Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

When Information Quality Substitutes for Experience: Explaining and Predicting Trekking Purchase Intention with PLS-SEM–ANN

Viet Thai Nguyen
Thuongmai University
Quang Vinh Nguyen
vinh.nq@tmu.edu.vn

Thuongmai University
Thị Ha Truong
Nha Trang Tourism College

Research Article

Keywords: Trekking tourism, Purchase intention, Information source quality, Perceived challenge, PLS-SEM–ANN hybrid, Vietnam

Posted Date: May 25th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9212496/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Additional Declarations: No competing interests reported.

Abstract

This study investigates how perceived challenge (CS), trekking motivation (TM), personal experience (PE), and information source quality (ISQ) shape trekkers' purchase intention (PI) through perceived trekking perceptions (PTT) and perceived value (PV), with ISQ moderating key decision pathways. Survey data were collected from 500 Vietnamese domestic trekkers in Ha Giang, Lam Đong, and Quang Binh (April–June 2025). Using a hybrid PLS-SEM–ANN approach, PLS-SEM confirms the proposed appraisal-to-intention mechanism ($R^2 = 0.295$), showing that CS increases PTT and TM but does not directly enhance PV, while PE strongly improves PTT, PV, and TM. ISQ strengthens PTT and TM and amplifies the CS and PTT link, yet it weakens the PE and TM relationship, indicating a substitution effect whereby high-quality information can compensate for limited experience. ANN yields superior predictive accuracy ($R^2 \approx 0.65$) and identifies PE, ISQ, and TM as the most influential predictors. The findings highlight ISQ as a boundary condition that reshapes trekking decision pathways and offer actionable guidance for transparent, experience-sensitive product and information design.

1. Introduction

Post-pandemic tourism demand has been increasingly shaped by travelers' desire to reconnect with nature and to challenge personal limits, leading to robust global growth in adventure tourism (Akaho, 2024). Among various adventure forms, trekking tourism has emerged as a prominent soft-adventure segment that combines physical challenge with immersive natural and cultural experiences (Grand View Research, 2024). Industry estimates value the global adventure tourism market at approximately USD 406 billion in 2024, with projections approaching USD 1 trillion by 2030 (Grand View Research, 2024). In Viet Nam, the tourism sector has rebounded rapidly, recording nearly 110 million domestic trips in 2024 (VNAT, 2025), signaling strong latent demand for nature-based and experiential travel.

Despite this growth, trekking tourism remains relatively underdeveloped among domestic travelers in Viet Nam. Participation is constrained by perceived physical and safety risks, limited prior experience, and, critically, uneven information quality across destinations and service providers. In emerging trekking destinations such as Hà Giang, where local authorities have set ambitious targets of 3.5 million visitors by 2025 (VietnamPlus, 2025), the ability to convert latent interest into actual participation depends not only on infrastructure and products, but also on the quality of information that travelers rely on before making decisions. In this context, information source quality functions as an implicit form of quality assurance, shaping expectations, reducing uncertainty, and signaling the credibility and feasibility of trekking experiences prior to consumption.

From a behavioral perspective, purchase intention represents a central outcome variable, linking beliefs, attitudes, and subjective norms to actual behavior, as articulated by the Theory of Planned Behavior (Ajzen, 1991). Prior tourism studies indicate that motivation, risk-related cognitions, and information sources jointly shape intention (Agag & El-Masry, 2017; Ismagilova et al., 2020), while value theory suggests that intention emerges when perceived benefits outweigh perceived costs (Zeithaml, 1988). More recent evidence further shows that tourism information quality on digital platforms influences travel intention through information processing and evaluation mechanisms rather than via simple direct effects, thereby extending TPB related explanations in tourism contexts (Hu et al., 2025; Shneikat et al., 2025). However, empirical evidence remains limited in domestic trekking tourism in Viet Nam, where challenge seeking intersects with both physical and psychological risks, and where information environments are highly fragmented across operator websites, social media, and peer communities. In particular, the role of information source quality in calibrating adventure-related perceptions and translating motivation and experience into favorable intentions remains underexplored.

Addressing this gap, the present study develops and tests an integrative model in which perceived challenge (CS), trekking motivation (TM), and personal experience (PE) influence trekkers' purchase intention (PI) indirectly through perceived trekking perceptions (PTT) and perceived value (PV). Beyond its direct cognitive role, information quality may substitute for experience by providing decision scaffolding (e.g., route diagnostics, preparedness cues, safety transparency), allowing novices to form motivation and confidence despite limited trekking history. Conceptually, this framework treats purchase intention as conditional rather than automatic: individuals are willing to engage in trekking only when expected value exceeds a psychological threshold, a threshold that is highly responsive to credible, timely, and trustworthy informational cues. This aligns with emerging tourism evidence that information quality can function as a decision enabling signal, improving diagnostic and reducing ambiguity in risk-salient travel choices (Hu et al., 2025; Shneikat et al., 2025; Teng et al., 2025).

Methodologically, the study integrates explanatory and predictive perspectives through a hybrid PLS-SEM and artificial neural network (ANN) approach. While PLS-SEM tests theoretically specified mechanisms and conditional effects (Hew, 2019; Shmueli & Koppius, 2011), ANN complements this by uncovering nonlinear predictive salience across drivers of intention an increasingly used strategy in tourism and consumer behavior research when decisions involve complex, experience-intensive trade-offs (Karkonasasi et al., 2023).

This study makes four key contributions. First, it focuses on domestic Vietnamese trekkers, a segment that remains largely overlooked in adventure and trekking decision research. Second, it advances understanding of behavioral mechanisms by empirically testing a dual mediation process through trekking perceptions and perceived value. Third, it clarifies the moderating role of information source quality, demonstrating how information can amplify or attenuate the effects of perceived challenge and experience on downstream appraisal and motivation. Finally, from a methodological perspective, the study employs a hybrid PLS-SEM–ANN approach to uncover nonlinear relationships and prioritize key predictors of purchase intention, while adhering to recommended out-of-sample predictive assessment practices. The remainder of the paper is organized as follows: Section 2 reviews the theoretical background and develops the research hypotheses. Section 3 outlines the research methodology and data. Section 4 presents the empirical results, followed by discussion in Section 5 and concluding implications in Section 6.

2. Literature review

2.1. Adventure tourism and purchase intention in trekking

Adventure tourism is commonly characterized by voluntary engagement with challenge, excitement elicited by task difficulty, and close connections to nature and local culture; trekking/hiking is often positioned as a prototypical form soft adventure that blends physical effort with experiential immersion (Swarbrooke & Horner, 2007). Post-pandemic demand has further strengthened travelers' pursuit of self-development, wellbeing, and nature reconnection, accelerating participation in outdoor and adventure activities (Akaho, 2024; Farkić & Gebbels, 2022). Yet trekking decisions are inherently uncertain and risk salient because prospective participants must evaluate not only hedonic benefits but also physical demands, route feasibility, weather variability, and safety conditions (Pomfret & Bramwell, 2016). Recent outdoor tourism scholarship emphasizes that satisfaction and safety hinge on the *matching* between perceived difficulty and participant capability, and that both tourists and operators increasingly rely on third-party difficulty gradings and trustworthy informational cues to reduce decision ambiguity in destinations that attract inexperienced clients (Buckley et al., 2025).

Within consumer decision-making, purchase intention functions as the proximal bridge between subjective evaluation and actual choice (Ajzen, 1991; Chen & Chen, 2010; Zeithaml, 1988). In tourism contexts, intention is typically shaped by attitudinal evaluation and perceived value trade-offs, particularly for experience-intensive products where benefits must outweigh psychological and functional costs (Tsaur et al., 2023). For trekking, perceived challenge understood as one's desired or perceived level of conquerable difficulty often serves as a central stimulus shaping appraisals and downstream intention (Jumanazarov et al., 2020). CS is theoretically linked to flow and sensation seeking, implying that manageable challenge can sustain engagement and intention when individuals perceive sufficient competence to cope with task demands. In parallel, information source quality has been shown to influence intention and key mediators (e.g., attitudes, value appraisals) because it reduces uncertainty and increases the diagnosticity of pre-consumption evaluation (Ismagilova et al., 2020; Qiu et al., 2016). Notably, recent work that integrates the heuristic systematic model with TPB demonstrates that tourism information quality can shape travel intention via cognitive evaluations rather than simple direct effects, reinforcing the importance of information as a decision-enabling mechanism (Hu et al., 2025)

2.2. Foundational theories

The present study draws on three complementary theories: Theory of Planned Behavior (TPB), Self-Determination Theory (SDT), and Self-Efficacy Theory (SET) to explain how cognitive, motivational, and experiential factors shape tourists' intention to choose trekking.

Under TPB, intention is driven by attitude, subjective norms, and perceived behavioral control (Ajzen, 1991). In trekking contexts, PTT and PV represent central evaluative judgments that closely map to attitudinal evaluation, while PE strengthens perceived control by reducing uncertainty and enhancing capability beliefs (Sujood et al., 2022). Recent reviews reiterate TPB's continuing relevance in

tourism while calling for more precise identification of boundary conditions and mechanisms across contexts (Esfandiar & Hadinejad, 2025).

SDT posits that intrinsic motivation derives from fulfilling basic psychological needs, especially competence and autonomy (Ryan & Deci, 2000b). In adventure tourism, CS reflects the desire to pursue optimally difficult tasks that satisfy competence needs. Likewise, TM represents intrinsic interest in physical challenge, natural environments, and mastery experiences. The challenge–flow–mastery process demonstrates that confronting optimal challenges generates flow and perceived mastery, which in turn reinforce positive activity beliefs and future participation intentions (Baumann & Scheffer, 2010; Ng & Hsu, 2024; Tsaur et al., 2013). Thus, SDT explains why CS and TM shape PTT and PV as well as downstream intention.

SET describes individuals' beliefs in their capability to perform a behavior successfully (Bandura, 1999). Personal experience acts as the primary source of efficacy, enabling trekkers to assess difficulty accurately, anticipate benefits, and perceive risks as manageable. High self-efficacy enhances both PTT and PV and ultimately promotes intention. This theory accounts for why PE is a robust cognitive-experiential antecedent in adventure decisions.

