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Bridging the intention–behavior gap: Digital engagement and low-carbon tourism among urban digitally literate seniors

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ABSTRACT

BACKGROUND AND OBJECTIVES: Low-carbon tourism was recognized as a crucial contributor to mitigating the effects of climate change; however, tourists often failed to translate pro-environmental intentions into actions. This study examined the influence of Digital Information Perception, the perceived credibility and usefulness of online information, and Social Media Engagement, the active interaction with social media content and peer networks, the perceived behavioral control through social media, on pro-environmental attitudes among urban, well-educated, and digitally literate seniors. The research aimed to identify the predictors of intention and behavior toward low-carbon tourism within a digital context.

METHODS: A cross-sectional online survey was conducted with 400 respondents. The data were analyzed using Structural Equation Modeling to test the extended Theory of Planned Behavior (TPB) model incorporating digital constructs. The variables included DIP, SME, attitude, subjective norms, perceived behavioral control, intention, and low-carbon behavior.

FINDINGS: The primary evidence from the SEM analysis reveals the significant predictors of intention to adopt low-carbon practices. The mean score discrepancy highlights the large gap between pro-environmental intentions and actual behaviors, with 78% of respondents reporting high pro-environmental intentions, reflected in a mean score of 4.29, in contrast to only 54% exhibiting consistent low-carbon behaviors, indicated by a lower mean score of 2.56. Additionally, the beta coefficient for the pathway from behavioral intention to low-carbon tourism behavior was found to be $\beta = 0.610$, emphasizing its strong influence in the model. These findings underscore the substantial intention–behavior gap in the context of low-carbon tourism among urban seniors.

CONCLUSION: The model fit was satisfactory, with indices indicating a good fit ($CFI > 0.90$, $RMSEA < 0.08$). This supports the validity of the extended Theory of Planned Behavior model in predicting low-carbon tourism intentions among urban seniors. This suggests that seniors find the credibility and usefulness of general online information (DIP) more influential for intention than active interaction with social media. So, to develop eco-friendly tourism among elders, the focus should be on low-carbon tourism options. Due to purposive, non-random sampling of urban, digitally literate seniors, the results should be interpreted as exploratory; future studies should employ representative and longitudinal designs to examine the persistence of low-carbon behaviors over time.

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INTRODUCTION

Background and rationale

The issue of climate change is among the most urgent problems of societies globally. Tourism presents a paradox in this regard: on the one hand, it contributes to economic growth and employment, while on the other hand, it is one of the primary sources of greenhouse gas emissions worldwide, primarily due to the energy-intensive nature of transportation and accommodation (Pathmanandakumar et al., 2021). Despite recognition of the importance of low-carbon tourism in mitigating climate change, there is a notable lack of existing research exploring how elderly-specific barriers, such as physical limitations and health concerns, interact with the intention-behavior gap in this context. Understanding these barriers is essential, as they may significantly influence the ability of older adults to translate their pro-environmental intentions into consistent low-carbon behaviors. As the elderly population continues to grow, particularly among digitally literate urban seniors, addressing this gap becomes increasingly important in fostering sustainable tourism practices that cater to their unique needs and circumstances. In an effort to ensure the sector has a limited environmental impact, the low-carbon tourism concept has been introduced, which encourages the adoption of activities that limit carbon emissions at all levels of the travel experience, including transport, accommodation, consumption, and recreational activities (Scott et al., 2012). Establishing low-carbon initiatives in Thailand, where tourism forms a main pillar of its economy, and promoting sustainable development. According to the United Nations World Tourism Organisation (Sofronov, B. (2017), tourism is a significant contributor to Thailand's GDP and helps sustain millions of jobs; however, it also adds pressure on the country's natural resources. Even though policymakers and operators within the tourism sector can create greener infrastructure and services, the environmental impact is highly dependent on the actions and decisions made by tourists themselves. The intention formation process among travelers who intend to participate in low-carbon tourism, and the reasons that lead to failure to act, has been an interesting area of research to understand. The elderly form a rapidly growing tourist market worldwide. Thailand is approaching the stage of a super-aged society, with the number of individuals aged 60 and above antici-

ipated to be close to 30 percent of the population by 2031 (Teerawichitchainan et al., (2015). Most of the elderly have the time and financial resources to travel; thus, they are a good yet complex market. They are choosing according to their personal preferences, as well as in light of their health and risk perceptions, and their generational attitude towards the environment (Patterson and Balderas, 2020). Simultaneously, the rapid process of digitalization is changing the way senior tourists plan and consume tourism. In defiance of stereotypes of digital illiteracy among older adults, an increasing proportion of Thai elderly living in urban areas are using the internet and social media to find insights into traveling and make bookings (Supansa, 2018; Caragliu et al., 2011; Zhao et al., 2024). For these digitally literate seniors, the credibility of information on the internet and social media usage can influence their attitudes towards the environment and perceived norms. This also raises key questions about whether online communication can reduce the intention-behaviour gap that persists, namely the disparity between claims of pro-environmental intentions and actual low-carbon behaviour in travel (Kollmuss and Agyeman, 2002). The study of the dynamics between urban, digitally literate, and educated Thai seniors is both theoretically and practically valuable: it applies the Theory of Planned Behaviour to the digital antecedents, and it offers policymakers and tourism operators insights into the design of effective low-carbon interventions to appeal to this powerful demographic. Digital Information Perception (DIP) refers to the understanding and evaluation of the credibility and usefulness of online information about low-carbon tourism, serving as an antecedent to the core Theory of Planned Behavior (TPB) constructs: attitudes (ATT), subjective norms (SN), and Perceived Behavioral Control (PBC). Similarly, Social Media Engagement (SME) represents the PBC derived from interactions on social media platforms. Both DIP and SME influence the formation of pro-environmental attitudes and behaviors among urban, digitally literate seniors.

