IMMERSIVE REALITY SYSTEMS AS STRATEGIC INSTRUMENTS TO IMPROVE CONSUMER KNOWLEDGE AND GASTRONOMIC MANAGEMENT

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Abstract

Purpose – This study examines consumers' perceptions concerning the adoption of digital technologies - specifically Augmented Reality (AR) and Virtual Reality (VR) - into exclusive gastronomic experiences. The research aims to elucidate the cognitive and affective processes that shape consumer acceptance of these technologies in luxury dining contexts, with particular attention to how individuals interpret technological value and emotional engagement when interacting with immersive tools during food experiences.

Methodology – A quantitative research design was adopted to analyze consumers' attitudinal dispositions and behavioral intentions in fine-dining environments. Data were gathered through a structured questionnaire targeting Portuguese citizens and residents who patronize luxury restaurants. The final dataset comprised 150 valid responses, which served as the empirical foundation for the subsequent statistical analyses.

Findings –The results indicate that consumers' acceptance of AR/VR technologies in fine-dining settings is primarily driven by perceived usefulness and hedonic value. Hedonic Motivation and Perceived Usefulness emerged as predictors of favorable attitudes, whereas Perceived Ease of Use exerted an indirect effect. Perceived Innovativeness exhibited no significant influence on attitude formation.

Originality of the research – This study provides original insights into Portuguese consumers' perceptions of immersive technologies in high-end gastronomy and identifies technological strategies of enhancing trust, transparency, and experiential value.

Keywords Augmented reality, consumer behavior, fine dining, traceability, and virtual reality.

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INTRODUCTION

In recent years, a series of high-profile food safety incidents has significantly undermined consumer confidence across Europe (Food Fraud: About 27 000 Tonnes off the Shelves, 2022). Limited access to clear and engaging information often erodes consumer trust - particularly in fine-dining contexts, where expectations of quality, authenticity, and service excellence are elevated. The core challenge lies in conveying complex traceability data in a manner that is both comprehensible and compelling.

Traditional communication channels - such as labels, menus, or websites - frequently fall short of meeting these expectations. Food safety scandals have intensified public demand for more trustworthy, intelligible, and verifiable food supply chains. Hommels et al. (2025) demonstrate that food safety risks in Europe stem from a constellation of 3 - 5 sub-drivers - social, technological, economic, environmental, and political. The interplay among these drivers underscores the need for comprehensive regulatory frameworks capable of safeguarding food integrity throughout the supply chain. Such frameworks already exist; for instance, in Portugal, the Economic and Food Safety Authority (ASAE) serves as the national regulatory body responsible for food safety oversight and economic surveillance. However, institutional regulation alone does not guarantee consumer trust, nor does it ensure effective communication regarding the provenance and journey of food products.

Against this backdrop, the present research seeks to address the following central question: which core factors shape consumers' acceptance and behavioural intentions regarding the adoption of Augmented Reality (AR) and/or Virtual Reality (VR) as advanced food-communication technologies, traceability and transparency in high-end and fine-dining restaurant environments?

The overarching objective of this study is to examine how consumers perceive the use of immersive technologies (AR/VR) as instruments to get more food traceability and transparency information, and to determine how these perceptions influence their intention to engage with such technologies during the dining experience. To achieve this aim, the research proposes to: i) Characterize consumer perceptions regarding Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Hedonic Motivation (HM), and Perceived Innovativeness (PI) of AR/VR as tools for improve communicating traceability and transparency information, and to examine behavioural intentions by analysing consumers' attitudes toward these technologies (ATT) and their intention to use them (ITU).

The dining sector constitutes a substantial component of the global economy. Full-service restaurants - where staff oversee the entire guest experience - represent a major segment of this industry, with market projections indicating growth from USD 1.65 trillion in 2025 to USD 1.97 trillion by 2032, at a CAGR of 2.6% (Patil, 2025). The fine-dining segment - characterized by formal service and gastronomic sophistication - was valued at USD 166.86 billion in 2024 and is expected to reach USD 243.17 billion by 2030, with a CAGR of 6.54% (TechSci Research, 2025). The food and grocery e-commerce sector expanded by 22.8% globally in 2024, surpassing USD 680 million in value. In Europe, however, this segment remains comparatively smaller,

