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Research Paper

A User Experience–Based Evaluation Model for AI-Enabled Digital Booking Engines in Tourism

Sunil Nanikram Daryanani Daryanani *
Carina Soledad González González**
Alfonso Ruiz Rallo***

ABSTRACT

Digital booking engines play a central role in contemporary tourism services, increasingly integrating artificial intelligence to personalize interactions and optimize decision-making processes. While these systems are widely adopted, there is a lack of comprehensive evaluation frameworks that integrate user experience (UX), service design principles, and emerging ethical considerations related to artificial intelligence (AI) enabled services. This paper proposes a UX-based evaluation model for AI-enabled digital booking engines in tourism, grounded in a multidisciplinary perspective that combines service design, human-centered design, UX evaluation models, and ethical guidelines for trustworthy AI. The model is operationalized through a structured evaluation questionnaire covering seven dimensions: tourism, usability, navigability, aesthetics, intelligence, ethics, and sociability. Methodologically, the study employs a qualitative, exploratory approach. An initial version of the model is applied illustratively as a proof of concept using a small, heterogeneous sample of users interacting with a widely used tourism booking platform. The exploratory application aims to assess the coherence, applicability, and refinement needs of the proposed model rather than to provide statistically generalizable results. The main contribution of this research lies in the conceptual and methodological articulation of an integrative evaluation framework that supports the assessment and improvement of AI-enabled tourism booking services from a user-centered and ethically informed perspective. Limitations related to sample size and empirical validation are acknowledged, and directions for future large-scale validation studies are outlined.

Keywords: User Experience Evaluation, Service Design, Digital Booking Engines, Tourism Technology, Artificial Intelligence, Ethics in Design.

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* University of La Laguna, Spain. alu0101380780@ull.edu.es
** University of La Laguna, Spain. cjgonza@ull.edu.es
*** University of La Laguna, Spain. aruiz@ull.edu.es

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1. INTRODUCTION

The digital transformation of services has profoundly reshaped the tourism sector, particularly through the widespread adoption of online booking engines and platform-based service ecosystems. These digital environments mediate key stages of the tourist journey, such as information search, comparison, booking, and post-purchase interaction, and increasingly determine perceived service quality. Recent research highlights that digital tourism has evolved into a complex, data-driven ecosystem in which smart technologies play a central role in value creation and service differentiation (Wu et al., 2024).

In this context, user experience (UX) has emerged as a strategic construct for tourism platforms. User evaluations of digital booking services are no longer limited to functional efficiency or task completion, but also encompass perceptions of ease of use, trust, confidence, and overall experiential value. Experience design research in tourism emphasizes the need to approach tourism services holistically, accounting for cognitive, emotional, and contextual dimensions that shape user perceptions before, during, and after interaction with digital systems (Tussyadiah, 2014).

Closely related to UX, Service Design (SD) provides a comprehensive framework for structuring and improving digital services by orchestrating processes, touchpoints, and interactions over time. Rather than focusing exclusively on interfaces, Service Design addresses the entire service ecosystem, aligning organizational processes with user needs and expectations. This approach is particularly relevant in tourism, where services account for a dominant share of economic activity and where digital platforms act as intermediaries between multiple stakeholders (Viladàs, 2010). Empirical studies in e-tourism confirm that website and platform features, such as usability, navigability, information quality, and visual coherence, significantly influence users' experience and evaluation of booking engines (Domínguez Vila et al., 2021).

The challenges associated with designing and evaluating tourism booking platforms are further intensified by the current phase of the Fourth Industrial Revolution (4IR), characterized by the pervasive integration of artificial intelligence (AI) into digital services. AI-enabled features, such as recommender systems, dynamic pricing, chatbots, and personalization mechanisms, are increasingly embedded in booking engines to enhance efficiency and relevance. However, their impact on user experience depends not only on technical performance, but also on users' perceptions of transparency, control, and alignment with their expectations (Stankov & Gretzel, 2020). Experimental research in tourism contexts suggests that AI-based conversational agents can influence booking intentions and satisfaction, reinforcing the need to explicitly consider AI as a core dimension in UX evaluation models for booking services (Wüst & Bremser, 2025).

At the same time, the growing reliance on AI raises critical ethical concerns related to data privacy, fairness, accountability, and user autonomy. These issues are particularly salient in booking environments, where algorithmic decisions may influence prices, recommendations, and consumer choices. The European Commission's Ethics Guidelines for Trustworthy AI identify key requirements, like human agency and oversight, transparency, privacy and data governance, and accountability, that are increasingly relevant for AI-enabled digital services (European Commission, 2019). Integrating these principles into UX and Service Design evaluation frameworks is essential to ensure that technological innovation remains aligned with human-centered and socially responsible values.