Literature review

Theoretical lens: The theory of planned behavior

Ajzen (1991) has applied the Theory of Planned Behavior (TPB) widely in tourism and environmental psychology to explain the reasons behind pro-environmental behaviors. TPB assumes that a person's inten-

tions to act depend on Attitudes Towards the Behavior (ATB), Subjective Norms (SN), and PBC. TPB is a widely used tool in sustainable tourism, such as eco-friendly options (Han *et al.*, 2010) (Dolnicar and Leisch, 2008) and sustainable transport (Chen and Tung, 2014). But tourists don't act on good intentions towards the environment; they fail to act sustainably because of convenience and cost. To acknowledge this clearly, researchers have expanded the factors to include environmental concern, trust, or identity (Stern, 2000; Meng *et al.*, 2023). Nowadays, Digital Information Perception (DIP) and Social Media Engagement (SME) are antecedents of attitudes, norms, and PBC in the digital age. For example, exposure to credible online information can enhance knowledge and attitudes towards sustainable practices, whereas active involvement with influencers or peer networks can strengthen subjective norms (De Veirman, Cauberghe, and Hudders, 2017; Harrigan *et al.*, 2021). However, the existing empirical studies do not pay much attention to seniors in the context of non-Western settings, and significant gaps in knowledge remain about how digital practices are intertwined with intentions toward pro-environmental tourism (Lu *et al.*, 2024).

Research gap

Despite the significant expansion of the literature on sustainable tourism, there are still substantial gaps. To begin with, the majority of the available literature focuses on younger tourists or tourists of mixed age, and rarely considers digitally engaged elderly people, despite older adults becoming a fast-growing consumer group with unique decision-making behaviors and their travel limitations (Shen, S. & Abdul Aziz, A. B., 2023). Second, although the TPB (Ajzen, 1991) is generally a popular theory to explain pro-environmental behaviour, it has rarely been applied to incorporate the digital factors of the theory like the credibility of online information or trends of online social media use—factors that are increasingly influencing the travel planning in new economies (Supansa, 2018; Wut *et al.*, 2023; Reinhold *et al.*, 2023). Third, the longstanding intention-behaviour gap, namely the long-reported failure of pro-environmental intentions to be translated into actual low-carbon behaviours, is not thoroughly studied among elderly people, whose physical constraints, convenience, and health-related concerns may pose specific obstacles. The need to fill these gaps is the main reason why this

study is necessary.

Objectives and research questions

The study pursues the following objectives:

1. To investigate the influence of DIP and SME on TPB antecedents (ATT, SN, PBC).
2. To examine the relationships among TPB constructs in shaping behavioral intention and behavior within the context of low-carbon tourism.
3. To assess the existence and extent of the intention–behavior gap in senior tourists' adoption of low-carbon practices.
4. To identify structural, informational, and social barriers that hinder seniors from translating intentions into actual low-carbon tourism behavior.

Accordingly, the central research question is:

Which digital and psychological factors explain the formation of intention and the execution of low-carbon tourism behavior among digitally engaged Thai seniors, and how can the intention–behavior gap be understood in this demographic?

Significance of the study

The importance of the given research is both theoretical and practical. It is conceptually a continuation of TPB, which explicitly includes the constructs of digital engagement and provides information on how seniors perceive online information and social media signals in sustainable tourism contexts. It is also used to contribute to discussions on the intention-behavior gap by placing it in a demographic setting that is highly digitally engaged, but less likely to be adaptable to behavioral change. In practice, the study has presented practical policy suggestions to policymakers, destination managers, and tourism companies in Thailand and other similar settings. Knowledge about what motivates or discourages the use of low-carbon practices by seniors can be used to shape interventions, whether in the form of digital information campaigns or infrastructural enhancements, to close the gap between intention and sustainable behavior.

MATERIALS AND METHODS

The study employed a robust cross-sectional online survey with a sample size of 400 respondents, which falls within the recommended range for Structural Equation Modeling (SEM) analyses (200-400). The

model fit indices were satisfactory, indicating a good fit of the data to the proposed model. These factors enhance the credibility of the findings, suggesting that the extended TPB effectively captures the predictors of low-carbon tourism intentions and behaviors among urban, digitally literate seniors.

Research design

The paper has used a cross-sectional quantitative survey to test an extended Theory of Planned Behaviour (TPB) model that incorporates two digital factors—DIP and SME — in explaining low-carbon tourism behaviour among urban, educated, digitally literate Thai elderly. A survey was suitable for investigating numerous latent variables and estimating how they are related to each other at a single point in time. The analysis of the measurement and structural model was conducted using Structural Equation Modelling (SEM), which enables the simultaneous estimation of direct, indirect, and mediating effects. The questionnaire was supplemented with short open-ended questions, which were asked at the end to encourage respondents to comment on their personal motivation and barriers to adopting low-carbon travel practices, thereby making the quantitative analysis more comprehensive and contributing to the interpretation of the identified intention-behavior gap.