representing roughly one-third of the U.S. market and one-fifth of the Asian market (Ho et al., 2022). Globally, approximately 78% of consumers dine out at least once per month, while 66% prefer delivery services (Innova Market Insights, 2025). European consumers, however, exhibit more moderate dining-out habits, with only 26% eating out weekly (Innova Market Insights, 2024). In Portugal, the pattern diverges: in 2023, 59% of Portuguese consumers reported dining out at least once per week, 10% did so four to five times weekly, and 3% reported eating out daily (Beatriz Luz, 2025). Because these figures do not specifically reflect fine-dining behaviour, this study restricts participation to individuals who visit fine-dining restaurants at least once per month. The food service sector remains dynamic, driven by consumer demand for convenience, personalization, and memorable experiences. Consequently, technological adoption has accelerated, particularly in areas such as: i) digital integration, ii) menu innovation, and iii) experiential dining. Despite these advancements, communication of food traceability remains insufficiently engaging to meet evolving consumer expectations. AR and VR therefore emerge as promising tools capable of delivering interactive, immersive, and emotionally resonant experiences that strengthen transparency and foster trust in fine-dining settings.

Within this research, it is posited that consumer adoption of AR/VR technologies is shaped by determinants that extend beyond functional or utilitarian considerations. Accordingly, the questionnaire employed in this study expands the traditional Technology Acceptance Model (TAM) by integrating hedonic constructs - namely Perceived Innovativeness and Hedonic Motivation - as supported by prior scholarship (Batat, 2021; Vieira et al., 2022). Although the conceptual model has previously been validated in an Indonesian context, where all proposed hypotheses were supported (Karimun et al., 2023), a critical gap remains in the literature. Specifically, despite the recognized relevance of traceability and transparency as key informational attributes, recent studies have not examined how AR/VR technologies may influence consumer trust, perceptions of traceability, or access to transparent food-system information. This gap motivated the present study, which employs a questionnaire cantered on these informational dimensions to explore consumers' willingness - or reluctance - to engage with AR/VR tools as a means of accessing value-chain information in high-end dining experiences.

This paper is structured into seven sections: i) introduction, ii) literature review, iii) methodology, iv) results, v) Conclusions. The anticipated contribution of this study is to identify the principal determinants influencing consumers' behavioural intentions toward AR/VR in a high-dinning gastronomy context. The findings are expected to clarify the consumer´s motivations as well as to offer valuable insights for high-end restaurants and to support strategies aimed at enhancing transparency, traceability and reinforcing consumer trust.

The findings substantiate that the successful implementation of AR/VR technologies in dining contexts is contingent upon consumers perceiving these systems as both useful and intrinsically enjoyable. Conversely, consumer innovativeness did not emerge as a significant antecedent of attitude formation, and perceived ease of use functioned solely as an indirect determinant - exerting influence only through its effect on perceived usefulness.

1. LITERATURE REVIEW

1.1 Food Traceability

Food traceability, as defined by Kabir et al. (2023) and by European Commission Regulation 178/2002, refers to the capacity to monitor and reconstruct the trajectory of food, feed, animals, or ingredients across all stages of the supply chain. In essence, it ensures the systematic tracking of products from "farm to fork," enabling compliance with regulatory, safety, and quality standards (Aung & Chang, 2014).

Traceability systems provide detailed information on product origin, composition, and processing history (Regattieri et al., 2007), thereby safeguarding consumer health. This concept is central to the present study, which examines the operational mechanisms of traceability, the technologies supporting it, consumer perceptions of these technologies, and innovative approaches to communicating traceability information.

1.2 Food Transparency

Several studies suggest using a digital tool to simulate agricultural processes from the field to the consumer, helping to estimate various indicators like economic, logistical, environmental, safety, and nutritional aspects of food orders (Guidani et al., 2024; Zarbà et al., 2024).

Transparency within supply chains functions as a critical mechanism for realizing the multifaceted advantages associated with enhanced information disclosure. These advantages encompass strengthened accountability across operational processes, the establishment of verifiable supply-chain clarity, the reinforcement of consumer trust, the effective deployment of corporate governance instruments, and improved access to data concerning the environmental consequences of food production and processing (Hobbs, 2004; Wadhwa et al., 2010; Egels-Zandén & Hansson, 2016). As supply chains expand in scale, complexity, and decentralization, the demand for transparency among firms and stakeholders correspondingly intensifies.