Taken together, the three theories form a coherent explanatory structure: SDT clarifies motivational and challenge-based antecedents (CS, TM), SET explains the experiential antecedent (PE), and TPB specifies how these inputs are translated into intention through PTT and PV. The moderating role of ISQ further reflects how credible information calibrates challenge and experience perceptions, refining the pathway of CS and PE – PTT and TM - PV - PI.

2.3. Theoretical framework and research hypotheses

Building on TPB–SDT–SET, we propose a decision model in which CS, TM, and PE influence PI primarily through two psychological transformations: PTT reflects trekkers' evaluation of the feasibility, attractiveness, and suitability of trekking, whereas PV captures the net trade-off between the expected benefits and the associated costs. Critically, ISQ is conceptualized not merely as a background communication factor but as a boundary condition that can reconfigure decision pathways through two roles: Interpretive facilitator: High ISQ reduces ambiguity and helps individuals interpret perceived challenge as manageable and worthwhile, strengthening the conversion of CS into favorable trekking perceptions. Compensatory mechanism: High ISQ can partially substitute for the role of experience by providing structured cues for preparedness and feasibility assessment. This implies that when ISQ is high, the effect of PE on motivation may weaken because informational support reduces reliance on accumulated experience. This dual role logic aligns with prior evidence that credible online information frames risk-related judgments and influences consumers' cognitive evaluations (Cheung M. F., 2019; Ismagilova et al., 2020), and with recent tourism studies showing that information quality shapes intention through information processing and TPB mechanisms (Hu et al., 2025).

Direct effects

Prior research shows that optimal challenge enhances approach, flow, and mastery (Baumann & Scheffer, 2010; Ng & Hsu, 2024; Tsaur et al., 2013), while experience strengthens proactive engagement and efficacy (Bandura, 1999). Adventure studies further confirm that controlled challenge and accumulated experience shape cognition and value(Gross et al., 2023; Tsaur et al., 2023), and that high quality information helps calibrate beliefs and reduce uncertainty (Cheung M. F., 2019; Cheung et al., 2008; Ismagilova et al., 2020). Challenge flow research also indicates that pursuing optimally difficult tasks fosters absorption and mastery, promoting favorable activity beliefs (Baumann & Scheffer, 2010; Ng & Hsu, 2024; Tsaur et al., 2013). In adventure tourism, perceived challenge reframes trekking as feasible and rewarding (Pomfret & Bramwell, 2016). From a value standpoint, perceived value reflects a benefit cost trade-off (Zeithaml, 1988), where controlled challenge boosts achievement related benefits. Motivation also rises when challenge is seen as conquerable (Piniel & Albert, 2020). Therefore, this study proposes:

H1: CS positively influences PTT.

H2: CS positively influences PV.

H3: CS positively influences TM.

Personal experience elevates perceived control and realism of expectations, improving activity appraisals (Baumann & Scheffer, 2010; Jiang et al., 2023). Experience trims learning costs and uncertainty, increasing perceived value from participation (Chen &

Chen, 2010). Accumulated skills and self-efficacy promote persistence and approach motivation in outdoor activities (Ng & Hsu, 2024). Accordingly, this study proposes the following hypothesis:

H4: PE positively influences PTT.

H5: PE positively influences PV.

H6: PE positively influences TM.

Information adoption research shows that credible, useful, expert, and timely information helps calibrate beliefs and reduce ambiguity(Cheung et al., 2008; Sussman & Siegal, 2003). In tourism, high quality information improves activity appraisals and clarifies benefit cost expectations (Cheng et al., 2024; Ismagilova et al., 2020). When uncertainty is reduced and controllability is signaled, motivation to engage tends to increase (L. Qiu et al., 2024; Sussman & Siegal, 2003). Accordingly, this study proposes the following hypothesis:

H7: ISQ positively influences PTT.

H8: ISQ positively influences PV.

H9: ISQ positively influences TM.

High quality information frames challenge as manageable (controlled challenge), strengthening the link between challenge and favorable beliefs (Cheung et al., 2008; Ismagilova et al., 2020). Accurate guidance and safety standards convert perceived challenge into approach motivation (M. Jackson, 2019; L. Qiu et al., 2024). Experienced trekkers better leverage high quality information to refine feasibility beliefs (Bandura, 1999). With credible information, prior experience converts more efficiently into motivation (Bandura, 1999; L. Qiu et al., 2024). Accordingly, this study proposes the following hypothesis:

Moderating effects of ISQ (pathway reconfiguration)

H10a: ISQ strengthens the positive effect of CS on PTT.

H10b: ISQ strengthens the positive effect of CS on TM.

H10c: ISQ strengthens the positive effect of PE on PTT.

H10d: (Substitution effect): ISQ negatively moderates PE on TM, such that the relationship becomes weaker when ISQ is high.

Downstream effects

SDT suggests that identified motivation stimulates information seeking and practice, which enrich feasibility attractiveness beliefs (Aicher & Brenner, 2015; M. Jackson, 2019; Ryan & Deci, 2000b). Motivated individuals perceive higher experiential benefits relative to costs, lifting perceived value (Chen & Chen, 2010). Accordingly, this study proposes the following hypothesis:

H11: TM positively influences PTT.

H12: TM positively influences PV.

H13: TM positively influences PI.

Motivational arousal directly propels commitment to participate in adventure activities (Carvache-Franco et al., 2024). Within TPB, favorable activity beliefs drive intention; tourism studies confirm PTT intention links in adventure settings (Fishbein M., 2010). Perceived value is a proximal determinant of behavioral intention across tourism forms (Chen & Chen, 2010; Zeithaml et al., 1996). Accordingly, this study proposes the following hypothesis:

H14: PTT positively influences PI.

H15: PV positively influences PI.

Mediating roles of PTT and PV

Mediating evidence in tourist behavior shows that experience strengthens feasibility attractiveness beliefs, which in turn elevate intention (Ajzen, 1991; Bandura, 1999). Likewise, perceived challenge fosters favorable trekking appraisals that translate into intention via the TPB pathway(Jackson, 2019; Qiu et al., 2024) Grounded in SDT and self-efficacy, intrinsic motivation stimulates information seeking and practice, which shape positive feasibility attractiveness beliefs about the activity(Ryan & Deci, 2000). In adventure contexts, approach motivation often leads to mastery and more favorable activity appraisals, which then translate into intention via the TPB pathway (Jackson, 2019). Accordingly, this study proposes the following hypothesis:

H16a: PTT mediates the relationship between PE and PI.

H16b: PTT mediates the relationship between CS and PI.

H16c: PTT mediates the relationship between TM and PI.

By reducing uncertainty and effort, experience raises value perceptions that translate into intention (Chen & Chen, 2010).Controlled challenge increases achievement-related benefits, which heighten value and subsequent intention (Aicher & Brenner, 2015). Tourism studies indicate that higher motivation elevates perceived experiential benefits (e.g., achievement, competence development) and reduces perceived costs (e.g., effort, uncertainty), thereby increasing perceived value a proximal antecedent of intention (Akaho, 2024; L. Qiu et al., 2024; Sujood et al., 2022). In means end terms, PV serves as a conduit through which motivation affects intention. Accordingly, this study proposes the following hypothesis:

H17a: PV mediates the relationship between PE and PI.

H17b: PV mediates the relationship between CS and PI.

H17c: PV mediates the relationship between TM and PI.

The proposed research model with the moderating role of ISQ is illustrated in Fig. 1.

3. Research methods

3.1. Research design and procedure

This study adopted a quantitative, cross-sectional survey design to examine how CS, TM, PE, and ISQ shape PI through PTT and PV, with ISQ additionally moderating selected decision pathways. Given the simultaneous goals of theory testing (explanatory modeling) and prediction (capturing potential nonlinear patterns), the study employed a hybrid analytical strategy integrating PLS-SEM and ANN, which is increasingly recommended for complex tourism decision contexts.

The research procedure followed four sequential stages. First, expert interviews and a pilot test were conducted to refine the wording, contextual relevance, and clarity of measurement items. Second, a main survey was administered to Vietnamese domestic trekkers who met the screening criteria. Third, PLS-SEM was applied to evaluate the measurement model and the structural model, including bootstrapping and Importance–Performance Map Analysis (IPMA). Fourth, an ANN model was developed to complement SEM results by capturing potential nonlinear relationships and identifying predictive importance of the antecedents through repeated train test validation, RMSE/SSE diagnostics, and sensitivity analysis of normalized importance.

3.2. Instrument and measures

The measurement items were adapted from validated scales in the adventure/trekking literature and related behavioral theories. All items were context adapted through expert review and pilot tested to ensure content validity and clarity. Constructs were measured on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). Table 2 reports the constructs, item wordings, and sources.

Table 2
Constructs, measurement items, and sources

Construct	Code	Measurement Items	Source
Challenge Seeking	CS1	I am interested in trekking routes with challenging difficulty levels.	Ng & Hsu (2024); Tsaur et al. (2013)
	CS2	I want to push my limits when trekking.	
	CS3	When the challenge level is optimal, I am more inclined to participate.	
Trekking Motivation	TM1	I trek to develop myself and my abilities.	Pomfret & Bramwell (2016); Ryan & Deci (2000)
	TM2	I trek to connect with nature and relieve stress.	
	TM3	I trek to explore new cultures/destinations.	
Personal Experience	PE1	I have participated in trekking before.	Bandura (1999); Llewellyn & Sanchez (2008)
	PE2	I am confident in my trekking skills (pace, navigation, teamwork).	
	PE3	I am knowledgeable about trekking safety and equipment.	
Information Source Quality	ISQ1	The information I consult is accurate and trustworthy.	Ismagilova et al. (2020); Sussman & Siegal (2003)
	ISQ2	The information is relevant to my trekking decision-making needs.	
	ISQ3	The information is timely and up to date.	
	ISQ4	The information helps me diagnose/assess route difficulty and risks.	
Perception of Trekking Tour	PTT1	I perceive trekking as an attractive activity that suits me.	Fishbein M. (2010); Roehl & Fesenmaier (1992)
	PTT2	I believe trekking provides substantial health and psychological benefits.	
	PTT3	The risks of trekking are acceptable and manageable.	
Perceived Value	PV1	The benefits I receive are worth the money/effort spent.	Chen & Chen (2010); Sweeney & Soutar (2001)
	PV2	Trekking delivers emotional value (achievement, excitement).	
	PV3	Overall, a trekking tour offers high value to me.	
Purchase Intention	PI1	I intend to book a trekking program within the next 6–12 months.	Ajzen (1991); Han H. (2010)
	PI2	I am willing to pay for a suitable trekking tour.	
	PI3	I am likely to choose trekking over other types of travel.	