Population and sampling

The target group consisted of Thai elderly individuals aged 60 years and older who frequently used the internet and showed an interest in traveling. The sampling strategy employed was purposive, as the study aimed to capture a digitally literate group of elderly individuals, as opposed to the general population, which would encompass a considerable number of non-technology users. The data were collected using an online questionnaire administered between April and May 2025. Respondents were checked by screening questions that ensured that they were:

1. Aged 60 or above,
2. Internet users, and
3. Interested in or experienced with travel.

Four hundred valid responses were received, and that is higher than the minimum sample size requirements of SEM. According to [Henseler et al., \(2014\)](#), the minimum sample size for the model is ten times the maximum number of paths to a latent construct that

can be detected. In this case, seven predictors are taken into account, which means that a minimum of 70 cases is required. On the same note, as observed by [RosakSzyrocka &Tiwari \(2023\)](#), the samples required for SEM are typically 200-400, and the current study falls within a suitable range for analysis.

Demographic Profile of Respondents

The sample exhibited features characteristic of a digitally active elderly population. Statistics. Most were women 85.3% with only 12.8% being males and 2% identifying as LGBTQP. The concentration of age in the 60-64 bracket was 89.8%, indicating the study centered on the young-old seniors. Most respondents have a high level of education, with 58.3% holding a bachelor's degree and 8.5% holding a postgraduate degree, and most of them belong to the middle-class group. Similarly, 82.8% used the internet and social media daily, with 34.5% rating themselves highly proficient. The highest geographic proportion (39%) was found in Bangkok and metropolitan areas; next in line were central, northern, and northeastern provinces. These figures suggest that the sample is not representative of the typical Thai elderly, but rather a well-educated, urban, and digitally proficient subgroup with a higher disposable income.

Research Instrument

The structured questionnaire was made up of four sections:

1. Eligibility screening questions,
2. Latent variables (DIP, SME, ATT, SN, PBC, BI, and LCTB) measurement items,
3. Demographics and socioeconomic data,
4. Open-ended questions on perceived barriers and motivations.

Data Analysis

The analysis of the data took a two-step SEM procedure, using AMOS 26:

Confirmatory Factor Analysis (CFA): It was performed to test the validity and reliability of the model of measurement.

- The standardized factor loading ranges were positive, and all of them are higher than 0.70, with a range between 0.716 and 0.892.
- Cronbach's alpha values were between 0.709 (LCTB) and 0.889 (BI), which are above the standard of 0.70.

- The values of Composite Reliability (CR) were between 0.712 and 0.879, and the Average Variance Extracted (AVE) values were between 0.553 and 0.758, which also substantiate convergent validity.
2. Structural Model Analysis: Hypothesized relationships were compared to determine the causal relationships between latent variables.
- Model fit: satisfactory CFI > 0.90, RMSEA < 0.08, and 8 (5) /df.
 - 8 of the 8 hypothesized paths were found to be supported, with the strongest effects being DIP to ATT (= -0.559), PBC to BI (= -0.677), and BI to LCTB (= -0.610). Unexpectedly, however, SME was not a significant predictor of BI (0.068, $p > 0.05$).

There was also a significant gap between attitudes/intentions and behaviors as revealed by descriptive statistics. Although the means of attitudinal and intentional items were high (i.e., ATT1 mean = 4.26, BI3 mean = 4.29), the actual behaviors were moderate (mean 2.5), which is an indication of the intention-behavior gap.

Ethical considerations

The research described in this article was reviewed and approved by the University of Phayao Human Ethics Committee, Thailand. The approval reference number is HREC-HSS 2.2/175/68. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study (Wu & Zhao, 2022).

Limitations of the methodology

Although the design and procedures were strict, several methodological limitations need to be mentioned. To start with, the non-random purposive sample will limit the extrapolation of the findings to the broader Thai seniors who are digitally engaged. Second, the cross-sectional design does not allow for causal inference, but only correlation. Third, self-reporting measures can be prone to social desirability bias, particularly when assessing pro-environmental attitudes. However, the sample size, good measurement validation, and the mix of quantitative

and qualitative aspects contribute to the credibility and relevance of the results.

RESULTS AND DISCUSSION

Descriptive statistics of the sample

Demographic information obtained from evaluating 400 interviewees constitutes valuable insights into the study population. There is a significant imbalance in gender representation, with the vast majority of 85.3% being female, as shown in Fig. 1. There is also a representation of males, who make up 12.8 percent of the sample and 2.0 percent of the LGBTQ+ population. Such overrepresentation of women is not a remote issue in survey-based tourism research, as women tend to be more involved in trip planning within families and are more likely to complete online survey forms. Such a skew implies that the results can be particularly valuable to elderly female travelers, who constitute a promising market niche for low-carbon tourism. The findings address the interpretation of the non-significant findings related to SME, framing it in the context of “slacktivism.” The negative beta value associated with SME should not be misinterpreted as indicating an inhibitory effect on low-carbon tourism behaviors. Instead, it highlights the lack of significance, suggesting that SME does not have a meaningful impact on the intention-behavior gap in this context. This distinction is crucial for accurately understanding the role of SME in influencing pro-environmental actions among seniors.

According to the age profile, the sample is denser in the 60-64 age group, with 89.8 respondents living in this age group. The number of those aged 65-69 was only 7.8 percent, and those above 70 were less than 3% are shown in Fig. 2. This can be assumed to indicate that the group of seniors captured by the study is more of the so-called young-old seniors who are still relatively healthy, mobile, and digitally involved. Low participation of elders highlights the lower visibility and underscores the need to recognize generational differences with elders.