Hofstede (2003) defined the transparency of a network chain as the extent to which all stakeholders have a shared understanding and access to product or service-related information without loss, noise, delays, or distortions.

Considering a Delphi research about transparency in the agri-food sector - from farmers to consumer, the experts reached a high level of consensus (Coefficient of Variation - CV=11.4%), regarding the possibility to achieve until 2027, an agri-food stakeholders' agreement to have an adopted transparency standard. They estimated that achieving transparency in agri-food systems requires companies in this sector to adopt co-creation marketing as a foundational strategy to promote transparent production, logistics, and marketing practices (Dias & Mendivil, 2025).

1.3 Consumer Trust

In academic literature, trust is often conceptualized as a cognitive substitute for complete knowledge, shaping consumer evaluations of benefits and risks (Harrison & Liem, 2025). In the food domain, trust is influenced by perceptions of safety, quality, and provenance. Given the increasing complexity of global supply chains, consumer trust has become fragile (Reitano et al., 2024). To address these concerns, the food and restaurant sectors have invested in technologies that strengthen traceability and preservation (Tadesse et al., 2025).

Empirical evidence shows that consumer expectations align with a willingness to pay for traceability. For example, Tran et al. (2024) found that consumers in China and the United States are willing to pay an average premium of 32% for traceable products. Kabir et al. (2023) reported similar findings in Bangladesh, with premiums of 19.5% and 19.7% for brinjal and tomatoes. These studies confirm that consumers value traceability when transparency and professional handling are assured. This reinforces the need for technologies capable of communicating traceability information in clear, engaging, and trustworthy ways.

1.4 Technologies Used in Traceability

As global supply chains expand, ensuring effective communication of traceability information and compliance with standards such as ISO 22000:2005 (Newslow, 2014) requires increasingly sophisticated technological solutions. This section outlines the evolution from conventional identification tools to advanced data-driven and interactive systems.

1.4.1 Conventional Identification Methods

QR codes, originally developed by DENSO WAVE engineers, have become ubiquitous across industries, and are widely used in food packaging (Li et al., 2024). Their two-dimensional structure enables rapid scanning and efficient communication of basic traceability data (Qian et al., 2021).

Radio-Frequency Identification (RFID) represents another foundational technology, offering non-contact identification, greater storage capacity, and bidirectional communication (Zhang et al., 2025). RFID tags transmit product information to a central system (Kuswandi, 2017), making them valuable for supply chain management, though they remain primarily business-facing rather than consumer-oriented.

1.4.2 Advanced Data Management Technologies

To overcome the limitations of conventional tools, new technologies have emerged. Blockchain is widely recognized as transformative for supply chain transparency and accountability (Singh & Kumar, 2024), though challenges persist regarding scalability, interoperability, and implementation costs (Yele & Litoriya, 2024).

The Internet of Things (IoT) further enhances traceability by enabling real-time monitoring through sensor-equipped devices (Zrelli & Rejeb, 2024). These systems ensure continuous quality control but remain highly technical, limiting their communicative value for consumers.

1.5 Augmented Reality (AR) and Virtual Reality (VR) in the Food Industry

AR overlays digital elements onto the physical environment, enhancing real-world perception through interactive virtual content (Söderström et al., 2024). It is increasingly used in marketing, tourism, education, and cultural applications (Oleksy et al., 2024). AR has been adopted in hospitality to enrich consumer experiences. Examples include Domino's AR pizza visualization (Jagtap et al., 2021) and high-end restaurants such as Narisawa and The Alchemist, which integrate AR and spatial projections to elevate the dining experience (Velasco et al., 2025). These cases demonstrate consumer readiness for technologically enhanced gastronomy.

Regarding the Virtual Reality (VR) concept used in the Food Industry could be defined as three-dimensional environments, typically via Head-Mounted Displays (HMDs) (Orús et al., 2021). Although VR adoption in food services remains limited,

research shows its value in product development, sensory testing, and marketing (Spence, 2023). VR is also explored for staff training (Clark et al., 2018). However, its application for communicating traceability in fine dining remains underexplored, positioning this study as a contribution to an emerging field.

Growing demand for transparency has intensified interest in immersive tools for communicating traceability. Traditional methods (e.g., QR codes) often overwhelm consumers with text, while blockchain and IoT remain backend technologies.
AR/VR can translate complex supply chain information into interactive, narrative-driven experiences that strengthen trust and engagement. These technologies can be deployed through portable devices or wearable systems, with HMDs producing stronger perceptual effects (Orús et al., 2021). This research therefore focuses on HMD-based experiences.