3.3 Sampling and data collection

The study used purposive sampling targeting Vietnamese adults (≥ 18 years) who had completed at least one trekking trip. Respondents were recruited offline at major trailheads and partner venues of trekking operators and clubs, as well as online via affiliated social media groups. Data were collected across three major trekking regions Lam Đong, Quảng Binh, and Ha Giang from April to June 2025 to ensure contextual diversity.

To evaluate sample adequacy, the study considered both the PLS 10-times rule and statistical power analysis ($\alpha = .05$; power = .80). Quotas were applied across the three provinces to maintain balanced regional representation. Participation was voluntary and anonymous. The research protocol was reviewed and approved by the Ethics Committee of Thuong Mai University (28 March 2025).

All participants received information about the study purpose, data usage, confidentiality, and their rights, and provided informed consent (including consent to publish) prior to completing the survey.

3.4 Internal validity and assumption checks

To ensure internal validity, several procedures were applied to mitigate Common Method Bias (CMB). Harman's single-factor test showed that the first factor explained only 42.8% of the variance below the 50% threshold indicating no major CMB issues (Podsakoff et al., 2003). VIF values were all below 3.3 (Kock, 2015), suggesting no multicollinearity and minimal method bias. Procedural controls such as randomized item order, reverse-coded items, and assurances of anonymity further reduced bias (Tehseen et al., 2017).

PLS-SEM was selected as an appropriate technique for analyzing complex models with multiple latent variables (Urbach & Ahlemann, 2010). Preliminary diagnostics confirmed model suitability: linearity was checked via ANOVA, while data normality was evaluated using Kolmogorov–Smirnov (KS) and Shapiro–Wilk (SW) tests (Lee et al., 2020). Table 3 presents ANOVA deviation-from-linearity results for predictors and PI.

Table 3
Linearity assessment between independent variables and behavioral intention

Variable Pair	Sum of Squares (Deviation from Linearity)	df	Mean Square	F-value	Significance (p-value)	Linear/Non-Linear
PI * CS	5.891	9	.655	1.210	.286	Linear
PI * TM	14.228	11	1.293	2.478	.005	Non-Linear
PI * PE	9.723	11	.884	1.828	.047	Non-Linear
PI * PPT	7.810	11	.710	1.275	.235	Linear
PI * ISQ	6.901	13	.531	.991	.459	Linear
PI* PV	10.919	11	.993	1.664	.078	Linear

Table 3 indicates significant nonlinear effects for PI in the TM ($F = 2.478$, $p = .005$) and PE ($F = 1.828$, $p = .047$) relationships, whereas CS, PTT, ISQ, and PV show no meaningful deviation from linearity. This mixed pattern supports the use of a hybrid SEM–ANN approach.

Although KS and SW tests returned $p < .05$ for all variables, the large sample size ($n = 500$) and skewness values within ± 1 suggest only minor departures from normality. Accordingly, PLS-SEM remains suitable as it does not assume multivariate normality and is prediction oriented, while ANN likewise operates without normality constraints and enhances predictive accuracy (Urbach & Ahlemann, 2010).

4. Empirical analysis

4.1 Descriptive analysis of the sample

A total of 500 valid cases were used for PLS-SEM and ANN analyses. Table 4 summarizes the demographic profile of the respondents.

Table 4
Demographic profile of respondents (n = 500)

Variable	Category	n	%
Gender	Female	246	49.2
	Male	254	50.8
Age	18–25	130	26.0
	26–35	261	52.2
	> 35	109	21.8
Education level	High school graduate or below	109	21.8
	Currently in university (undergraduate)	255	51.0
	University graduate or above	136	27.2
Destination	Ha Giang	134	26.8
	Lam Đong	179	35.8
	Quang Binh	187	37.4
Trekking experience	One time	143	28.6
	Two times	190	38.0
	More than Two times	167	33.4

Table 4 summarizes the demographics of the 500 valid respondents. The sample is gender balanced (49.2% female; 50.8% male), reducing bias. Most participants are aged 26–35 (52.2%), followed by 18–25 (26.0%), indicating that trekking mainly attracts young and middle-aged adults. Educational attainment is relatively high: 51.0% are current university students and 27.2% hold a university degree or higher, consistent with evidence that experience based tourism appeals to more educated travelers.

Destination representation is evenly distributed across Ha Giang (26.8%), Lam Đong (35.8%), and Quang Binh (37.4%), ensuring geographic diversity. Trekking experience is also balanced, with 28.6% having trekked once, 38.0% twice, and 33.4% more than twice. This composition supports meaningful comparisons across experience levels and strengthens the predictive validity of the subsequent PLS-SEM and ANN analyses.

4.2 PLS-SEM results

4.2.1 Measurement Model Assessment

Table 5 shows that all constructs meet the required reliability standards, with Cronbach's alpha (0.808–0.892) and Composite Reliability (0.874–0.933) exceeding the 0.70 threshold, confirming strong internal consistency (Nunnally & Bernstein, 1994). All AVE values are above 0.50, ranging from 0.635 to 0.822, demonstrating satisfactory convergent validity (Fornell & Larcker, 1981). In addition, all item loadings surpass 0.70, indicating solid indicator reliability. Overall, the measurement model exhibits robust reliability and convergent validity.

Table 5
Construct reliability and convergent validity

Construct	Item	Outer Loading	Cronbachs Alpha	CR	AVE
CS	CS1	0.863	0.884	0.928	0.812
	CS2	0.925			
	CS3	0.913			
TM	TM1	0.906	0.892	0.933	0.822
	TM2	0.912			
	TM3	0.902			
PE	PE1	0.819	0.808	0.886	0.723
	PE2	0.868			
	PE3	0.862			
ISQ	ISQ1	0.757	0.810	0.874	0.635
	ISQ2	0.726			
	ISQ3	0.869			
	ISQ4	0.829			
PV	PV1	0.888	0.858	0.913	0.778
	PV2	0.899			
	PV3	0.859			
PTT	PTT1	0.905	0.890	0.932	0.820
	PTT2	0.905			
	PTT3	0.907			
PI	PI1	0.892	0.892	0.933	0.822
	PI2	0.917			
	PI3	0.911			

To ensure a robust evaluation of discriminant validity, two complementary criteria were applied: to assess discriminant validity, both the Fornell–Larcker criterion and the HTMT ratio were applied. As shown in Table 6, the square roots of each construct's AVE (0.797–0.907) exceed all corresponding inter construct correlations, indicating that each construct shares more variance with its own indicators than with others. This confirms that the Fornell–Larcker criterion is satisfied.

Table 6
Fornell–Larcker criterion

CS	CS	TM	PE	ISQ	PV	PTT	PI
	0.901						
TM	0.298	**0.907**					
PE	0.411	0.372	**0.850**				
ISQ	0.413	0.318	0.354	**0.797**			
PV	0.152	0.241	0.265	0.146	**0.882**		
PTT	0.307	0.515	0.333	0.355	0.112	**0.906**	
PI	0.440	0.447	0.522	0.455	0.323	0.412	**0.907**

The HTMT ratios in Table 7 are all below the conservative 0.85 cutoff (0.126–0.612), consistent with Henseler et al. (2015). This confirms that the constructs are empirically distinct and that multicollinearity is minimal. Combined with the Fornell–Larcker results, the model demonstrates satisfactory discriminant validity across all latent constructs.

Table 7
Heterotrait-monotrait ratio - matrix

TM	CS	TM	PE	ISQ	PV	PTT
	0.333					
PE	0.487	0.435				
ISQ	0.487	0.368	0.432			
PV	0.172	0.276	0.314	0.171		
PTT	0.343	0.578	0.392	0.404	0.126	
PI	0.496	0.502	0.612	0.533	0.364	0.462

4.2.3 Structural Model Evaluation and Hypothesis Testing

To evaluate the performance and predictive power of the structural model, several key criteria were examined, including the coefficient of determination (R^2), effect size (f^2), variance inflation factor (VIF), and predictive relevance (Q^2), following the recommendations of Götz et al. (2009); Hair et al. (2021). The results summarized in Table 8 provide an overview of these indicators for all endogenous constructs, thereby demonstrating the model's explanatory strength and predictive validity.

Table 8
Summary of structural model evaluation

Coefficient evaluation	Variables/ contructs	Testing values				Reference values
R^2		R^2		R^2 Adjusted		>=0.75: considerable =<0.5: Moderate =< 0.25: Weak (Hair et al., 2021)
	TM	0.295		0.291		
	PV	0.095		0.087		
	PTT	0.329		0.321		
	PI	0.295		0.291		
Effect Size(f^2)	f^2					
		TM	**PV**	**PTT**	**PI**	0.35 = > Large effect 0.15 = > Medium 0.02 = > Small effect (Hair et al., 2021)
	CS	0.015	0.000	0.008		
	TM		0.023	0.198	0.068	
	PE	0.065	0.030	0.010		
	ISQ	0.023	0.000	0.029		
	PV				0.072	
	PTT				0.066	
	PI					
Collinearity(Inner VIF)	VIF					
	CS	1.341	1.352	1.361		VIF < 5.0 (Hair et al., 2021)
	TM		1.232	1.249	1.428	
	PE	1.267	1.349	1.349		
	ISQ	1.314	1.307	1.345		
	PV				1.062	
	PTT				1.362	
	PI					
Predictive Relevance(Q^2)	Q^2					Q^2 >0: Predictive relevance (Götz et al., 2009)
	TM	0.182				
	PV	0.065				
	PTT	0.178				
	PI	0.263				

The R^2 values show moderate explanatory power for TM (0.295), PTT (0.329), and PI (0.295), while PV (0.095) is weakly explained (Hair et al., 2021). This indicates that the model accounts for a meaningful share of variance in key trekking perceptions and intention.

