and mixed-method studies incorporating behavioral data could assess whether social norms, destination characteristics, authenticity and co-creation expectations shape these relationships. These extensions would clarify whether the present findings are context-specific or represent broader conditions in metaverse tourism.

In conclusion, this research contributes to theory and practice by clarifying the psychological mechanisms driving Gen Z engagement in metaverse tourism. Meaningful participation stems from the combination of positive affect, cognitive processing and active user involvement. Tourism is increasingly intertwined with digital experiences. Understanding how younger generations interact in immersive environments is key to sustaining competitiveness and innovation. The future of tourism lies not only in destinations but also in designing experiences that connect, inspire and engage in both real and virtual worlds.

Abbreviations

None.

Acknowledgement

None.

Author Contributions

Pham Thanh Huyen: Writing - Original Draft, Review and Editing, Project Administration, Nguyen Thi Thuy Duong: Investigation, Methodology, Nguyen Van Phuong: Data Curation, Pham Minh Tien: Formal Analysis, Conceptualization.

Conflict of Interest

No potential conflict of interest was reported by the author(s).

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Declaration of Artificial Intelligence (AI) Assistance

During the preparation of this manuscript, the authors used ChatGPT (OpenAI) to improve the clarity, grammar and language of the manuscript. The authors reviewed and edited all outputs and take full responsibility for the content of this publication.

Ethics Approval

Informed Consent: The survey participants have been informed about the use of the data.

Funding

No funding is involved in this study.

References

1. Dwivedi YK, Hughes L, Baabdullah AM, *et al.* Metaverse beyond the hype: multidisciplinary perspectives on emerging challenges, opportunities and agenda for research, practice and policy. *Int J Inf Manag.* 2022;66:102542. doi: 10.1016/j.ijinfomgt.2022.102542
2. Buhalis D, Leung D, Lin M. Metaverse as a disruptive technology revolutionising tourism management and marketing. *Tour Manag.* 2023;97:104724. doi: 10.1016/j.tourman.2023.104724
3. Buhalis D, Lin MS, Leung D. Metaverse as a driver for customer experience and value co-creation: implications for hospitality and tourism management and marketing. *Int J Contemp Hosp Manag.* 2023;35(2):701–716. doi: 10.1108/IJCHM-05-2022-0631
4. Hudson S, Matson-Barkat S, Pallamin N, *et al.* With or without you? Interaction and immersion in a virtual reality experience. *J Bus Res.* 2019;100:459–468. doi: 10.1016/j.jbusres.2018.10.062
5. Li FS, Shang Y, Su Q. The influence of immersion on tourists' satisfaction via perceived attractiveness and happiness. *Tour Rev.* 2022;78(1):122–141. doi: 10.1108/TR-02-2022-0078