The level of education in the sample is 58.3% with a bachelor's degree and 8.5% with a postgraduate degree. This sample suggests that respondents are generally capable of understanding sustainable information online. In terms of economic crises, 34.5% reported a monthly income of around 15,001-30,000 THB, whereas 28.3% earn above 30,000 THB. The

Gender Distribution of Sample (N=400)

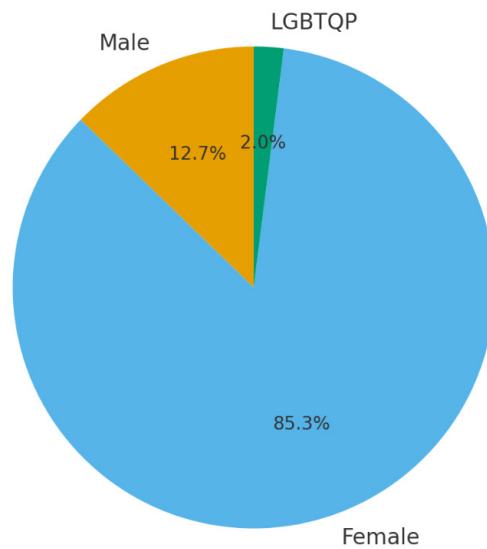


Fig 1: Gender distribution of the Sample(N=400)

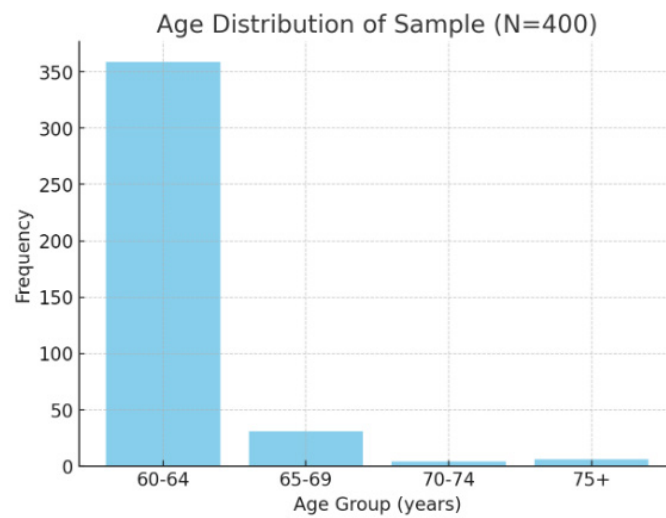


Fig. 2: Age distribution of the sample

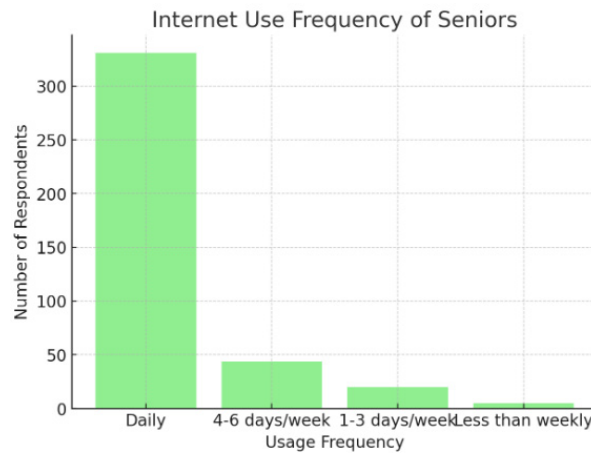


Fig 3: Internet use frequency of Seniors

middle-class and upper-class incomes are enough to spend on eco-friendly travel opportunities, which are viewed as the most expensive. Clues of online savvy suggested that the sample actually consisted of a set of highly connected individuals. 82% of respondents reported being online every day, with another 11% reporting being online 4 to 6 days a week. This was the same case with social media use, as shown in Fig. 3. Regarding their self-rated internet skills, 47.8% belong to the intermediate user population, and 34.5% belong to the more advanced population. This is indicative of a group that is not only connected but also assured of navigating digital tools.

This study reveals that 75.8% of people travel through information from social media, and 75.5% of people travel from recommendations from their family and friends, far surpassing traditional sources such as television, radio, and newspapers. These findings suggest that digital platforms influence the travel choices of respondents. However, the descriptive method indicates that this study is not for Thai older seniors because they have less knowledge of digital platforms. Rather, the results demonstrate that this study is for a specific group of urban, educated, and financially stable early seniors who frequently use digital platforms for travel options (Thébault et al., 2013). The intention-behavior gap is the R^2 value of 37.2%, which indicates that behavioral intention explains a substantial portion of the variance in low-carbon tourism behavior. This finding underscores the gap between the high levels of pro-environmental intentions reported by respondents and their actual

low-carbon behaviors. The significant yet incomplete explanatory power of behavioral intention suggests that other factors are likely influencing the discrepancy, further emphasizing the need for additional research to identify and address these barriers.