Effect-size results (f^2) fall mostly within the small and medium range, with TM exerting the strongest influence medium to large on PTT (0.198) and moderate on PI (0.068). Other predictors (CS, PE, ISQ) show smaller effects ($f^2 < 0.07$), highlighting the central role of motivation.

All VIF values are well below 5.0, confirming no multicollinearity. Q^2 values for TM (0.182), PTT (0.178), PV (0.065), and PI (0.263) are all above zero, indicating predictive relevance (Götz et al., 2009).

Bootstrapping with 5,000 subsamples (Tables 9–11) confirms the significance of the hypothesized structural paths.

Table 9
Evaluation of direct effects in the structural model

Hypothesis	Path	β	T Statistics	P Values	Result
H1	CS -> PTT	0.084	2.013	0.044	Supported
H2	CS -> PV	0.018	0.334	0.738	Unsupported
H3	CS -> TM	0.126	2.666	0.008	Supported
H4	PE -> PTT	0.094	2.077	0.038	Supported
H5	PE -> PV	0.191	3.891	0.000	Supported
H6	PE -> TM	0.256	5.640	0.000	Supported
H7	ISQ -> PTT	0.163	3.648	0.000	Supported
H8	ISQ -> PV	0.021	0.439	0.661	Unsupported
H9	ISQ -> TM	0.156	3.350	0.001	Supported
H11	TM -> PTT	0.407	8.785	0.000	Supported
H12	TM -> PV	0.158	3.211	0.001	Supported
H13	TM -> PI	0.262	5.406	0.000	Supported
H14	PTT -> PI	0.251	5.325	0.000	Supported
H15	PV -> PI	0.232	6.801	0.000	Supported

The PLS-SEM results (Table 9) support most hypotheses. CS positively predicts PTT (H1; $\beta = 0.084$, $p = .044$) and TM (H3; $\beta = 0.126$, $p = .008$), while its effect on PV is nonsignificant (H2). Personal experience shows significant positive effects on PTT (H4), PV (H5), and TM (H6), highlighting its strong experiential contribution. Information source quality likewise enhances PTT (H7; $\beta = 0.163$, $p < .001$) and TM (H9; $\beta = 0.156$, $p = .001$), though not PV (H8).

Motivation (TM) strongly predicts PTT (H11), PV (H12), and PI (H13), confirming its central role. Both PTT (H14; $\beta = 0.251$, $p < .001$) and PV (H15; $\beta = 0.232$, $p < .001$) significantly shape PI, supporting the sequential mechanism from perception and value to intention.

Table 10 reports the moderation results for ISQ on the CS, PE, TM, and PTT relationships.

Table 10
Moderation Effects of ISQ in the Structural Model

Hypothesis	Path	β	T Statistics	P Values	Result
H10a	ISQ x CS -> PTT	0.079	2.228	0.026	Supported
H10b	ISQ x CS -> TM	0.044	1.120	0.263	Unsupported
H10c	ISQ x PE -> PTT	0.006	0.164	0.869	Unsupported
H10d	ISQ x PE -> TM	-0.101	2.764	0.006	Supported

The moderation results show that ISQ significantly strengthens the effect of CS on PTT (H10a; $\beta = 0.079$, $p = .026$), indicating that credible information enhances how challenge perceptions translate into favorable trekking perceptions. However, ISQ does not moderate the effects of CS on TM (H10b) or PE on PTT (H10c).

Notably, ISQ negatively moderates the PE and TM relationship (H10d; β = − 0.101, p = .006), suggesting that high quality information may partially substitute for personal experience in shaping motivation reducing the dependence on experiential knowledge among less experienced trekkers. Overall, information quality plays a dual role: reinforcing cognitive perception while attenuating the experiential–motivational link. Figure 2 illustrates the moderation effects within the structural model.

.

To examine the mediating effects within the structural model, this study conducted a bootstrapping procedure with 5,000 subsamples using the PLS-SEM framework. Table 11 presents the results of the mediation analysis, examining the indirect effects of PE, CS, and TM on PI through perceived PTT and PV

.

Table 11
Mediation effects of PTT and PV on the PI

Hy	Mediated Pathway	β	T	P	95% CI (Lower)	95% CI (Upper)	Result
H16a	PE -> PTT -> PI	0.023	1.826	0.068	0.001	0.050	Unsupported d
H16b	CS -> PTT -> PI	0.021	1.759	0.079	0.001	0.048	Unsupported
H16c	TM -> PTT -> PI	0.102	4.715	0.000	0.062	0.147	Supported
H17a	PE -> PV -> PI	0.044	3.192	0.001	0.020	0.074	Supported
H17b	CS -> PV -> PI	0.004	0.329	0.742	-0.019	0.030	Unsupported
H17c	TM -> PV -> PI	0.037	3.152	0.002	0.014	0.060	Supported

Results show that PTT mediates only the TM → PI relationship (H16c; β = 0.102, p < .001), indicating that motivation shapes intention mainly by influencing how trekkers perceive the activity. The indirect effects via PTT for PE (H16a) and CS (H16b) were nonsignificant, suggesting their impacts occur through direct or alternative routes.

For value-based mediation, both PE → PV → PI (H17a; β = 0.044, p = .001) and TM → PV → PI (H17c; β = 0.037, p = .002) were supported, whereas the CS → PV → PI pathway (H17b) was not supported. This indicates that experience and motivation enhance intention by increasing perceived value, while challenge perception alone does not. Overall, PTT and PV serve distinct mediating roles: PTT explains how motivation translates into intention, whereas PV links both experience and motivation to intention. This dual pattern highlights the importance of both experiential perception and value evaluation in shaping trekking purchase intention.

4.2.3 Importance–Performance Map Analysis (IPMA)

Figure 3 presents the IPMA results, comparing the relative importance and performance of key predictors of PI. This analysis complements the PLS-SEM findings by showing both the strength of each causal path and the practical performance of the underlying constructs (Hair et al., 2021).

The IPMA results show that TM is the most influential predictor of PI, with the highest importance (~ 0.40) and above average performance (~ 64). PV and PTT follow with moderate importance (~ 0.25–0.27), indicating that strengthening perceived value and experience interpretation remains essential. PE and ISQ display lower importance (~ 0.15 and ~ 0.10), and CS shows the weakest impact (~ 0.08), suggesting that experience, information quality, and challenge awareness play comparatively smaller roles once motivation and value are considered.

4.3 ANN Results

To complement the linear PLS-SEM results and capture nonlinear patterns, an ANN model was developed using CS, TM, PE, PTT, PV, and ISQ as inputs and PI as the output. As shown in Fig. 4, the network includes two hidden layers (4 and 3 neurons) with sigmoid activation functions, following common practice in tourism analytics (Leong, 2020). This structure enables the ANN to model more complex nonlinear relationships among the variables.

To ensure ANN robustness, the dataset was randomly split into training (~ 80%) and testing (~ 20%) sets and repeated across ten runs. Predictive performance was assessed using RMSE and SSE for each iteration. Following Leong (2019), R^2 was calculated using $R^2 = 1 - \frac{RMSE^2}{S^2}$, where RMSE is the testing error and S^2 is the variance of PI. This procedure is well established in hybrid SEM–ANN research (Hidayat-ur-Rehman & Alsolamy, 2023; Leong et al., 2020).

As reported in Table 12, the ANN model demonstrated stable learning and strong generalization across the 10 runs. Testing RMSE values clustered tightly around ≈ 0.10, with minimal dispersion across repetitions (SD ≈ 0.006), indicating consistent out-of-sample performance. Training RMSE values were similarly stable across runs and remained close to the testing RMSE, suggesting no meaningful overfitting. Consistent with these diagnostics, the ANN achieved predictive accuracy of approximately $R^2 \approx 0.65$ (Table 12), supporting the model's suitability for capturing nonlinear behavioral patterns beyond the explanatory PLS-SEM results.

Table 12
Predictive performance of ANN models

	ANN-Model (R^2= 65%)					
	Training - Phase			**Testing - Phase**		
ANNs	N-1	SSE	RMSE	N-2	Testing - SSE	Testing - RMSE
ANN-1	404	4.660	.966	96	0.107	0.100
ANN-2	398	4.509	.967	102	0.106	0.097
ANN-3	385	4.34	1.25	115	0.106	0.104
ANN-4	389	4.202	1.303	111	0.104	0.108
ANN-5	394	4.569	1.126	106	0.108	0.103
ANN-6	395	4.518	.957	105	0.107	0.095
ANN-7	398	4.327	1.062	102	0.104	0.102
ANN-8	390	4.132	1.345	110	0.103	0.111
ANN-9	401	4.673	1.102	99	0.108	0.106
ANN-10	394	4.02	1.416	106	0.101	0.116
Average		4.395	1.149		0.105	0.104
Std-Dev.		0.214	.160		0.002	0.006

Note. RMSE = Root Mean Square Error; SSE = Sum of Square Error; ANN model performance averaged over ten runs with 80/20 training–testing split.

Figure 5 further visualizes RMSE stability across the ten training–testing repetitions. The narrow fluctuation band, especially in the testing phase, indicates that the ANN model generalizes well across different data partitions and produces reliable predictive outcomes.

To identify the relative predictive contribution of each antecedent, a sensitivity analysis was performed using MLP- ANN. Following prior studies (Leong et al., 2020; Hidayat-ur-Rehman & Alsolamy, 2023), the ANN was executed ten times, and the average relative and normalized importance of each input variable were computed.