6. Yung R, Khoo-Lattimore C, Potter LE. Virtual reality and tourism marketing: conceptualizing a framework on presence, emotion and intention. *Curr Issues Tour.* 2020;24(11):1505–1525. doi: 10.1080/13683500.2020.1820454
7. Kim MJ, Lee CK, Jung T. Exploring consumer behavior in virtual reality tourism using an extended stimulus-organism-response model. *J Travel Res.* 2020;59(1):69–89. doi: 10.1177/0047287518818915
8. Bennett S, Maton K, Kervin L. The ‘digital natives’ debate: a critical review of the evidence. *Br J Educ Technol.* 2008;39(5):775–786. doi: 10.1111/j.1467-8535.2007.00793.x
9. Helsper EJ, Eynon R. Digital natives: where is the evidence? *Br Educ Res J.* 2010;36(3):503–520. doi: 10.1080/01411920902989227
10. Horváth ZI, Kupi M, Kundi V. Digitalization and tourism: how X, Y and Z generations make travel decisions in the online era. *GeoJournal Tour Geosites.* 2025;60(2spl):1302–1314. doi: 10.30892/gtg.602spl26-1502
11. Zhang J, Mohammad J. Metaverse tourism and Gen-Z and Gen-Y’s motivation: “Will you, or won’t you travel virtually?” *Tourism Review.* 2024;79(2):304–320. doi: 10.1108/TR-06-2023-0393
12. Mehrabian A, Russell JA. The basic emotional impact of environments. *Percept Mot Skills.* 1974;38(1):283–301. doi: 10.2466/pms.1974.38.1.283
13. Talwar S, Kaur P, Nunkoo R, Dhir A. Digitalization and sustainability: virtual reality tourism in a post pandemic world. *Journal of Sustainable Tourism.* 2023;31(11):2564–2591. doi: 10.1080/09669582.2022.2029870
14. Epstein S. Intuition from the perspective of cognitive-experiential self-theory. In: Plessner H, Betsch C, Betsch T, editors. *Intuition in judgment and decision making.* Mahwah (NJ): Lawrence Erlbaum; 2008. p. 23–37. <https://psycnet.apa.org/record/2007-15735-002>
15. Belk R, Humayun M, Brouard M. Money, possessions and ownership in the metaverse: NFTs, cryptocurrencies, Web3 and wild markets. *J Bus Res.* 2022;153:198–205. doi: 10.1016/j.jbusres.2022.08.031
16. Wang Y, Su Z, Zhang N, *et al.* A survey on metaverse: fundamentals, security and privacy. *IEEE Commun Surv Tutor.* 2022;25(1):319–352. doi: 10.1109/COMST.2022.3202047
17. Kye B, Han N, Kim E, *et al.* Educational applications of metaverse: possibilities and limitations. *J Educ Eval Health Prof.* 2021;18:32. doi: 10.3352/jeehp.2021.18.32
18. Hollensen S, Kotler P, Opresnik MO. Metaverse—the new marketing universe. *J Bus Strategy.* 2022;44(3):119–125. doi: 10.1108/JBS-01-2022-0014
19. Faraboschi P, Frachtenberg E, Laplante P, *et al.* Virtual worlds (Metaverse): from skepticism, to fear, to immersive opportunities. *Computer.* 2022;55(10):100–106. doi: 10.1109/MC.2022.3192702
20. Lee SA, Lee M, Jeong M. The role of virtual reality on information sharing and seeking behaviors. *J Hosp Tour Manag.* 2021;46:215–223. doi: 10.1016/j.jhtm.2020.12.010
21. Díaz S, Zafra-Calvo N, Purvis A, *et al.* Set ambitious goals for biodiversity and sustainability. *Science.* 2020;370(6515):411–413. doi: 10.1126/science.abe1530
22. Israfilzade K. Marketing in the Metaverse: a sceptical viewpoint of opportunities and future research directions. *Eurasia Proc Educ Soc Sci.* 2022;24:53–60. doi: 10.55549/epess.1179349
23. Shin H, Kang J. How does the metaverse travel experience influence virtual and actual travel behaviors? Focusing on the role of telepresence and avatar identification. *J Hosp Tour Manag.* 2024;58:174–183. doi: 10.1016/j.jhtm.2023.12.009
24. Rancati E, D’Agata A. Metaverse in tourism and hospitality: empirical evidence on Generation Z from Italy. *Eur Sci J.* 2022;18(34):122. doi: 10.19044/esj.2022.v18n34p122
25. Pham MT. Emotion and rationality: a critical review and interpretation of empirical evidence. *Rev Gen Psychol.* 2007;11(2):155–178. doi: 10.1037/1089-2680.11.2.155
26. Yu J, Kim S, Hailu TB, Park J, Han H. The effects of virtual reality (VR) and augmented reality (AR) on senior tourists’ experiential quality, perceived advantages, perceived enjoyment and reuse intention. *Curr Issues Tour.* 2024;27(3):464–478. doi: 10.1080/13683500.2023.2165483
27. Pandita S, Mishra HG, Chib S. Psychological impact of COVID-19 crises on students through the lens of Stimulus-Organism-Response (S-O-R) model. *Child Youth Serv Rev.* 2021;120:105783. doi: 10.1016/j.childyouth.2020.105783
28. Kim MJ, Hall CM. A hedonic motivation model in virtual reality tourism: Comparing visitors and non-visitors. *International Journal of Information Management.* 2019;46:236–249. doi: 10.1016/j.ijinfomgt.2018.11.016
29. Leveau PH, Camus E. Embodiment, immersion and enjoyment in virtual reality marketing experiences. *Psychol Mark.* 2023;40:1329–1343. doi: 10.1002/mar.21822
30. Lo WH, Cheng KLB. Does virtual reality attract visitors? The mediating effect of presence on consumer response in virtual reality tourism advertising. *Inf Technol Tour.* 2020;22(4):537–562. doi: 10.1007/s40558-020-00190-2
31. Rasoolimanesh SM, Md Noor S, Schuberth F, *et al.* Investigating the effects of tourist engagement on satisfaction and loyalty. *Serv Ind J.* 2019;39(7–8):559–574. doi: 10.1080/02642069.2019.1570152
32. Yung R, Khoo-Lattimore C. New realities: a systematic literature review on virtual reality and augmented reality in tourism research. *Curr Issues Tour.* 2017;22(17):2056–2081. doi: 10.1080/13683500.2017.1417359
33. Priporas CV, Stylos N, Fotiadis AK. Generation Z consumers’ expectations of interactions in smart retailing: a future agenda. *Comput Human Behav.* 2017;77:374–381.