Descriptive statistics of latent variables

A further understanding of the cognitive and behavioral orientations of seniors toward low-carbon tourism is achieved through the analysis of the measurement items. Attitude variables/measures (ATT) and Behavioral Intentions (BI) consistently had high mean scores of above 4.0 on a 5-point scale, indicating a high proportion of respondents supported the value of low-carbon tourism. For example, the measure of activity that requires low-carbon tourism had a mean of 4.26, whereas the measure of activity that I will also attempt to reduce the types of waste I produce during my travels (BI3) scored even better, with a mean of 4.29. This research suggests that participants have positive attitudes toward sustainable tourism. On a 3-point scale, the average score of approximately 2.5 indicates that Low-Carbon Tourism Behavior (LCTB) practices are for occasional use and fill a gap between what they believe and do. Indicatively, LCTB3, which involves bringing a reusable water bottle and a cloth bag when I travel, provides a mean response of 2.56, whereas LCTB2, which involves attempting to save water and electricity in my hotel room, records 2.46. This deviation between the bold plans and moderate actions is the initial indication of

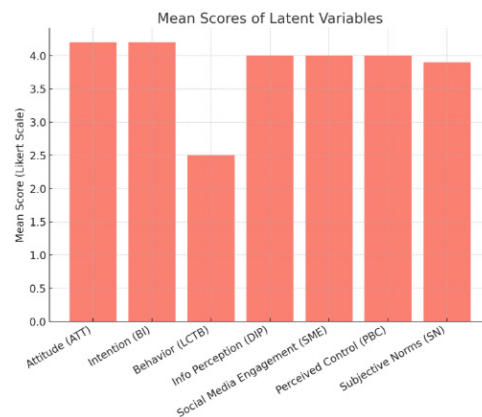


Fig 4: Mean scores of Latent variables

the intention-behavior gap in this population (Zainal Abidin *et al.*, 2023).

Similar factors, such as Digital Information Perception (DIP), latent Social Media Engagement (SME), PBC, and SN, are reported near 4.0 and are shown in Fig. 4. This suggests that seniors are highly engaged in digital activities and perceive effective sustainable behavior. These frequent positive ratings suggest that the challenge is not in convincing seniors; it depends on the mindset to make it easier and sustainable actions during travel. The mean low-carbon tourism behavior score of 2.5 on a 3-point scale indicates moderate behavior, contrasting with the high behavioral intention mean of 4.29 on a 5-point scale. This inconsistency in scales could lead to misunderstandings, particularly in the bar chart (Fig. 4), which mixes these scales. Standardizing the presentation of all scores will enhance the comprehensibility of the findings and facilitate accurate interpretations of the intention-behavior gap.

Measurement model assessment

Confirmatory factor Analysis (CFA) was conducted to examine the reliability and validity of the measurement model. All factor loadings were greater than 0.70, indicating good reliability of the indicators. They are DIP4 (0.876), SME5 (0.832), ATT3 (0.845), and PBC4 (0.821). Internal consistency was high, with Cronbach's alpha ranging from 0.709 (LCTB) to 0.889 (BI), which exceeds the acceptable threshold of 0.70. The values of Composite Reliability (CR) ranged from 0.712 to 0.879, and the Average Variance Extracted (AVE) was between 0.553 and 0.758,

confirming convergent validity. Discriminant validity was, however, less desirable. There were correlations between DIP, SME, and PBC exceeding the square roots of their AVEs. For example, the square root of 0.788 is lower than the correlation between DIP and SME of 0.909. This implies that the elderly may not have a fine line between information reception, interaction with social networks, and the ability to act. Even though all these constructs are reflected as one dimension of digital empowerment, this is a statistical limitation, as it views various digital factors for seniors.

Structural model and hypothesis testing

The SEM results revealed several key findings:

1. *DIP → ATT (Supported)*: Digital information perception significantly influenced attitudes toward low-carbon tourism ($\beta=0.559$, $p<0.001$). Seniors who perceived online information as credible and useful were more likely to develop positive attitudes.
2. *SN → ATT (New Path)*: Subjective norms significantly influenced attitudes ($\beta=0.294$, $p<0.001$). While not originally hypothesized, this finding suggests that family and peer approval enhance positive evaluations.
3. *ATT → BI (Supported)*: Attitudes significantly predicted intentions ($\beta=0.305$, $p<0.001$), consistent with TPB.
4. *PBC → BI (Supported)*: Perceived behavioral control was the strongest predictor of intention ($\beta=0.677$, $p<0.001$). This indicates that seniors' sense of feasibility and capability

plays a more decisive role than attitudes or norms.

5. *SME → BI (Not Supported)*: Social media engagement had no significant effect on intention ($\beta = -0.068$, $p = 0.676$). Despite daily use of social media, mere interaction with content did not translate into stronger intentions.
6. *BI → LCTB (Supported)*: Intention significantly predicted behavior ($\beta = 0.610$, $p < 0.001$). However, intention explained only 37.2% of behavioral variance, leaving 62.8% unexplained, evidence of a substantial intention-behavior gap.

Together, these results demonstrate that while seniors hold positive attitudes and intentions, actual behaviors are influenced by perceived feasibility and external conditions more than by social media trends.

Model fit

The last model of SEM fitted well to the fundamental measures: $2/df = 2.71$, CFI = 0.93, TLI = 0.91, and RMSEA = 0.067. Such values are within acceptable limits, which validates the model's intensity in providing a sound depiction of the data.

Summary of findings

Most implications of the extended TPB version are supported by the findings. DIP and PBC turned out to be the most positive predictors of intention, which explains the use of credible information and a sense of feasibility. SN has influenced attitudes, demonstrating the role of social networks in shaping them. Surprisingly, SME did not have that impact, implying that the seniors do not use social media as a source of behavior more than they use it as an information source. Lastly, the significant intention-behavior gap highlights the need to more fully convert well-meaning intentions into regular, sustainable behaviors, a subject of further discussion.