Table 13
Relative and normalized importance of predictors in ANN models:

ANN Model	CS	TM	PE	PTT	PV	ISQ
ANN-1	.164	.109	.291	.086	.157	.193
ANN-2	.123	.176	.257	.105	.140	.199
ANN-3	.062	.152	.300	.116	.095	.275
ANN-4	.187	.134	.268	.106	.137	.169
ANN-5	.148	.123	.283	.100	.128	.219
ANN-6	.087	.161	.306	.078	.141	.227
ANN-7	.147	.144	.241	.085	.169	.213
ANN-8	.117	.156	.242	.125	.170	.191
ANN-9	.142	.170	.231	.108	.161	.188
ANN-10	.146	.154	.245	.082	.167	.206
Average Relative Importance	0.132202	0.147805	0.266341	0.099206	0.14645	0.207997
Normalized Importance (%)	12.91%	15.17%	26.38%	10.05%	14.54%	20.95%

As shown in Table 13, personal experience (PE) emerged as the strongest predictor of purchase intention (26.38%), followed by information source quality (ISQ) (20.95%) and trekking motivation (TM) (15.17%). Perceived value (PV) (14.54%) and perceived challenge (CS) (12.91%) showed moderate influence, whereas PTT (10.05%) had the lowest normalized importance. Overall, the ANN results indicate that experience-based and information-driven factors play the most decisive predictive roles in shaping trekking purchase intention, while motivational and perceptual variables contribute in a complementary manner.

3.4 Sensitivity analysis

A sensitivity analysis comparing PLS-SEM (IPMA) and ANN results (Table 14) shows that both methods identify PE, ISQ, and TM as key predictors of PI, though their rankings differ. ANN, which captures nonlinear effects, highlights PE (26.38%), ISQ (20.95%), and TM (15.17%) as the strongest contributors. In contrast, the IPMA results emphasize TM (≈ 0.40 total effect) as the most influential construct, followed by ISQ and PE.

These differences reflect the distinct strengths of each method: PLS-SEM explains linear causal relationships, whereas ANN delivers superior predictive accuracy by modeling complex interactions. The higher R^2 of the ANN model (0.65 vs. 0.295) further confirms its predictive advantage. Overall, the findings underscore the value of combining SEM and ANN for deeper and more reliable insights into trekking intention.

Table 14
Comparative results between SEM–IPMA and ANN analyses

Variable	ANN		PLS-SEM	
	Normalized	Rank	IPMA	Rank
PE	26.38%	1	≈ 59	3
ISQ	20.95%	2	≈ 65	2
TM	15.17%	3	≈ 64	1
PV	14.54%	4	≈ 61	4
CS	12.91%	5	≈ 65	5
PTT	10.05%	6	≈ 60	6
R^2	0.650		0.295	

5. Discussion

Consistent with challenge–flow research (Jackson et al., 2019; Piniel & Albert, 2020), the findings indicate that CS strengthens both PTT and TM, suggesting that trekking is more likely to be evaluated favorably when the challenge is appraised as optimal and conquerable. This pattern resonates with adventure tourism evidence that an appropriate level of challenge can transform uncertainty into achievement-oriented enjoyment and mastery (Pomfret & Bramwell, 2016; Tsaur et al., 2013). However, the nonsignificant CS and PV pathway refines this argument: challenge alone does not directly elevate value. Rather, value appears to be constructed when challenge is meaningfully interpreted and managed through motivational resources, prior experience, and/or reliable informational cues (Farkić & Gebbels, 2022). This distinction is theoretically important because it moves trekking decision research beyond the assumption that more challenge, more value, and instead frames value as a downstream appraisal outcome contingent on capability and interpretive support.

The results also confirm robust effects of PE on PTT, PV, and TM, aligning with self-efficacy theory (Bandura, 1999). Accumulated trekking experience functions as a capability resource that reduces uncertainty, increases perceived control, and promotes proactive engagement. Experienced trekkers are better able to judge feasibility and risk, which strengthens positive perceptions and motivation while also enhancing the perceived benefits to costs trade-off captured by PV. Importantly, the mediation evidence suggests that experience does not merely operate as a direct “confidence booster”; it translates into intention through (i) cognitive feasibility appraisal (PTT) and (ii) evaluative value judgment (PV), echoing the logic of experiential tourism research in which experience shapes behavioral outcomes through internal evaluations as finding ofChen & Chen (2010) and Buckley et al. (2025)

In parallel, TM exerts significant effects on PTT, PV, and PI, consistent with self-determination theory (Ryan & Deci, 2000). Intrinsically motivated trekkers are more likely to interpret trekking experiences as meaningful, persist through effort, and anticipate higher benefits. This aligns with prior work suggesting that motivation enhances positive interpretation and increases perceived benefits in adventure contexts (Carvache-Franco et al., 2024; Pomfret & Bramwell, 2016). The convergent evidence from both ANN (normalized importance ≈ 15.17%) and IPMA (importance ≈ 0.40) reinforces TM as a central psychological engine that connects antecedent conditions to intention, yet it operates most strongly when paired with supportive appraisal and value formation, rather than as a standalone driver.

Turning to ISQ, the direct-effect results provide a nuanced picture: ISQ significantly improves PTT and TM but does not directly influence PV. This suggests that information quality primarily shapes cognition and motivation by clarifying risks, logistics, and feasibility rather than directly producing value judgments (Hu et al., 2025; Teng et al., 2025). In other words, high-quality information appears to function as a decision-enabling signal that stabilizes beliefs and energizes willingness to act, consistent with information diagnosticity and credibility arguments in digital contexts (Cheung et al., 2008; Ismagilova et al., 2020). Value, by contrast, is more tightly tied to motivational orientation and experiential capability and thus may require more than information clarity alone to increase.

The moderation findings offer the study's most distinctive theoretical contribution. First, the positive ISQ × CS → PTT interaction indicates that information source quality strengthens the translation of challenge into favorable trekking perceptions. This supports an interpretive facilitator account: when information is credible and diagnostic, tourists are better able to calibrate what the challenge entails and interpret it as manageable and worthwhile. Second, and more novel, the significant but negative ISQ × PE → TM interaction suggests a substitution effect, whereby reliable information partially replaces the motivational role of personal experience. Under high ISQ, less experienced trekkers can rely on informational scaffolding (route details, preparedness guidance, safety cues) to form motivation, reducing dependence on experiential mastery as the primary motivational source (Hu et al., 2025; Shneikat et al., 2025). This finding extends information adoption perspectives by demonstrating that digital information and personal experience are not simply additive; they can interact in compensatory ways to shape adventure motivation, especially in risk-salient choices.

Consistent with these arguments, PTT and PV emerge as essential mediators that connect antecedent conditions to purchase intention. The supported mediation patterns indicate two complementary mechanisms: a cognitive feasibility route in which motivation and/or experience shape intention through trekking perceptions, and a value evaluation route in which motivation and experience shape intention through perceived value. This dual-mechanism explanation extends TPB logic by showing that, in trekking contexts, intention is jointly driven by belief-based feasibility appraisal (PTT) and evaluative benefit–cost assessment (PV) two processes that can be amplified by motivation and experience. The relatively weaker indirect role of CS through PV further reinforces the earlier insight that challenge contributes to intention primarily via motivation and interpretive appraisal rather than direct value inflation.

Finally, the hybrid SEM–ANN results clarify why the study should not be viewed as method-driven but theory-relevant. PLS-SEM confirms the hypothesized causal structure and mediation logic with moderate explanatory power ($R^2 \approx 0.295$), whereas ANN delivers substantially stronger out-of-sample prediction ($R^2 \approx 0.65$), indicating that trekking intention likely involves nonlinear and interaction-like patterns among experience, information quality, and motivation. ANN sensitivity analysis further identifies PE (26.38%), ISQ (20.95%), and TM (15.17%) as the most influential predictors, implying that experiential capability and information quality may surpass motivation alone in predictive salience. These predictive insights complement IPMA, where TM and PV show high importance but only moderate performance, highlighting managerial leverage points strengthening motivational framing and value delivery while simultaneously underscoring the strategic role of information quality in enabling novices to convert challenge into favorable appraisals.

Overall, the findings suggest that trekking purchase intention is best understood as an appraisal-to-action process shaped by the combined effects of experience, motivation, and information quality. Perceived challenge functions primarily as an enabling condition that becomes influential when it is interpretively supported (via ISQ) and psychologically energized (via TM), rather than as a direct generator of perceived value. By positioning ISQ as a boundary condition that both amplifies challenge appraisal and substitutes for experiential capability in motivating engagement, and by validating nonlinear predictive hierarchies through ANN, the study offers a more theoretically enriched explanation of how trekkers move from uncertainty and appraisal to intention and choice.

6. Conclusion and implications

This study investigated how CS, TM, PE, and ISQ shape trekkers' PI through PTT and PV, using a hybrid PLS-SEM and ANN approach. Across the explanatory and predictive analyses, the results converge in showing that TM, PE, and ISQ constitute the most influential determinants of trekking purchase intention, while PTT and PV operate as pivotal mediating mechanisms that translate psychological triggers into intention. Notably, the explanatory model (PLS-SEM) provides moderate variance explained ($R^2 = 0.295$), whereas the ANN model achieves markedly stronger predictive performance ($R^2 \approx 0.65$), highlighting that trekking decisions may involve nonlinear and interaction-like patterns that go beyond purely linear causal structures.

6.1. Theoretical implications

The study advances trekking and adventure tourism decision theory in three important ways. First, rather than treating challenge as a uniformly positive driver, the findings support an appraisal-to-action logic: perceived challenge influences intention primarily through its cognitive and motivational transformation. Specifically, CS strengthens PTT and TM, while its direct effect on PV is not supported, indicating that challenge alone does not automatically create value. Value appears to emerge when challenge is

interpreted as manageable and worthwhile and is supported by motivational resources and capability cues. This refinement helps reconcile mixed findings in adventure tourism research in which challenge is sometimes a motivator and sometimes a deterrent.