Despite the relevance of UX, SD, AI, and ethics in digital tourism, existing evaluation approaches remain fragmented. Prior studies often focus on isolated aspects, such as usability, technology adoption, or satisfaction drivers, without offering integrative frameworks that systematically combine experiential, service-oriented, technological, and ethical criteria (Raghavendra et al., 2024). Consequently, there is a lack of structured and operational evaluation models specifically tailored to AI-enabled tourism booking engines.

Addressing this gap, the present study proposes a user experience–based evaluation model for AI-enabled digital booking engines in tourism, grounded in a multidisciplinary perspective that integrates UX research, SD principles, and ethical guidelines for trustworthy AI. The model is operationalized through a structured evaluation questionnaire and presented within a conceptual and exploratory research design. An initial application of the model is conducted as a proof of

concept to assess its coherence, applicability, and potential for refinement, providing a foundation for future large-scale empirical validation.

2. LITERATURE REVIEW

2.1 UX in digital tourism platforms

UX has become a central construct in evaluating digital tourism services, as interactions with online platforms increasingly mediate the tourist journey (Rusu et al., 2015). Unlike traditional service encounters, digital tourism experiences are shaped by interfaces that support information search, comparison, decision-making, and booking. Consequently, UX in tourism extends beyond usability and efficiency to encompass cognitive, emotional, and contextual factors that influence users' perceptions and satisfaction (Tussyadiah, 2014).

Prior research emphasizes that tourism experiences are inherently experiential and subjective, underscoring the critical role of UX in value creation in digital tourism environments. Tussyadiah (2014) argues that experience design in tourism must consider the dynamic and temporal nature of user interactions, particularly in digitally mediated contexts. This perspective is reinforced by studies showing that users evaluate tourism platforms not only based on functional performance, but also on trust, perceived control, and emotional comfort during interaction (Stankov & Gretzel, 2020).

Empirical work on e-tourism platforms and booking engines demonstrates that UX-related attributes, like ease of navigation, clarity of information, visual coherence, and interaction feedback, significantly affect users' evaluations and intentions to use booking services (Domínguez Vila et al., 2021). These findings suggest that UX assessment in tourism requires multidimensional approaches capable of capturing both instrumental and non-instrumental qualities of interaction. However, many existing studies operationalize UX through isolated indicators or adoption-oriented models, limiting their ability to holistically evaluate the experiential quality of booking platforms.

2.2 Service design and experience evaluation

SD provides a complementary and broader perspective for understanding and evaluating digital tourism services. Rather than focusing solely on interfaces or individual touchpoints, SD conceptualizes services as systems composed of interconnected processes, actors, and interactions unfolding over time. This systemic perspective is particularly relevant in tourism, where services

are co-created through interactions between users, platforms, and multiple service providers (Viladàs, 2010).

From a SD standpoint, the quality of a tourism booking engine depends on how effectively it aligns organizational processes, technological infrastructures, and user needs. Shostack's foundational work on service design highlights the importance of explicitly designing and evaluating service processes to ensure consistency and quality in service delivery (Shostack, 1982, 1984). More recent research confirms that digital tourism platforms function as service ecosystems in which design decisions at the process level directly influence user experience and perceived value (Stankov & Gretzel, 2020).

Despite its relevance, SD is often underrepresented in empirical evaluations of tourism platforms, which tend to privilege usability testing or satisfaction metrics. The lack of structured evaluation frameworks that integrate Service Design principles into UX assessment limits the capacity to diagnose systemic design issues in booking engines. This gap suggests the need for evaluation models that explicitly incorporate service-oriented dimensions alongside UX metrics.

2.3 Artificial intelligence and ethics in tourism services

The integration of artificial intelligence (AI) into tourism booking platforms has introduced new interaction paradigms and design challenges. AI-driven mechanisms, like recommender systems, dynamic pricing algorithms, personalization engines, and conversational agents, are increasingly used to support decision-making and enhance service efficiency. These technologies are often positioned as enablers of Tourism 4.0, characterized by smart, adaptive, and data-driven services (Stankov & Gretzel, 2020).

Empirical studies indicate that AI-based features can positively influence users' perceptions of relevance and convenience in booking processes. For example, experimental research on chatbot-supported booking environments shows that conversational agents can affect booking intention and satisfaction, depending on their perceived usefulness, transparency, and ease of interaction (Wüst & Bremser, 2025). However, the introduction of AI also increases system complexity and may negatively affect UX if users perceive intelligent behaviors as opaque, intrusive, or difficult to understand.

Despite the growing adoption of AI in tourism platforms, existing UX evaluation approaches often treat AI implicitly or as a background technology. Few studies operationalize AI-related interaction qualities, such as explainability, perceived intelligence, or adaptive behavior, as explicit

evaluation dimensions. This limitation highlights the need for UX models that explicitly account for AI as a core component of user experience in booking engines.