AR/VR adoption has expanded across hospitality and tourism (Lim, 2025). In 2025, the global AR/VR market is projected to reach USD 46.6 billion, with Portugal contributing USD 87.5 million (Statista Market Insights, 2025).
Key advantages of AR/VR for traceability communication include: i) higher engagement through interactive content (Velasco et al., 2025), ii) improved comprehension via visual storytelling (Negi, 2024), iii) strengthened trust through transparent narratives and iv) enhanced experiential value, particularly relevant in fine dining (Ju et al., 2025)
Concerning the challenges of using this technologies, high development costs remain a major barrier, though metaverse-based prototyping may reduce expenses (Singh & Kumar, 2024). Effective implementation also requires robust data to ensure accurate storytelling. AR/VR can shift traceability from a passive information check to an integrated experiential component of the meal. Immersive "story-living" approaches - such as virtual farm visits during dish preparation - can deepen emotional engagement and reinforce brand affinity.

1.6. Technology Acceptance Model (TAM)

TAM explains technology adoption through perceived usefulness and ease of use, (Davis, 1989). Although originally designed for workplace systems, its limitations in experiential contexts have led to numerous extensions (Wei et al., 2025).
Given the experiential nature of AR/VR, this study incorporates hedonic constructs - Perceived Innovativeness and Hedonic Motivation - following prior research (Batat, 2021; Vieira et al., 2022; Karimun et al., 2023).

1.6.1. Utilitarian Factors

Perceived Usefulness (PU): Central to TAM and essential for understanding traceability information (Ikhsan et al., 2025).
Perceived Ease of Use (PEOU): Technologies perceived as simple are more likely to be adopted (Sharma et al., 2025). Device type significantly shapes these perceptions (Orús et al., 2021).

1.6.2. Hedonic Factors

Perceived Innovativeness (PI): Influences early adoption and positive attitudes toward novel technologies (Bär et al., 2025; Mathew et al., 2021). Hedonic Motivation (HM): Reflects enjoyment and emotional value, crucial in fine dining (Perez et al., 2023).

1.7. Consumer Attitude (ATT) and Intention to Use (ITU)

Successful implementation of AR/VR for traceability depends on consumer acceptance. Attitudes, shaped by PU, PEOU, PI, and HM, strongly predict behavioral intention (Du et al., 2025). This study therefore examines how these constructs jointly influence consumers' willingness to use AR/VR as traceability tools in fine-dining contexts.

2. METHODOLOGY

A quantitative research design was employed because it provides the methodological structure necessary to evaluate individuals' attitudes toward AR/VR and their intention to use these technologies in fine-dining scenarios. Quantitative methodologies are characterized by deductive reasoning, objective measurement, structured procedures, and the systematic application of numerical instruments. These methodological attributes enable the examination of theoretically derived hypotheses through statistical techniques and facilitate the identification of significant patterns within the target population. As emphasized by Lim (2025), "quantitative methods provide empirical rigor to derive actionable insights from data and allow to quantify the numeric collected data." The choice of a quantitative paradigm is particularly appropriate for studies grounded in models such as the Technology Acceptance Model (TAM), originally formulated by Davis (1989). TAM operates on the premise that technology adoption is shaped by key latent constructs - namely Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) - which must be operationalized and empirically tested using structured measurement scales. Extending TAM to include additional dimensions relevant to experiential and hedonic contexts, such as Perceived Innovativeness (PI) and Hedonic Motivation (HM),

further reinforces the necessity of quantitative procedures. These extensions draw upon the conceptual contributions of Agarwal and Prasad (1998), Mathew et al. (2021), Perez et al. (2023), Akdim et al. (2022), and Karimun et al. (2023), who argue that consumer responses to novel and immersive technologies are significantly shaped by emotional, sensory, and experiential drivers that traditional TAM constructs alone cannot fully capture.

The study targeted a highly specific consumer segment: Portuguese citizens or residents who dine at highend or finedining restaurants at least once per month. This population is inherently niche due to the exclusivity and elevated price range associated with finedining establishments. To ensure that only eligible participants were included, the survey incorporated strict inclusion criteria: i) respondents had to be Portuguese citizens or residents, ii) aged 18 or older, and iii) frequent finedining restaurants at least once per month. Those who did not meet these criteria were automatically excluded from the dataset.