- doi: 10.1016/j.chb.2017.01.058
34. Hair JF Jr, Hult GTM, Ringle CM, *et al.* Partial least squares structural equation modeling (PLS-SEM) using R: a workbook. Cham: Springer; 2021. doi: 10.1007/978-3-030-80519-7
 35. Kline RB. Principles and practice of structural equation modeling. 4th ed. New York: Guilford Press; 2015. <https://psycnet.apa.org/record/2015-56948-000>
 36. Loureiro SMC. Overview of the brand journey and opportunities for future studies. *Ital J Mark.* 2023;2023(2):179-206. doi: 10.1007/s43039-023-00069-0
 37. Mandal S, Paul J, Kotni DP, Chintaluri MG. The orientation of Gen Zs towards metaverse tourism. *Journal of Destination Marketing & Management.* 2024;32:100871. doi: 10.1016/j.jdmm.2024.100871
 38. Li H, Dong W, Wang Z, *et al.* Effect of a virtual reality-based restorative environment on the emotional and cognitive recovery of individuals with mild-to-moderate anxiety and depression. *Int J Environ Res Public Health.* 2021;18(17):9053. doi: 10.3390/ijerph18179053
 39. Biswas C, Deb SK, Hasan AA, *et al.* Mediating effect of tourists' emotional involvement on the relationship between destination attributes and tourist satisfaction. *J Hosp Tour Insights.* 2021;4(4):490-510. doi: 10.1108/JHTI-05-2020-0075
 40. Sarstedt M, Ringle CM, Hair JF. Partial least squares structural equation modeling. In: Homburg C, Klarmann M, Vomberg A, editors. *Handbook of Market Research.* Cham: Springer; 2022. p. 587–632. doi: 10.1007/978-3-319-56435-7_15-1
 41. Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behav Res Methods.* 2008;40(3):879-891. doi: 10.3758/BRM.40.3.879
 42. Aiken LS, West SG, Reno RR. Multiple regression: testing and interpreting interactions. Newbury Park (CA): Sage Publications; 1991. https://books.google.com.vn/books?id=LcWLUyXcmnkC&redir_esc=y
 43. Fornell C, Larcker DF. Evaluating structural equation models with unobservable variables and measurement error. *J Mark Res.* 1981;18(1):39-50. doi: 10.1177/002224378101800104
 44. Henseler J, Ringle CM, Sarstedt M. A new criterion for assessing discriminant validity in variance-based structural equation modeling. *J Acad Mark Sci.* 2015;43:115-135. doi: 10.1007/s11747-014-0403-8
 45. Garson GD. Partial least squares: regression and structural equation models. Asheboro (NC): Statistical Associates Publishing; 2016. doi: 10.1201/b16017-6
 46. Nguyen TBT, Le TBN, Chau NT. How VR technological features prompt tourists' visiting intention: an integrated approach. *Sustainability.* 2023;15(6):4765. doi: 10.3390/su15064765
 47. Woodworth RS. *Experimental psychology.* Holt; 1929. <https://archive.org/details/in.ernet.dli.2015.188225>
 48. Hair JF, Hult GTM, Ringle CM, Sarstedt M. A primer on partial least squares structural equation modeling (PLS-SEM). 2nd ed. Thousand Oaks (CA): SAGE Publications; 2017. <https://uk.sagepub.com/en-gb/eur/a-primer-on-partial-least-squares-structural-equation-modeling-pls-sem/book244583>
 49. Tussyadiah IP, Wang D, Jung TH, tom Dieck MC. Virtual reality, presence and attitude change: Empirical evidence from tourism. *Tour Manag.* 2018;66:140-154. doi: 10.1016/j.tourman.2017.12.003
 50. Anaya-Sánchez R, Rejón-Guardia F, Molinillo S. Impact of virtual reality experiences on destination image and visit intentions: the moderating effects of immersion, destination familiarity and sickness. *Int J Contemp Hosp Manag.* 2024;36(11):3607-3627. doi: 10.1108/IJCHM-09-2023-1488
 51. Huang X, Zhao Q, Jiang J, *et al.* Effects of level of immersion on cognitive and psychological outcomes in virtual reality science learning. *J Math Sci Technol Educ.* 2025;2(1):55-68. doi: 10.12973/jmste.2.1.55
 52. Huang W, Roscoe RD, Johnson-Glenberg MC, Craig SD. Motivation, engagement and performance across multiple virtual reality sessions and levels of immersion. *J Comput Assist Learn.* 2021;37:745-758. doi: 10.1111/jcal.12520
 53. Shamim N, Gupta S, Shin M. Evaluating user engagement via Metaverse environment through immersive experience for travel and tourism websites. *Int J Contemp Hosp Manag.* 2025;37(4):1132-1174. doi: 10.1108/IJCHM-10-2023-1590

How to Cite: Huyen PT, Duong NTT, Phuong NV, Tien PM. Exploring Gen Z Tourists' Engagement in the Metaverse: A Stimulus-organism-response Approach with Cognitive Experiential Self-Theory Integration. *Int Res J Multidiscip Scope.* 2026;7(4):784-804. DOI: 10.47857/irjms.2026.v07i04.011512