Discussion

Overview of key findings

This research outcome supports the stance that the extended Theory of Planned Behavior (TPB) provides a constructive framework for explaining low-carbon tourism behavior among digitally competent Thai elderly individuals. DIP and PBC emerged as the strongest predictors of intention, while Behavioral

Intention (BI) was a significant predictor of Low-Carbon Tourism Behavior (LCTB). Subjective Norms (SN), which indirectly affected intention, did so through attitude; however, this was not the case with Social Media Engagement (SME). Notably, intentions were high, but the actual behaviors were middling, signifying a significant gap between intention and behavior. These results support the previous studies, which emphasize the explanatory potential and the limitations of TPB (Ajzen, 1991; Han *et al.*, 2010; Chen and Tung, 2014). The existing work contributes to the literature by incorporating digital constructs into TPB and focusing on an underrepresented population group (the elderly in Thailand) and empirically illustrating an interaction of digital-specific factors, perceptions of its feasibility, and attitudes to form pro-environmental behavior.

Digital information perception as a driver of attitudes

The significant impact of Digital Information Perception (0.559, $p < 0.001$) indicates that seniors' positive attitudes towards tourism strongly depend on online information; the more credible the information, the more interest they show in sustainable travel (Cheung and Thadani, 2012; Harrigan *et al.*, 2021). In the case of seniors, whose travel choices can necessitate a significantly more considered approach to health, safety, and convenience, online information, credibility, and clarity can hold even greater significance than in the case of younger generations. This implies that online information that is clear, reliable, and easy to use must be targeted in sustainable tourism campaigns for seniors. Complicated or unconfirmed content cannot only demotivate sustainable decisions but also erode the confidence of providers. Conversely, attitudes and later intentions may be influenced by information that demonstrates the actual advantages, protection, and affordability of low-carbon behaviors.

The role of perceived behavioral control in forming intentions

The strongest predictor of intention was PBC ($\beta = 0.677$, $p < .001$), which validated its key role in TPB applications to pro-environmental behavior. Past reports have reached the same conclusion, with the role of feasibility perceptions overriding that of attitudes in determining the choice of a green hotel (Han *et al.*, 2010) or the preference for eco-friendly accommodation (Chen and Tung, 2014). In the current setting, the perception that seniors have of the feasibility of low-carbon operations, including

saving energy at hotels or reducing emissions from vehicle use, could influence whether they would follow through on the action. This points to the hard-faced fact that positive attitudes are not enough. The seniors might also appreciate the concept of low-carbon tourism, but they may not implement it simply because they do not see it as feasible. This is consistent with the application of Ajzen (1991), which states that PBC is used to portray the existence of actual conditions of control, closing the gap between cognition and limitations. Managerially, this observation suggests that low-carbon tourism promotion among seniors should focus on comfort and convenience. In one example, hotels might make recycling easier, explicitly lay out eco-advisories, or offer low-carbon transport services and accommodation that are accessible to seniors. The intentions are strengthened through the empowerment of seniors with the resources and support, which makes them feel in charge.

The limited role of social media engagement

Surprisingly, SME was not a significant predictor of intention ($\beta = -0.068$, $p = 0.676$). This was unexpected, as 82.8 percent of respondents used social media daily, and the literature names engagement as a source of normative and attitudinal change (De Veirman et al., 2017; Wut et al., (2023). One reason could be that, for seniors, social media serves more as a source of information than motivation. Seniors can scroll, like, or share content, but these actions do not lead to meaningful engagement or behavior change. This observation also aligns with critiques of 'slacktivism' (Morozov, 2009), which suggests that social network support does not necessarily translate into real-life actions. For seniors, engagement offers exposure rather than commitment. Since SME was not significant, it is crucial to distinguish between digital activity and digital influence. Social media may provide awareness, but it might not influence motivation unless the information is credible and appears feasible.

Attitudes, subjective norms, and their indirect effects

The showing practice of attitudes positively influencing intention ($p < 0.001$, $\eta^2 = 0.305$) is in line with the TPB and the literature on sustainable tourism in general (Dolnicar and Leisch, 2008; Han et al., 2010). Older generations that regarded low-

carbon practices as important and useful were more willing to adopt them. Attitudes were also influenced by subjective norms ($B = 0.294$, $p = 0.001$), indicating that ratings by seniors are shaped one-third by family and peer endorsement. This circuitous route serves to highlight the importance of utilizing social networks in enhancing positive assessments, especially in collectivist cultures like Thailand's, where family and community may tend to dominate the decision-making process. However, in contrast to some TPB applications, norms overall had no direct effect on intention. This means that in the case of seniors, peer pressure does not contribute adequately to behavioral modeling unless it provides attitude transformation. This implication further enriches TPB to underscore the fact that exposure to influence can vary depending on demographics and culture.

Intention-behavior gap in senior tourism

Those findings were the most striking, as a considerable intention-behavior gap was observed. Although intentions were strong predictors of behavior (0.610, $p=0.001$), intentions accounted for only 37.2 percent of the variance of behavior. There were only moderate practices in actual low-carbon behaviors, including the use of reusable bottles and energy-conservation practices in hotels (mean ≈ 2.5 on a 3-point scale). This is reminiscent of past work, which has consistently shown that pro-environmental intentions are not realized (Kollmuss and Agyeman, 2002; Li, Liu, and Li, 2023; Warren, J. P. & Burns, P. M., (2011).