Second, the study conceptualizes information source quality (ISQ) as a theoretically meaningful boundary condition that reshapes trekking decision pathways. The positive moderation effect (ISQ × CS → PTT) suggests that ISQ functions as an interpretive facilitator: credible, complete, and diagnostic information enables tourists to convert challenge perceptions into favorable trekking perceptions by reducing ambiguity and calibrating feasibility judgments. More distinctively, the negative moderation effect (ISQ × PE → TM) indicates a substitution/compensatory mechanism, whereby high-quality information partially substitutes for personal experience in generating motivation. This insight extends tourism information and experience-based decision research by showing that information and experience may interact in non-additive ways—sometimes amplifying appraisal processes and sometimes compensating for capability gaps—especially in risk-salient adventure contexts.

Third, by confirming the dual mediating roles of PTT and PV, the study integrates cognitive feasibility appraisal and value evaluation into a unified intention-formation framework. This extends TPB reasoning in adventure tourism by demonstrating that intention is shaped jointly by belief-based feasibility and attractiveness (PTT) and benefit–cost evaluation (PV), while SDT and self-efficacy mechanisms explain how motivation and experience energize these internal transformations. Taken together, the results offer a more theoretically enriched explanation of how trekkers progress from challenge and uncertainty toward intention.

Methodologically, the study demonstrates the value of integrating PLS-SEM and ANN for trekking decision research. PLS-SEM validates a theory-driven causal model, revealing mediation and moderation mechanisms consistent with appraisal-based decision logic. ANN complements SEM by improving out-of-sample prediction and uncovering the relative predictive salience of determinants under potential nonlinear relationships. The substantially higher predictive accuracy of ANN ($R^2 \approx 0.65$ vs. SEM $R^2 = 0.295$) suggests that trekking intention is shaped by complex patterns involving experience, information quality, and motivation patterns that may be underrepresented in strictly linear specifications. Hence, the hybrid design provides both explanatory validity and predictive utility, offering a balanced methodological template for future tourism behavior research in experience-intensive contexts.

6.2. Practical implications

The results provide actionable guidance for trekking operators, destination managers, and digital platforms seeking to convert interest into booking intention and repeat participation.

First, treat information source quality as a core product capability rather than a communication add-on. Because ISQ strengthens the conversion of perceived challenge into favorable trekking perceptions, practitioners should implement a standardized challenge transparency pack for each trekking program, including: (1) route facts (distance, elevation gain, terrain type, expected duration by checkpoints), (2) seasonal risk and weather windows, (3) safety protocols and guide-to-guest ratio, (4) fitness prerequisites and equipment checklists, and (5) realistic photo/video evidence and map-based navigation cues. This reduces ambiguity, increases diagnostic, and helps novices interpret challenge as manageable, thereby strengthening PTT and intention.

Second, segment product design and messaging by experience level. Since experience is the strongest predictor in ANN (PE = 26.38%), operators should develop differentiated pathways: novice-oriented packages should emphasize guided preparedness, logistics support, and progressive difficulty levels; experienced trekkers should be offered mastery-oriented routes, technical variety, and achievement-based framing. Importantly, the substitution effect (ISQ × PE → TM negative) implies that high-quality information can motivate less-experienced trekkers; thus, novice segments may respond disproportionately well to verified, structured, and transparent information.

Third, design motivation-enhancing experiences that translate into value. Because TM and PV strongly shape intention, operators should strengthen intrinsic motivation via autonomy and competence cues (e.g., multi-level routes, skill-building micro-modules, milestone certificates, and narrative storytelling emphasizing self-growth). Value can be increased through authentic cultural encounters, community-based components, and service personalization (e.g., local guides, cultural micro-experiences, and responsible trekking practices), which enhance perceived benefits beyond physical challenge.

Fourth, strengthen information governance at the destination and platform level. DMOs and platforms can improve ecosystem-level ISQ through verified operator badges, standardized route fact sheets, and structured post-trip reviews that capture objective

elements (actual duration, hazards, crowding, route changes). Such mechanisms increase trust, reduce decision friction, and support sustainable trekking development by aligning expectations with on-site realities.

6.3. Limitations and future research

Several limitations should be noted. First, the cross-sectional design constrains causal inference; longitudinal research can examine how information exposure and experience accumulation reshape challenge appraisal and intention over time. Second, the sample focused on domestic trekkers in selected Vietnamese destinations, which may limit generalizability; future studies should test the model across cultures and across soft- versus hard-adventure contexts. Third, ISQ was treated as an aggregate construct; future research should disentangle dimensions such as credibility, completeness, timeliness, and diagnostic and compare source types (official channels, UGC, influencers) to identify which information architectures best facilitate challenge interpretation. Fourth, while ANN improves prediction, future work could explore more interpretable nonlinear approaches (e.g., explainable AI methods, deep learning with interpretability constraints, or fuzzy neural networks) and incorporate additional variables such as risk perception, destination image, emotional regulation, or trust. Finally, qualitative or mixed-method designs especially interviews with repeat trekkers and novices—could deepen understanding of how challenge, mastery, and value are narratively constructed and how information quality substitutes for experience during decision-making.

Declarations

Declaration of conflicting interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding statements

The author(s) received no financial support for the research, authorship, and/or publication of this article

Author Contribution

Nguyen Viet Thai wrote the main manuscript text, built research modelNguyen Quang Vinh prepared all the fingers and methodologyTruong Thi Ha collected survey formAll authors reviewed the manuscript

Data Availability

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to confidentiality agreements with participating firms and privacy/ethical restrictions.

References

1. Agag, G.M., El-Masry, A.A.: Why Do Consumers Trust Online Travel Websites? Drivers and Outcomes of Consumer Trust toward Online Travel Websites. J. Travel Res. **56**(3), 347–369 (2017). https://doi.org/10.1177/0047287516643185
2. Aicher, T.J., Brenner, J.: *Individuals' motivation to participate in sport tourism: a self-determination theory perspective.* (2015)
3. Ajzen, I.: The Theory of planned behavior. Organ. Behav. Hum Decis. Process. **50**, 179–211 (1991)
4. Akaho, Y.: Conceptualizing the adventure tourist as a cross-boundary learner. J. Outdoor Recreation Tourism. **47**, 100795 (2024)
5. Bandura, A.: Social cognitive theory of personality. Handb. Personality. **2**(1), 154–196 (1999)
6. Baumann, N., Scheffer, D.: Seeing and mastering difficulty: The role of affective change in achievement flow. Cogn. Emot. **24**(8), 1304–1328 (2010)
7. Buckley, R., Underdahl, S., Cater, C., Pereira, E., Cooper, M.-A., Liddon, M., Westaway, D., Doran, A., Zhang, Z.J., O'keeffe, P.: Matching destination difficulty and participant capability in outdoor recreation and tourism: role of third-party certifications for 15 activities in 52 countries. J. Outdoor Recreation Tourism. **52**, 100983 (2025)

8. Carvache-Franco, M., Regalado-Pezúa, O., Carvache-Franco, O., Carvache-Franco, W.: Sociodemographic aspects, satisfaction, loyalty, and motivations in religious tourism. Cogent Social Sci. **10**(1), 2401145 (2024)
9. Chen, C.-F.F., Chen, F.-S.S.: Experience quality, perceived value, satisfaction and behavioral intentions for heritage tourists. Tour. Manag. **31**(1), 29–35 (2010). https://doi.org/10.1016/j.tourman.2009.02.008
10. Cheng, W., Tian, R., Chiu, D.K.W.: Travel vlogs influencing tourist decisions: information preferences and gender differences. Aslib J. Inform. Manage. **76**(1), 86–103 (2024)
11. Cheung, M.F.,T. W. M: An extended model of value-attitude-behavior to explain Chinese consumers' green purchase behavior. J. Retailing Consumer Serv. **50**, 145–153 (2019)
12. Cheung, Y.T., Chau, P.H., Yip, P.S.F.: A revisit on older adults suicides and Severe Acute Respiratory Syndrome (SARS) epidemic in Hong Kong. Int. J. Geriatric Psychiatry: J. Psychiatry Late Life Allied Sci. **23**(12), 1231–1238 (2008)
13. Esfandiar, K., Hadinejad, A.: A critical review of the theory of planned behaviour in tourism research. Curr. Issues Tourism, 1–15. (2025)
14. Farkić, J., Gebbels, M.: Enframing adventure tourism in 21st century. In: The Adventure Tourist: Being, Knowing, Becoming, pp. 9–31. Emerald Publishing Limited (2022)
15. Fishbein, M.,A. I: Predicting and changing behavior: The reasoned action approach. Psychology Press (Taylor & Francis (2010)
16. Fornell, C., Larcker, D.F.: Evaluating structural equation models with unobservable variables and measurement error. J. Mark. Res. **18**(1), 39–50 (1981)
17. Götz, O., Liehr-Gobbers, K., Krafft, M.: Evaluation of structural equation models using the partial least squares (PLS) approach. In: Handbook of partial least squares: Concepts, methods and applications, pp. 691–711. Springer (2009)
18. Grand View Research: *Adventure Tourism Market (2025–2030)*. (2024). https://www.grandviewresearch.com/industry-analysis/adventure-tourism-market-report
19. Gross, S., Sand, M., Berger, T.: Examining the adventure traveller behaviour-Personality, motives and socio-demographic factors as determinants for German adventure travel. Eur. J. Tourism Res. **33**, 3307 (2023)
20. Hair, J.F. Jr., Hult, G.T.M., Ringle, C.M., Sarstedt, M.: A primer on partial least squares structural equation modeling (PLS-SEM). Sage (2021)
21. Han, H., H. L.-T. J.S. C: Application of the theory of planned behavior to green hotel choice: Testing the effect of environmental friendly activities. Tour. Manag. **31**(3), 325–334 (2010)
22. Hew, J.-J., L. L.-Y. T. G. W.-H. O. K.-B.L. V.-H: The age of mobile social commerce: An Artificial Neural Network analysis on its resistances. Technol. Forecast. Soc. Chang. **144**, 311–324 (2019)
23. Hidayat-ur-Rehman, I., Alsolamy, M.: A SEM-ANN analysis to examine sustainable performance in SMEs: The moderating role of transformational leadership. J. Open. Innovation: Technol. Market Complex. **9**(4), 100166 (2023)
24. Hu, Y., Lu, Y., Kuang, T.: How does tourism information quality affect tourists' intention to visit Portugal: integrating the heuristic-systematic model with the theory of planned behavior. Humanit. Social Sci. Commun. **12**(1), 1749 (2025)
25. Ismagilova, E., Slade, E.L., Rana, N.P., Dwivedi, Y.K.: The effect of electronic word of mouth communications on intention to buy: A meta-analysis. Inform. Syst. Front. **22**(5), 1203–1226 (2020)
26. Jackson, C., Snyder, J., Crooks, V.A., Lavergne, M.R.: Exploring isolation, self-directed care and extensive follow-up: factors heightening the health and safety risks of bariatric surgery abroad among Canadian medical tourists. Int. J. Qualitative Stud. Health Well-Being. **14**(1), 1613874 (2019)
27. Jackson, M.: Utilizing attribution theory to develop new insights into tourism experiences. J. Hospitality Tourism Manage. **38**, 176–183 (2019)
28. Jiang, S., Moyle, B., Yung, R., Tao, L., Scott, N.: Augmented reality and the enhancement of memorable tourism experiences at heritage sites. Curr. Issues Tourism. **26**(2), 242–257 (2023)
29. Jumanazarov, S., Kamilov, A., Kiatkawsin, K.: Impact of Samarkand's destination attributes on international tourists' revisit and word-of-mouth intention. Sustainability. **12**(12), 5154 (2020)
30. Karkonasasi, K., Cheah, Y.-N., Vadiveloo, M., Mousavi, S.A.: Acceptance of a text messaging vaccination reminder and recall system in Malaysia's healthcare sector: extending the technology acceptance model. Vaccines. **11**(8), 1331 (2023)