2.4 Research gap

The reviewed literature reveals several limitations in current approaches to evaluating digital tourism booking engines. First, UX studies in tourism often focus on isolated dimensions such as usability or adoption, without capturing the holistic and experiential nature of user interactions. Second, SD principles are insufficiently integrated into evaluation models, despite their relevance for understanding booking platforms as service systems. Third, AI-related interaction qualities and ethical considerations are frequently treated implicitly or omitted altogether from UX assessment frameworks.

As a result, there is a lack of integrative, operational evaluation models that combine UX, SD, AI-related dimensions, and ethical criteria into a coherent framework tailored to digital booking engines. Addressing this gap, the present study proposes a UX-based evaluation model for AI-enabled tourism booking platforms that explicitly incorporates SD and ethical considerations. The model is operationalized through a structured questionnaire and introduced through an exploratory application as a proof-of-concept, laying the groundwork for future empirical validation and refinement.

The problem lies in the lack of studies on the quality of use of systems in digital environments and on the delivery of tourism services or the tourist experience. This type of study requires examining how these processes are defined, what design management they have had, whether they are genuinely user-oriented, and whether they respect human values. It is essential to consider whether these processes can be designed differently and how they could become an optimal solution for the user, not just for the company, whether private or public. The research should also address issues such as threats to user privacy, concerns about the right to be forgotten, anonymity, and other privacy-related considerations. Data protection and privacy laws are now crucial for all environments, and compliance is essential. All these are intended in the current research.

3. METHODOLOGY

3.1 Research design

This study adopts a qualitative, exploratory, and conceptual research design to propose and structure a user experience–based evaluation model for AI-enabled digital booking engines in the

tourism sector. Given the novelty and multidimensional nature of the research problem, integrating UX, SD, AI, and ethical considerations, the study is positioned as a model proposal accompanied by an illustrative exploratory validation, rather than as a statistically generalizable empirical investigation.

Exploratory research designs are particularly appropriate when the objective is to conceptualize frameworks, define evaluation dimensions, and assess the feasibility and coherence of newly proposed instruments (Creswell & Poth, 2018). Accordingly, the methodological focus of this study lies in the development, operationalization, and initial application of an evaluation model, with the explicit aim of informing future large-scale empirical validation.

3.2 Research goals

The main objective is to propose and operationalize a user experience–based evaluation model for AI-enabled digital booking engines in tourism, integrating SD principles and ethical considerations, and to explore its applicability through an initial proof-of-concept. Following the principal objective, the specific objectives are proposed:

1. To identify and systematize key evaluation dimensions derived from UX research, SD theory, AI-enabled interaction, and ethical design guidelines relevant to digital tourism booking platforms.
2. To operationalize these dimensions into a structured and scalable evaluation instrument in the form of a questionnaire.
3. To conduct an exploratory application of the proposed evaluation model in a real digital booking environment as a proof of concept.
4. To analyze the coherence, applicability, and refinement needs of the proposed model based on the exploratory application.

3.3 Development of the evaluation model

The proposed evaluation model was developed through a multidisciplinary synthesis of existing theoretical and methodological frameworks. Specifically, the model draws on UX evaluation approaches that emphasize multidimensional assessment of user interaction quality (González Sánchez, 2010; Aciar & Aciar, 2017), SD principles that conceptualize services as integrated systems of interactions and processes (Shostack, 1982; Viladàs, 2010), AI-related criteria derived from the European Commission's Ethics Guidelines for Trustworthy AI (European Commission, 2019), and ethical design principles associated with "good design" and human-centered approaches (Papanek, 2016; Real García, 2020). Based on this synthesis, seven evaluation

dimensions were defined: Tourism, Usability, Navigability, Aesthetics, Intelligence, Ethics, and Sociability. These dimensions were selected to capture both instrumental (e.g., usability, navigability) and non-instrumental (e.g., ethics, trust, perceived intelligence) aspects of user experience in AI-enabled booking environments.

3.4 Operationalization: the evaluation questionnaire

The evaluation model was operationalized through a structured questionnaire designed as the primary assessment instrument. The questionnaire translates each evaluation dimension into a set of items formulated to capture users' subjective perceptions during interaction with digital booking platforms.

The questionnaire structure was informed by previously validated UX evaluation instruments, particularly the gameplay-based evaluation model proposed by González Sánchez (2010), which was adapted to the tourism booking context following recommendations by Stankov and Gretzel (2020). Additional UX-related constructs were integrated following Aciar and Aciar (2017), emphasizing experiential qualities such as attraction, efficiency, clarity, stimulation, and novelty.

To ensure consistency and interpretability, all items were rated on a six-point Likert-type scale (0–5), with higher values indicating more positive evaluations. The questionnaire was intentionally designed to be comprehensive, acknowledging that its length may affect user effort while still allowing a detailed assessment of complex service environments. The instrument is conceived as scalable and adaptable, enabling future refinement, reduction, or extension of items during subsequent validation studies.

3.5 Exploratory application

An exploratory application of the questionnaire was conducted as a proof-of-concept to assess the feasibility, coherence, and usability of the proposed evaluation model. The questionnaire was administered on a widely used digital booking platform (Booking.com), selected for its relevance and extensive adoption in the Spanish tourism market.