In older individuals, such a discrepancy can be because of several factors:

1. Physiological constraints: lugging reusable products or travelling in eco-friendly vehicles can be regarded as inconvenient, or even a strain on the body.
2. Health issues: behaviors that are regarded as risky (e.g., walking long distances to cut carbon) can be foregone.
3. Structural barriers: the interventions can be hindered by the lack of accessible eco-infrastructure (e.g., hotels without obvious ways to recycle).
4. Cognitive dissonance: the elders can consider intended actions as sufficient contributions, without acting.

It shows the difficulty of converting pro-environmental thinking into action, especially with ageing individuals. It reconfirms the necessity of psychological intervention (in order to make these commitments stronger) as well as structural intervention (in order to make these commitments less impeded).

Theoretical implications

The study aids the literature in the following three aspects:

1. Duration of TPB with digital variables: Basing the study on combining DIP and SME, the study answers the call of providing an updated version of information on the need to revise models of behavior to adapt to digital reality. DIP was very influential, and the lack of an effect of SME questions the assumptions regarding the motivational effect of social media.
2. Lighting up to the evidence of digital empowerment being a latent feature: The discriminant validity of the situational case of DIP, SME, and PBC being a collection of seniors proposes that they may be subject to one such attribute of digital empowerment. This provides a fresh theoretical insight for future research.
3. Precision in TPB pathways among an aged population: The indirect role of norms through attitudes demonstrates the specifics of a demographic and cultural process and introduces yet another feature of TPB explanatory variability.

A significant limitation of this study is the potential failure of discriminant validity, as indicated by the Fornell-Larcker criterion. If the criterion is not met, it suggests that DIP and SME may be measuring the same underlying construct rather than functioning as distinct factors. This overlap weakens the argument that these constructs independently contribute to the intention-behavior gap in low-carbon tourism. Consequently, further research is needed to clarify the relationships among these constructs and establish a more nuanced understanding of how they influence pro-environmental behaviors among seniors. This study's findings show the importance of the quality of interaction between digital and low-carbon tourism and seniors, highlighting the need to bridge the digital divide to enhance sustainable tourism. Urban locations

can feature technological innovations that largely promote sustainable tourism, as proposed by [Vujko, Knezevic, and Arsio \(2025\)](#). [Mohan et al., \(2024\)](#) note that it is necessary to ensure that the elderly group is digitally inclusive to encourage their participation in this type of initiative. Similarly, [Diana et al., \(2025\)](#) observe the influence of urban and rural environments on the well-being of elderly citizens, affecting their participation in low-carbon tourism. [Heiets and La \(2025\)](#) also explain how digital technologies assist in enhancing the travel experience of older patients. According to [Lin et al., \(2022\)](#), expanding knowledge about low-carbon tourism can lead to more positive outcomes in collective happiness and environmental growth. Zhang, Papp-Vary, and Szabo (2025) comment on how digital interaction improves visitor satisfaction in tourist locations and is essential for ensuring sustainable tourism. Furthermore, Marin Diaz, Galdon Salvador, and Galan Hernandez (2023) consider the role of digital maturity in personalizing tourist recommendations. In their study, [Loos et al., \(2020\)](#) emphasize that creating transport systems friendly to the elderly is crucial for enabling them to move around. According to [Ai, Zhang, and Yan \(2024\)](#), the digital economy should be integrated into urban low-carbon approaches for successful transitions. [Sylaiou et al., \(2025\)](#) suggest that integrating older adults into the digital age could be improved through the empowerment of older adults, which could be achieved with the support of digital heritage. Together, these findings can lead to special interventions to attract older generations to sustainable tourism by enhancing their online availability and designing personalized programs. This study further demonstrates that digital engagement plays a significant role in closing the gap between intention and action in low-carbon tourism among urban seniors. According to [Koufodontis et al., \(2025\)](#), affective-symbolic urbanism is still relevant in determining tourists' perceptions, which is crucial for understanding low-carbon practices among senior travelers. [Ni et al., \(2025\)](#) also point out that older adults need specific solutions to climate change that can enhance their interest in sustainable tourism practices. [Aina et al., \(2023\)](#) explain how digitalization can improve cities' resilience and positively impact the tourism industry in a post-pandemic environment. Additionally, [Zeqiri et al., \(2025\)](#) highlight the importance of digital platforms in promoting Sustainable Development Goals, which can

help integrate sustainability into tourism practices. Similarly, the article by Pan et al., (2024) emphasizes the significance of digital inclusion in helping older adults acquire the necessary digital skills and influence their attitudes towards the environment and eco-friendly behavior. Collectively, these sources support the claim that improving digital literacy among the elderly can enhance their participation in low-carbon tourism and reduce the intention-behavior gap observed in this consumer group.

Practical implications

Stakeholders should simplify the sustainability of low-carbon tourism for seniors, making it believable and personal. With real-life performance (e.g., refill stations, towel reuse, and ways to get there), tourism operators can redesign touchpoints using content that is simple, elderly-accessible (e.g., large-type multilingual guides, plain infographics), and strategic (e.g., in-room cues). The importance of accessibility to infrastructure must be enhanced by policymakers' attractive features, such as low-energy usage hotels, shaded footways, self-reliant, low-emission transport with priority seating, and noticeable recycling and water-efficient features, which increase the perceived locus of control. Marketers must utilize social media as a point of entry for awareness, with posts featuring valid links, checklists, and how-to reels that can turn interest into actionable procedures at the booking and pre-departure levels. One way community organizations can utilize family influence is through the marketing of intergenerational eco-itineraries, a volunteer weekend, and a pledge program, making sustainable solutions accepted by all age groups. Collectively, these activities ensure that the quality of information, feasibility, and social support—the three levers—will translate positive attitudes and plans into stable, low-carbon practices among digitally active Thai seniors.