31. Lee, V.-H., Hew, J.-J., Leong, L.-Y., Tan, G.W.-H., Ooi, K.-B.: Wearable payment: A deep learning-based dual-stage SEM-ANN analysis. Expert Syst. Appl. **157**, 113477 (2020)
32. Leong, L.Y., W., H.T.S.T.G. H.O. K. B: Predicting customer loyalty in the mobile broadband Internet service sector using SEM and ANN. Industrial Manage. Data Syst. **120**(3), 409–431 (2020)
33. Leong, L.-Y., Hew, T.-S., Ooi, K.-B., Dwivedi, Y.K.: Predicting trust in online advertising with an SEM-artificial neural network approach. Expert Syst. Appl. **162**, 113849 (2020)
34. Llewellyn, D.J., Sanchez, X.: Individual differences and risk taking in rock climbing. Psychol. Sport Exerc. **9**(4), 413–426 (2008)
35. Ng, S.-L., Hsu, M.-C.: Motivation-Based segmentation of hiking tourists in Taiwan. Tourism Hospitality. **5**(4), 1065–1082 (2024)
36. Nunnally, J.C., Bernstein, I.H.: Psychometric Theory, 3rd edn. McGraw-Hill, Inc (1994)
37. Piniel, K., Albert, Á.: Motivation and flow. In: The Palgrave handbook of motivation for language learning, pp. 579–597. Springer (2020)
38. Podsakoff, P.M., MacKenzie, S.B., Lee, J.-Y., Podsakoff, N.P.: Common method biases in behavioral research: a critical review of the literature and recommended remedies. J. Appl. Psychol. **88**(5), 879 (2003)
39. Pomfret, G., Bramwell, B.: The characteristics and motivational decisions of outdoor adventure tourists: A review and analysis. Curr. Issues Tourism. **19**(14), 1447–1478 (2016)
40. Qiu, G.P., Sun, S.P., Wang, F.T., Chao, W.S.: Architecture-Oriented Design Method for Smart Tourism City Internet of Things System. *Source: Advances in …*, *February 2021*. (2016). https://www.researchgate.net/profile/William-S-Chao/publication/335158373_Architecture-Oriented_Design_Method_for_Smart_Tourism_City_Internet_of_Things_System/links/602340b5a6fdcc37a815e1cf/Architecture-Oriented-Design-Method-for-Smart-Tourism-City-Intern
41. Qiu, L., Li, X., Choi, S.: Exploring the influence of short video platforms on tourist attitudes and travel intention: A social–technical perspective. J. Destination Mark. Manage. **31**, 100826 (2024)
42. Roehl, W.S., Fesenmaier, D.R.: Risk perceptions and pleasure travel: An exploratory analysis. J. Travel Res. **30**(4), 17–26 (1992)
43. Ryan, R.M., Deci, E.L.: Intrinsic and extrinsic motivations: Classic definitions and new directions. Contemp. Educ. Psychol. **25**(1), 54–67 (2000a). https://doi.org/10.1006/ceps.1999.1020
44. Ryan, R.M., Deci, E.L.: Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. Am. Psychol. **55**(1), 68 (2000b)
45. Shmueli, G., Koppius, O.R.: Predictive analytics in information systems research. MIS Q., 553–572. (2011)
46. Shneikat, B., Elfekair, A., Laradi, S., Wondirad, A.: The impact of information quality on behavioral intention: New insights from North African tourism sector. Acta. Psychol. **256**(10502), 4 (2025)
47. Sujood, Hamid, S., Bano, N.: Behavioral intention of traveling in the period of COVID-19: an application of the theory of planned behavior (TPB) and perceived risk. Int. J. Tourism Cities. **8**(2), 357–378 (2022)
48. Sussman, S.W., Siegal, W.S.: Informational influence in organizations: An integrated approach to knowledge adoption. Inform. Syst. Res. **14**(1), 47–65 (2003)
49. Swarbrooke, J., Horner, S.: Consumer behaviour in tourism. Routledge (2007)
50. Sweeney, J.C., Soutar, G.N.: Consumer perceived value: The development of a multiple item scale. J. Retail. **77**(2), 203–220 (2001)
51. Tehseen, S., Ramayah, T., Sajilan, S.: Testing and controlling for common method variance: A review of available methods. J. Manage. Sci. **4**(2), 142–168 (2017)
52. Teng, W., Chen, Y., Zhang, S.: A Study on Travel Decisions of Potential Adventure Tourists Under Risk Contexts: Based on the Extended Theory of Planned Behavior. SAGE Open. **15**(2), 21582440251335810 (2025)
53. Tsaur, S.-H., Lin, W.-R., Liu, J.S.: Sources of challenge for adventure tourists: Scale development and validation. Tour. Manag. **38**, 85–93 (2013)
54. Tsaur, S.-H., Yen, C.-H., Yang, M.-C., Yen, H.-H.: Leisure crafting: Scale development and validation. Leisure Sci. **45**(1), 71–91 (2023)
55. Urbach, N., Ahlemann, F.: Structural equation modeling in information systems research using partial least squares. J. Inform. Technol. Theory Application (JITTA). **11**(2), 2 (2010)

56. VietnamPlus: *Ha Giang targets 3.5 million visitors in 2025*. (2025). https://en.vietnamplus.vn/ha-giang-targets-35-million-visitors-in-2025-post312962.vnp
57. VNAT: *Viet Nam records more than 17.5 million international visitor arrivals in 2024*. (2025). https://vietnamtourism.gov.vn/en/post/20764
58. Zeithaml, V.A.: Consumer perceptions of price, quality, and value: a means-end model and synthesis of evidence. J. Mark. **52**(3), 2–22 (1988)
59. Zeithaml, V.A., Berry, L.L., Parasuraman, A.: The behavioral consequences of service quality. J. Mark. **60**(2), 31–46 (1996)