Five participants with heterogeneous profiles (age, gender, and professional background) were invited to complete the questionnaire after interacting with the platform. The small and diverse sample was intentionally chosen to obtain varied perspectives and identify potential comprehension issues, ambiguities, or limitations of the instrument. The results of this application are treated as illustrative insights, not as statistically representative findings. The data obtained were normalized and analyzed descriptively to identify patterns, inconsistencies, and areas

requiring refinement. Particular attention was paid to dimensions related to Intelligence, Ethics, and Sociability, which were expected to present higher levels of complexity and interpretation variability.

4. PROPOSAL OF THE EVALUATION MODEL

The proposed evaluation model is a conceptual and methodological framework designed to assess user experience in AI-enabled digital booking engines in the tourism sector. The model responds to the need for integrative evaluation approaches capable of capturing the complexity of contemporary digital tourism services, which operate at the intersection of UX, SD, AI, and ethical considerations.

Rather than focusing on isolated usability metrics or technology adoption indicators, the model adopts a systemic and user-centered perspective, treating booking platforms as service ecosystems in which interactions, processes, and intelligent behaviors jointly shape the overall experience. In this sense, the model aligns with Human-Centered Design principles and with SD approaches that emphasize coherence across touchpoints and over time.

4.1 Conceptual Foundations of the Model

The evaluation model is grounded in a multidisciplinary synthesis of established theoretical frameworks. First, it draws on UX evaluation models that conceptualize experience as a multidimensional construct encompassing instrumental, emotional, and cognitive qualities of interaction. In particular, prior work on experiential assessment highlights the importance of considering attraction, efficiency, clarity, stimulation, and novelty as core experiential dimensions.

Second, the model incorporates SD principles, understanding booking engines not merely as interfaces, but as service systems that mediate interactions between users, platforms, and multiple tourism providers. From this perspective, the quality of the experience depends on how effectively digital processes, informational structures, and interaction flows are designed and orchestrated.

Third, the model explicitly integrates artificial intelligence as an experiential dimension. AI-enabled features, such as personalization mechanisms, recommender systems, and conversational agents, are not treated as background technologies but as elements that actively shape users' perceptions of intelligence, transparency, control, and trust.

The model embeds ethical design principles as a core component of evaluation. Drawing on frameworks for trustworthy and responsible AI, ethical considerations are incorporated to assess

whether booking engines respect user autonomy, fairness, transparency, and data protection, thus aligning technological innovation with human-centered and socially responsible values.

4.2 Structure and dimensions of the evaluation model

Based on these conceptual foundations, the proposed evaluation model is structured around seven interrelated dimensions, each addressing a critical aspect of user experience in digital tourism booking environments (Table 1).

Table 1. Dimensions of the Evaluation Model.

Dimensions	Description
Tourism	This dimension captures domain-specific aspects related to tourism services, including clarity of pricing and conditions, transparency of offers, legal and regulatory compliance, and the adequacy of information provided to support travel-related decision-making. It reflects the contextual nature of tourism experiences and the importance of trust and reliability in booking processes.
Usability	Usability addresses the extent to which users can effectively and efficiently interact with the booking platform to achieve their goals. This dimension includes aspects such as ease of use, consistency, error prevention, and learnability, which are fundamental to reducing cognitive effort and frustration during interaction.
Navigability	Navigability focuses on the structural and informational organization of the platform, assessing how easily users can move through the system, locate relevant information, and maintain orientation throughout the booking process. This dimension is particularly relevant in complex platforms that offer large volumes of information and comparison options.

Aesthetics	The aesthetics dimension evaluates the visual and sensory qualities of the booking engine, including layout, visual coherence, and perceived attractiveness. Beyond visual appeal, aesthetics contribute to first impressions, perceived credibility, and emotional engagement, all of which influence overall user experience.
Intelligence	Intelligence refers to users' perceptions of AI-enabled behaviors within the platform. This dimension assesses aspects such as personalization, adaptiveness, perceived relevance of recommendations, transparency of intelligent features, and users' understanding of how automated decisions are generated.
Ethics	The ethics dimension evaluates whether the booking platform adheres to principles of responsible and trustworthy design. This includes respect for privacy, clarity regarding data use, avoidance of manipulative design patterns, fairness in recommendations and pricing, and the presence of mechanisms that support user autonomy and informed decision-making.
Sociability	Sociability addresses the social and relational aspects of the booking experience, such as access to reviews, social proof, comparison with other users, and features that support shared decision-making or group travel planning. This dimension reflects the inherently social nature of tourism experiences.

These seven dimensions are not treated as independent variables, but as interconnected components that collectively shape the quality of the user experience. Their integration enables a holistic assessment of booking engines as complex service systems.