Limitations and future research

There are several limitations to the study. The study primarily focused on urban, digitally literate seniors. By expanding the sample to encompass digitally less-active seniors, future research can provide a more comprehensive understanding of the diverse attitudes and behaviors related to low-carbon tourism across different segments of the elderly population. This inclusion will help to identify specific barriers and opportunities for promoting sustainable tourism

practices among all seniors, not just those who are more digitally engaged. A purposive sample was used, focusing on digitally active seniors, which limited the potential extrapolation of the targeted technologies to lower digital literacy groups. It lacks causal inferences, as the employed design is cross-sectional, and there is a possibility of social desirability bias due to self-reports. The next research should utilize longitudinal study designs, as this approach would observe changes in intentions as they are converted into behaviors in the future. Comparative cross-cultural research would evaluate the possibility that norms have a more direct effect in more collectivist contexts. Lastly, a qualitative study might examine the lived experiences of seniors with barriers and provide more details on the intention-behavior gap.

Summary of discussions

The discussion suggests that the concern driving low-carbon tourism among Thai seniors is based on plausible online information and perceived as possible, although it is limited by physical, structural, and cognitive costs. The findings refine TPB theory by incorporating digital constructs and highlighting the indirect nature of norms. In practical terms, they demand interventions that integrate clear information, help improve the infrastructure, and support social contexts to bridge the intention-behavior gap.

CONCLUSION

This study investigated low-carbon tourist behavior among digitally active Thai seniors, focusing on two digital variables: DIP and SME. Data gathered from the survey of 400 participants were evaluated using Structural Equation Modeling (SEM). The outcome revealed that intention was strongly affected by DIP and perceived Behavioral Control (PBC) in comparison to attitudes, and SME was not found to have a significant impact. Intentional subjective norms had an indirect effect on intentions through attitudes, identifying an intention-behavior gap. The study has contributed to the literature on sustainable tourism by incorporating digital constructs, emphasizing the importance of cultural sensitivity in decision-making, and exploring the role of family in influencing decisions. The policy implications are to make digital information seniors-friendly, increase control by having ready infrastructure, utilize family and peer influence, and revise social media

strategies to transform awareness into action. Limitations include a purposive sample, a cross-sectional study design, self-report data, and limited broad applicability. Further studies should adopt longitudinal and cross-cultural designs, incorporate digitally fewer literate seniors, and employ mixed-methods designs to gain a better understanding of the intention-behavior gap. From a policy and practical standpoint, this research highlights that improving the credibility, accessibility, and personalization of online environmental information can significantly strengthen intention formation among seniors. Governments, tourism boards, and industry operators should develop senior-friendly digital communication platforms and inclusive eco-tourism programs that simplify sustainable choices while addressing perceived constraints. Encouraging intergenerational digital mentoring and family-inclusive low-carbon campaigns may further bridge the intention-behavior gap by leveraging social support and familiarity with digital systems. While the study contributes meaningful insights, several limitations must be acknowledged. The non-probability sampling method limits the generalizability of the findings, and the cross-sectional design restricts causal inference. Additionally, reliance on self-reported measures introduces potential biases in respondents' representation of actual behaviors. Future studies should employ longitudinal approaches to assess behavioral consistency over time, adopt mixed-methods designs to capture qualitative nuances, and include digitally less-active seniors for a more representative perspective. Cross-cultural comparisons could also reveal how digital behaviors and environmental attitudes vary across aging populations in diverse socio-economic contexts. In essence, the research underscores that fostering sustainable tourism among older adults in the digital era requires integrating credible digital communication, structural support, and cultural sensitivity. Bridging the intention-behavior gap in this demographic is not merely a behavioral challenge but a digital inclusion imperative, calling for collaborative action between policymakers, scholars, and industry practitioners.

AUTHOR CONTRIBUTIONS

W. Madhyamapurush: Conceptualization; Methodology; Investigation; Data Curation; Formal Analysis; Writing – Original Draft; Writing – Review & Editing; Visualization; Supervision; Project Administration.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the authors have acknowledged the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy, which have been fully addressed.

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ABBREVIATIONS (NOMENCLATURE)

α	measure of internal consistency/ (Cronbach's α) reliability
AMOS	Analysis of Moment Structures
ATT	Attitude toward the Behavior
AVE	Average Variance Extracted
β	Standardized Regression Coefficient
BI	Behavioral Intention
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index (model fit measure)
CR	Composite Reliability
DIP	Digital Information Perception
HREC	Human Research Ethics Committee
HREC-HSS	Human Research Ethics Committee – Human and Social Sciences
LCTB	Low-Carbon Tourism Behavior
N	Sample Size
p	Probability Value indicating statistical significance
PBC	Perceived Behavioral Control
R ²	Coefficient of Determination (explained variance in a model)
RMSEA	Root Mean Square Error of Approximation (model fit index)
SD	Standard Deviation
SEM	Structural Equation Modeling
SME	Social Media Engagement
SN	Subjective Norms

TLI	Tucker–Lewis Index (model fit indicator in SEM)
TPB	Theory of Planned Behavior
η^2	Eta Squared measure of effect size in statistical analysis
χ^2/df	Chi-Square divided by Degrees of Freedom – model fit ratio

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