Figures

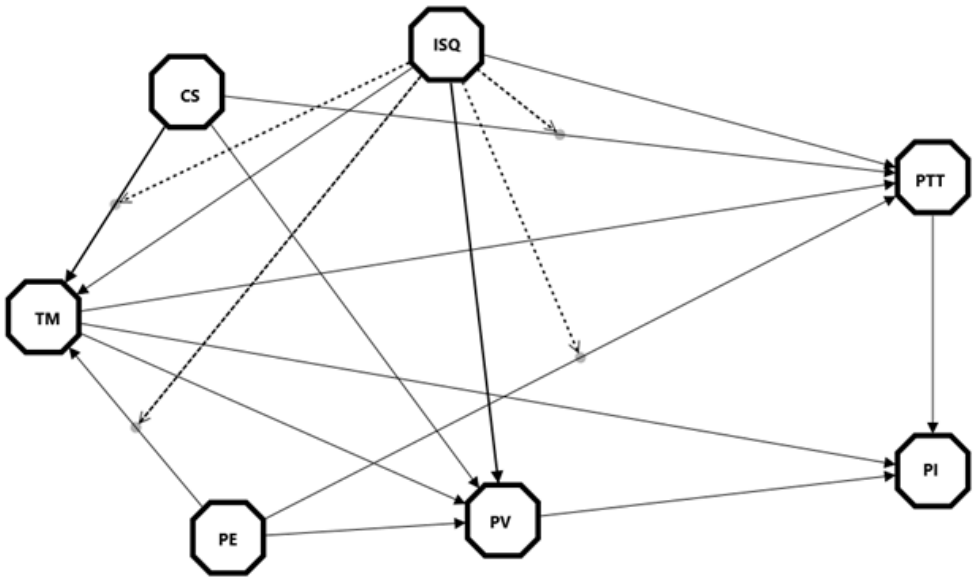


Figure 1

Proposed research model

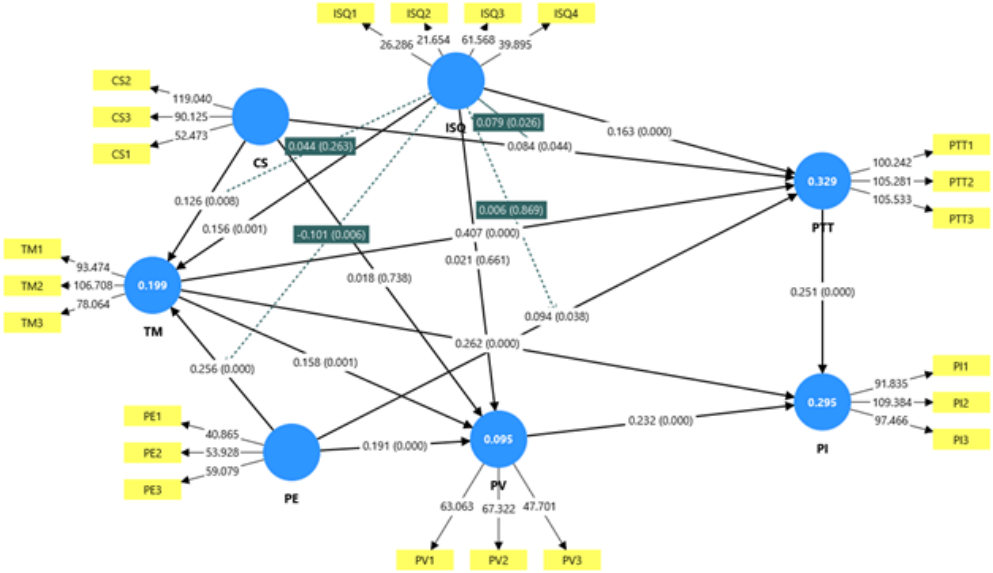


Figure 2

Results of the PLS-SEM structural model

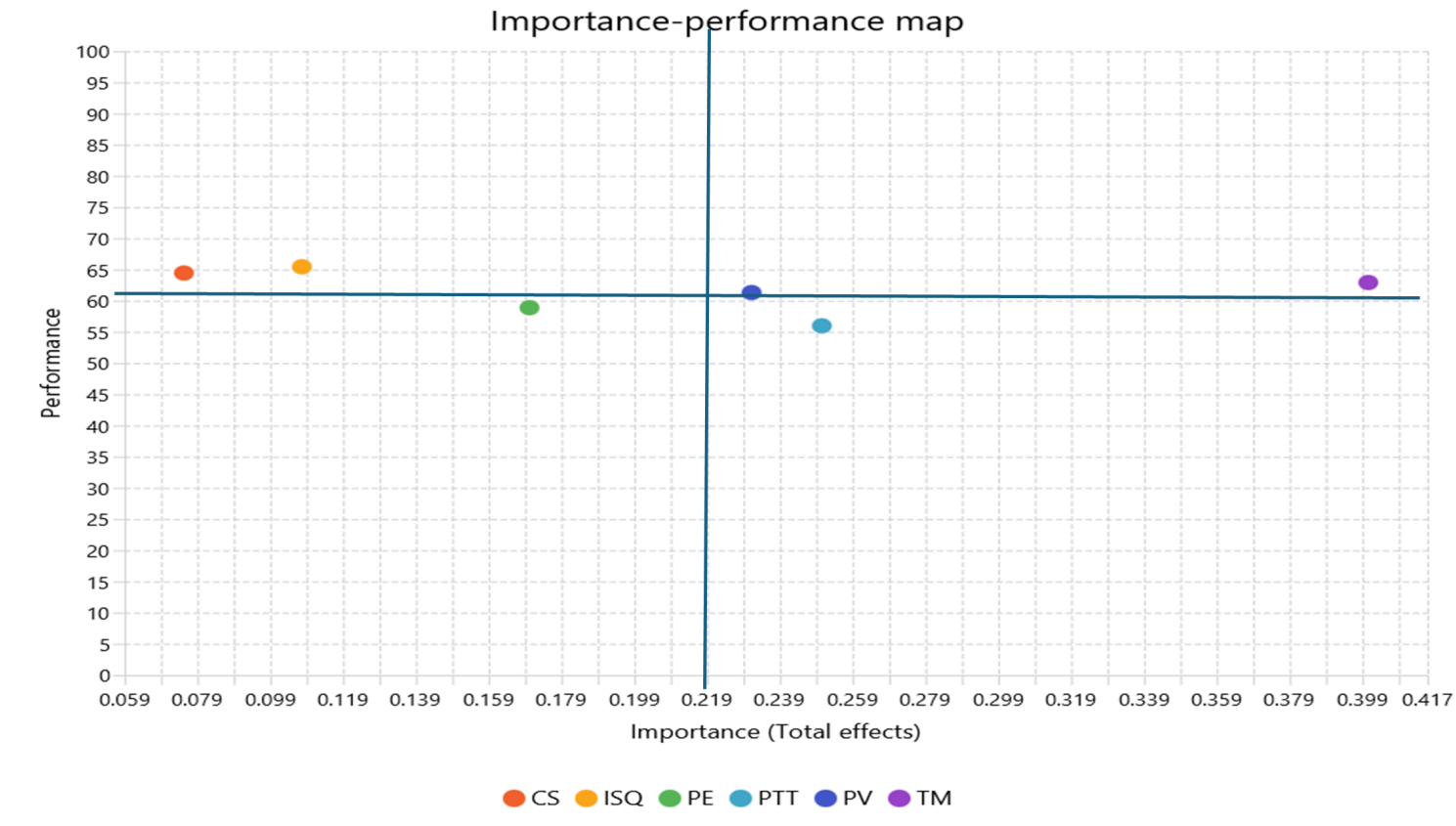


Figure 3

Importance–performance map for purchase intention

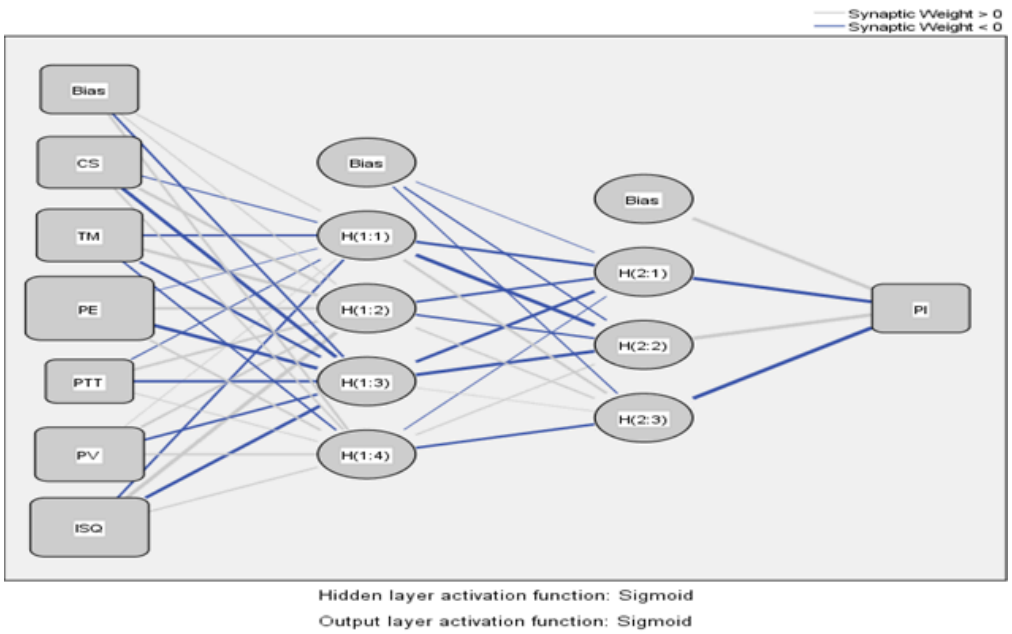


Figure 4

Architecture of the ANN model for predicting purchase intention

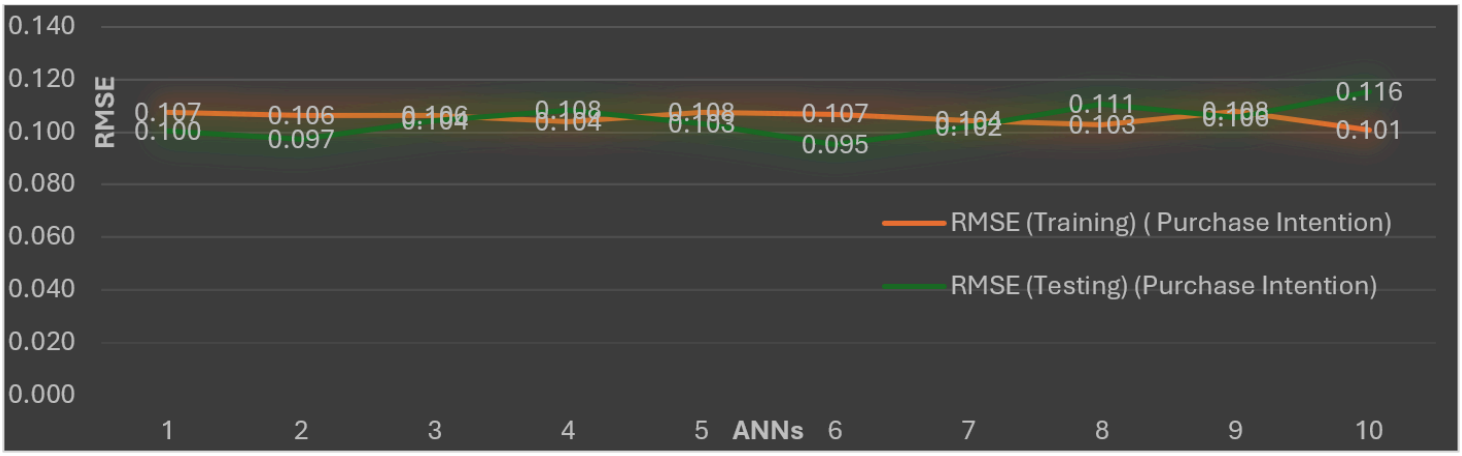


Figure 5

Model stability across ANN runs