4.3 Operational logic of the model

The evaluation model is operationalized through a structured questionnaire designed to translate each dimension into observable and assessable indicators. The questionnaire serves as the primary

instrument for applying the model, enabling the systematic collection of users' subjective perceptions across the seven dimensions.

Each dimension is represented by a set of items formulated to capture both positive and negative aspects of interaction, supporting a balanced assessment of strengths and weaknesses. A uniform rating scale is employed to facilitate comparability across dimensions and to enable descriptive analysis of results.

Importantly, the model is conceived as scalable and adaptable. The set of dimensions provides a stable conceptual backbone, while the specific items within each dimension can be refined, expanded, or reduced in future iterations. This flexibility allows the model to evolve in response to technological advances, changes in tourism services, and insights derived from empirical applications.

Within the scope of this study, the proposed evaluation model is presented as a conceptual artefact supported by an exploratory application, rather than as a finalized or fully validated measurement instrument. Its primary purpose is to structure evaluation criteria, support reflective analysis of digital booking environments, and provide a foundation for future research.

By integrating UX, SD, AI, and ethical considerations into a single framework, the model contributes to ongoing discussions on how digital tourism services can be systematically assessed and improved from a human-centered perspective. The subsequent exploratory validation, presented as a proof of concept, aims to illustrate the applicability of the model and to identify areas for refinement, paving the way for future large-scale validation studies.

5. EXPLORATORY VALIDATION

Once the evaluation questionnaire was developed, an exploratory application was conducted as a proof of concept in order to assess the feasibility, coherence, and practical usability of the proposed evaluation model. This phase was explicitly conceived as an illustrative and formative stage, not as a statistically robust empirical validation.

5.1 Context and platform selection

The exploratory application was carried out using Booking.com, a widely adopted digital booking platform in the tourism sector and one of the most frequently used booking services in Spain. The platform was selected as a representative and feature-rich example, incorporating key elements

relevant to the proposed evaluation dimensions, such as search and comparison tools, recommendation mechanisms, user reviews, and AI-supported functionalities.

Only one platform was intentionally used at this stage, as the objective was not to compare booking engines, but to test the applicability and internal coherence of the evaluation model within a real and well-established digital tourism environment.

Five participants with heterogeneous profiles were recruited for the exploratory validation. Diversity in age, gender, and professional background was deliberately sought in order to capture different perspectives and interaction patterns. The participant profiles were as follows (Table 2).

Table 2. Participants details

Participant	Sex	Age	Occupation
A	Male	23	University Student
B	Female	16	University Student
C	Male	46	University Professor
D	Female	52	Professional Travel Agent
E	Male	52	Professional Travel Agent

The number of participants was considered the minimum required to establish a proof of concept, consistent with exploratory research practices. While a larger sample would be necessary for statistical validation, the present study explicitly limits its scope to an initial exploratory approach.

5.2 Procedure

Each participant received the evaluation questionnaire along with instructions to use the selected booking platform and rate their experience. Items were rated on a 6-point scale from 0 (lowest evaluation) to 5 (highest evaluation), based on participants' subjective perceptions.

The exploratory application was conducted over a 15-day period, allowing participants to interact with the platform in a naturalistic context. Upon completion, raw scores were normalized to percentages for each evaluation dimension to facilitate interpretation and comparison across dimensions. This normalization process involved rescaling the original 0–5 scores to a 0–100 range, while accounting for the fact that each dimension comprised a different number of items.

5.3 Structure of the questionnaire

The comprehensive nature of the questionnaire reflects the complexity of digital booking environments and the multidimensional scope of the proposed model. The number of items per dimension was: Tourism (17), Usability (12), Navigability (19), Aesthetics (17), Intelligence (31), Ethics (25), Sociability (15). Items within each dimension were intentionally formulated using a mix of positively, negatively, and neutrally worded statements. This design choice aimed to capture both strengths and weaknesses of the evaluated environment and to reduce response bias by preventing automatic or patterned answering.

5.4 Exploratory findings and observations

The exploratory application generated a set of indicative observations related to both the evaluated platform and the evaluation instrument itself. Overall, participants completed the questionnaire and related its items to their interaction experience, suggesting that the proposed dimensions are conceptually meaningful.

However, several issues emerged during completion. Participant A was unable to complete the Intelligence dimension, reporting difficulty understanding some AI-related concepts. Participant C did not complete the final sections on Intelligence, Ethics, and Sociability, citing the questionnaire's overall length and time constraints. Similar situations have been reported in prior UX research involving comprehensive evaluation instruments (Aciar et al., 2020).

Participants also noted that not all items were aligned in terms of polarity, as some questions were formulated positively, others negatively, and others neutrally. While this design was intentional, feedback suggested that clearer guidance would help users better understand the rationale behind this structure.