The final sample size - 150 respondents, is justified by literature on quantitative research and technology adoption models, which suggests that sample sizes between 150 and 200 participants are sufficient to ensure statistical power and reliability of measurement instruments (Buckley, 2024).

The data collection instrument employed in this study was a structured, self-online administered questionnaire. The survey was utilized to gather empirical data for the purpose of characterizing the behavioural patterns of the sample and evaluating the relationships among the variables under investigation. The survey was administered via Google Forms from 19 June to 5 January. Respondents were recruited online through multiple channels, including LinkedIn posts, a TikTok video with a 24-hour €2 promotion, repeated Instagram stories and WhatsApp status shares, and distribution through industry professionals via the advisor's network.

Three pilot tests were conducted to assess clarity, flow, and completion time. Subsequently, a willingness-to-pay item was added to know about the add payment level, and several variables were revised for clarity.

It was designed on five main sections, each one to capture different dimensions of the research model.

The first section introduced the research context and presented a visual scenario depicting the use of HeadMounted Displays (HMDs) in a dining environment. The second section collected demographic information, including gender, age, education level, dining frequency, familiarity with AR and VR technologies, and district of residence. The third, fourth, and fifth sections contained the measurement items for the study's constructs. These included: i) utilitarian factors: PEOU (4 items) and PU (4 items), ii) hedonic factors: PI (4 items) and HM (4 items), iii) behavioural factors: ATT (4 items) and ITU (4 items) and iv) willingness to pay (WTP): a single item with five price options. The WTP scale was informed by market research on VR experiences in Portugal, including museums, gaming hubs, and immersive dining venues (News Museum, 2024; Pereira, 2024; The Park, 2025; Zero Latency VR, 2025). All construct items were adapted from established literature and validated through factor analysis. Table 1 in the document provides the theoretical foundations for each construct.