Table 3 presents the exploratory results from applying the evaluation questionnaire to a digital tourism booking platform. The figure shows the normalized scores for each evaluation dimension, calculated by rescaling participants' original ratings from a 0–5 scale to a 0–100 percentage scale. This normalization allows for comparability across dimensions, while accounting for the fact that each dimension comprises a different number of items. The values represent aggregated and descriptive insights derived from participants' subjective evaluations and are intended solely for illustrative purposes within the proof-of-concept stage.

Table 3. Exploratory results obtained from the application of the evaluation questionnaire to a digital tourism booking platform

Dimension /Participant	A	B	C	D	E
Tourism	50,58%	64,70%	63,52%	57,64%	54,12%
Usability	73,33%	71,66%	88,33%	75,00%	81,67%
Navigation	49,47%	83,15%	63,15%	81,35%	78,94%
Aesthetic	62,35%	77,65%	68,23%	78,82%	85,88%
Intelligence	-	69,00%	-	60,00%	34,00%
Ethics	49,60%	84,85%	-	86,40%	80,83%
Sociability	52%	65,33%	-	61,33%	33,33%

Figures 1 and 2 illustrate the descriptive outcomes of the exploratory application. Figure 2 compares normalized scores across participants (columns B–E) and the author (column F), allowing for the identification of potential deviations grounded in each user's ontology of the evaluated platform. Results show relatively stable patterns in Tourism and Usability, and greater variability in Navigability, although trends remain directionally consistent across participants. These visualizations support a comparative and interpretative analysis of participants' responses without implying statistical generalization.

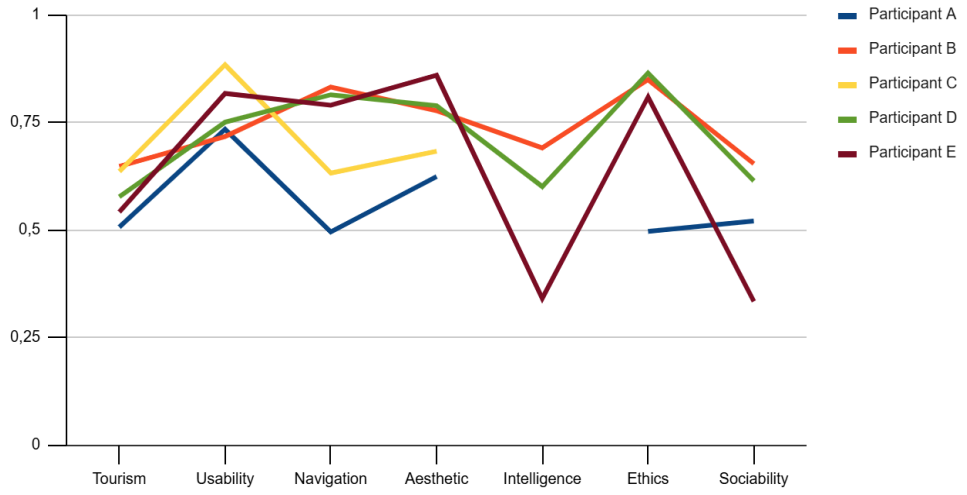

Figure 1. Comparison of normalized exploratory scores across participants.

Figure 2 presents the distribution of scores across the seven evaluation dimensions. The dimensions of Intelligence, Ethics, and Sociability exhibited the greatest challenges during questionnaire completion, suggesting higher levels of abstraction and interpretation variability compared to more established UX dimensions.

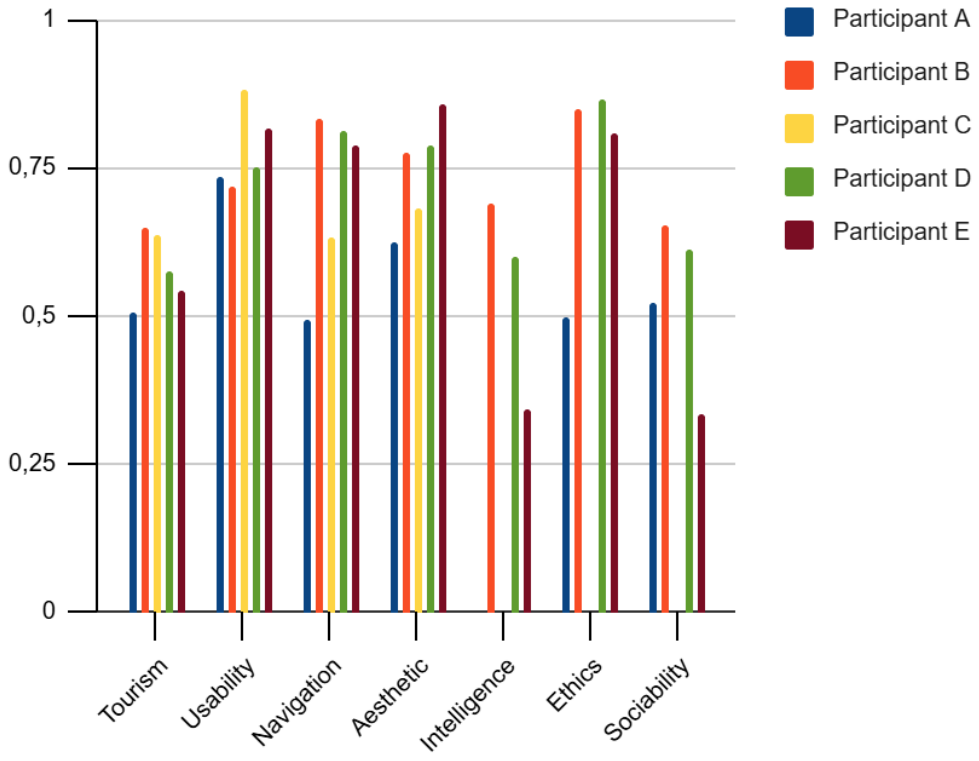

Figure 2. Distribution of exploratory scores across evaluation dimensions

6. DISCUSSION

The objective of this study was to propose and explore a user experience–based evaluation model for AI-enabled digital booking engines in tourism, integrating perspectives from UX research, SD, artificial intelligence, and ethical design. The exploratory application presented as a proof of concept, together with the subsequent expert review of the evaluation instrument, provides a basis for discussing the conceptual robustness, methodological implications, and potential contribution of the proposed model.

6.1 Contribution to UX and digital tourism research

The discussion of the exploratory findings reinforces the relevance of adopting a multidimensional approach to UX evaluation in digital tourism platforms. As suggested in prior research, tourism-related user experience cannot be reduced to usability or efficiency alone; it involves emotional, cognitive, and contextual dimensions that shape user perceptions throughout the booking journey (Tussyadiah, 2014; Stankov & Gretzel, 2020).

By structuring UX evaluation around seven interrelated dimensions—Tourism, Usability, Navigability, Aesthetics, Intelligence, Ethics, and Sociability—the proposed model contributes to the literature by offering an integrative framework that captures both instrumental and non-instrumental aspects of interaction. The exploratory application suggests that traditional UX dimensions are more readily interpretable by users, whereas AI- and ethics-related dimensions introduce greater complexity. This observation aligns with current discussions on the challenges users face in interpreting the behaviors of intelligent systems and the ethical implications of digital services (European Commission, 2019).

6.2 Service design perspective

From an SD perspective, the model supports interpreting booking engines as service ecosystems rather than isolated digital interfaces. The relative stability observed in dimensions such as Tourism, Usability, and Navigability indicates that these aspects are already embedded in mainstream design practices for booking platforms. In contrast, greater variability in Intelligence and Sociability highlights areas where service processes, interaction logic, and communication strategies may not yet be fully aligned with user expectations.

This reinforces arguments in the SD literature that emphasize the importance of systemic and process-oriented evaluation tools capable of identifying deeper design and orchestration issues beyond surface-level usability (Shostack, 1982; Viladàs, 2010). In this regard, the proposed model offers a structured mechanism for bridging UX assessment with SD analysis.

6.3 AI, ethics, and user interpretation

One of the most salient discussion points concerns the interpretative challenges posed by AI and its ethical dimensions. Difficulties encountered by participants during questionnaire completion, as well as greater variability in these dimensions, suggest that these constructs remain less tangible to users than more established UX criteria.

Rather than representing limitations of the model itself, these challenges highlight the necessity of explicitly addressing AI transparency, explainability, and ethical communication within both

digital services and their evaluation instruments. This finding is consistent with frameworks for trustworthy AI, which emphasize that user trust depends not only on technical robustness but also on users' understanding of how intelligent systems operate and affect their choices (European Commission, 2019).

6.4 Methodological implications

Beyond the exploratory application conducted with end users, the evaluation model and its associated questionnaire were subsequently subjected to a qualitative expert review aimed at supporting instrument refinement rather than empirical validation.

The exploratory application involved five participants with heterogeneous profiles: two university students (Participants A and B), one university professor (Participant C), and two professional travel agents (Participant D and E). This diversity was useful for identifying practical issues related to comprehension, completion effort, and interpretation variability across dimensions, particularly in those that require higher levels of abstraction (e.g., Intelligence and Ethics).

The participants provided more than 20 qualitative recommendations to improve the clarity, structure, and usability of the instrument. Their feedback emphasized the need for clearer guidance for respondents (e.g., a brief user manual), especially for AI- and ethics-related items, and highlighted the importance of maintaining neutral and unambiguous wording across all questions, particularly given the intentional inclusion of both positively and negatively phrased items. This review reinforces the interpretation of the proposed evaluation model as a dynamic and evolving framework, explicitly designed to support iterative refinement. Rather than serving as a mechanism for formal validation, this qualitative review complements the exploratory user application by identifying conceptual ambiguities, cognitive demands, and practical challenges associated with the current version of the instrument. It is important to note that the number of experts involved represents a minimal yet appropriate threshold for qualitative methodological feedback at this exploratory stage. While a broader and more diverse expert panel would be required for formal reliability testing and validation studies, the present expert review fulfills its intended role within the research design: to inform the progressive development and maturation of the evaluation instrument prior to large-scale empirical assessment.

6.5 Practical implications for platform design and evaluation

From a practical standpoint, the proposed evaluation model offers designers, developers, and service managers a structured lens through which to assess and reflect on digital booking

environments. By explicitly incorporating AI and ethics as evaluation dimensions, the model encourages stakeholders to consider how intelligent features and data-driven processes are perceived by users, rather than focusing exclusively on functional performance.

The feedback obtained during both the exploratory application and expert review suggests that such an evaluation approach can support more informed design decisions, particularly in relation to transparency, trust, and long-term user engagement, critical factors in highly competitive digital tourism markets.

6.6 Limitations and further work

Several limitations of the present study must be acknowledged. First, the exploratory validation used a small, heterogeneous sample of users, which precludes any statistical inference or generalization. Second, the expert review, while valuable, was conducted with a limited number of specialists, primarily from UX-related domains. Additionally, the questionnaire is an initial, intentionally comprehensive version of the evaluation instrument. Its length and complexity may affect user engagement and completion rates, particularly for dimensions related to AI and ethics that require greater abstraction and interpretation. These limitations are consistent with the exploratory and proof-of-concept nature of the study and have been explicitly considered in the interpretation of results.

Future research should focus on iterative refinement and empirical validation of the proposed evaluation model. Based on user and expert feedback, several directions for future work have been identified, including developing a user manual that provides clear explanations of the questionnaire's purpose, structure, and estimated completion time. Besides, it is needed to simplify, modularize, or reduce questionnaire items to improve usability without compromising conceptual coverage. Also, the model needs to be extended to support multilingual versions and adapt to different tourism contexts, such as excursions or alternative tourism services. And we will continue exploring additional features, including mechanisms for user comments, enhanced sociability assessment, and integration with recommender system evaluation. Large-scale empirical studies involving diverse user populations and multiple booking platforms, enabling psychometric validation and comparative analysis.

These future directions reinforce the positioning of the proposed model as a scalable, adaptable, and evolving evaluation framework, capable of responding to technological advances and changing user expectations in digital tourism services.

7. CONCLUSIONS

This study has proposed a user experience–based evaluation model for AI-enabled digital booking engines in tourism, developed from a multidisciplinary perspective that integrates User Experience, SD, AI, and ethical design principles. The model has been operationalized through a structured questionnaire and examined within the context of an exploratory proof-of-concept study, explicitly positioned as a conceptual and methodological contribution rather than a statistically generalizable empirical investigation.

The research was motivated by the lack of integrative evaluation frameworks capable of assessing digital booking platforms beyond traditional usability or adoption metrics. Existing approaches tend to address UX, SD, AI, or ethics in isolation, while contemporary digital tourism services increasingly require holistic assessment models that capture both instrumental and non-instrumental dimensions of user experience. The proposed model responds to this gap by articulating seven interrelated evaluation dimensions (Tourism, Usability, Navigability, Aesthetics, Intelligence, Ethics, and Sociability) within a unified framework.

From a methodological standpoint, the study demonstrates that the proposed evaluation model is applicable and conceptually coherent when applied to a real digital booking environment. The exploratory application with heterogeneous participants and the subsequent qualitative expert review provided valuable insights into the strengths, limitations, and refinement needs of the instrument. Importantly, variability in responses and completion challenges, particularly in AI, and ethics-related dimensions were interpreted not as shortcomings, but as indicators of the complexity inherent in evaluating intelligent and ethically sensitive digital services.

The findings reinforce the interpretation of the evaluation model as a dynamic and evolving framework, intentionally designed to support iterative refinement rather than to function as a static measurement tool. The questionnaire constitutes the initial operational instrument of the model, while leaving open the possibility of incorporating additional evaluation tools and methods in future research.

The contribution of this work lies primarily in its conceptual and methodological integration. By combining established UX evaluation approaches, SD principles, ethical guidelines for trustworthy AI, and domain-specific tourism considerations, the study offers a structured basis for evaluating and improving AI-enabled digital services from a human-centered perspective. This contribution

is relevant not only for academic research, but also for practitioners involved in the design, development, and management of digital booking platforms.

The results presented in this paper are explicitly indicative and exploratory, and should not be interpreted as statistically generalizable findings. Future research should focus on large-scale empirical validation, psychometric testing of the instrument, cross-platform comparisons, and adaptation of the model to other digital tourism contexts and platforms, including mobile applications and emerging generative AI–based services.

The proposed evaluation model represents a foundational step toward more comprehensive and responsible assessment of AI-enabled digital booking environments. Rather than offering a final solution, it provides a flexible and scalable framework intended to evolve alongside technological advances, changing user expectations, and the ongoing transformation of digital tourism services.

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