Table 1: **Theoretical fundamentals**

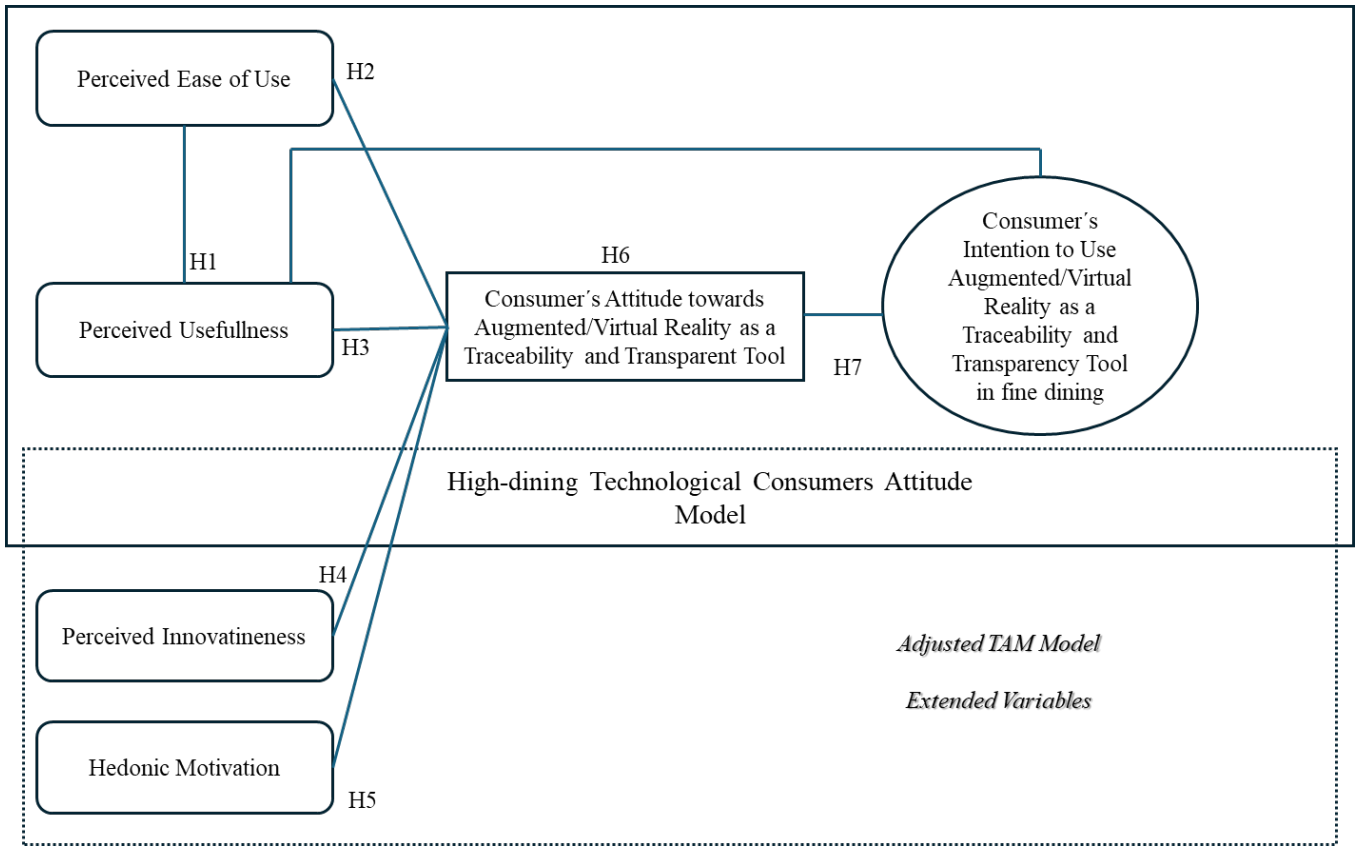
Construct	Declarations	Literature
Perceived Ease of Use	PEOU1 - I would find it easy to navigate the AR/VR system for food traceability and transparency in a restaurant. PEOU2 - Using AR/VR to access food traceability and transparency information in a restaurant would be easy for me. PEOU3 - Learning to use AR/VR for food traceability and transparency in a restaurant would be a simple process. PEOU4 - Overall, I would consider AR/VR for food traceability and transparency in a restaurant to be user-friendly.	(Davis, 1989); (Akdim et al., 2022); (Perez et al., 2023)
Perceived Usefulness	PU1 - Using AR/VR to access food traceability and transparency information in a restaurant would be useful. PU2 - AR/VR would provide me with valuable information about the origin and quality of the food in a restaurant. PU3 - Using AR/VR would enhance my understanding of food traceability and transparency in a restaurant. PU4 - AR/VR would improve my overall dining experience in a restaurant.	(Davis, 1989); (Akdim et al., 2022); (Casallas-Hernández et al., 2025);

Construct	Declarations	Literature
Perceived Innovativeness	PI1 - I think using AR/VR to access food traceability and transparency information in a restaurant is a cutting-edge idea. PI2 - Using AR/VR for food traceability and transparency in a restaurant would make me feel innovative. PI3 - I would perceive a restaurant that uses AR/VR for food traceability and transparency as being innovative. PI4 - I would consider myself an early adopter if I used AR/VR for food traceability and transparency in a restaurant.	(Agarwal & Prasad, 1998); (Mathew et al., 2021); (Karimun et al., 2023)
Hedonic Motivation	HM1 - Using AR/VR to access food traceability transparency information in a restaurant would be enjoyable. HM2 - I would find using AR/VR for food traceability and transparency in a restaurant to be a fun experience. HM3 - Using AR/VR in a restaurant would be exciting. HM4 - I would find using AR/VR for food traceability and transparency in a restaurant to be entertaining.	(Davis, 1989); (Akdim et al., 2022)
Attitude towards technologies (ATT)	ATT1 - Using AR/VR to access food traceability and transparency information in a restaurant is a good idea. ATT2 - My opinion of using AR/VR for food traceability and transparency in a restaurant is favourable. ATT3 - Overall, I like the idea of using AR/VR for food traceability and transparency in a restaurant. ATT4 - Using AR/VR for food traceability and transparency in a restaurant is desirable.	(Davis, 1989); (Akdim et al., 2022)
Intention of use	ITU1 - If a restaurant offers AR/VR to access food traceability and transparency information I will intend to use it. ITU2 - I will use AR/VR for food traceability and transparency in a restaurant if it is available. ITU3 - I am likely to use AR/VR to access food traceability and transparency information in a restaurant. ITU4 - I would be willing to use AR/VR to get traceability and transparency information.	(Davis, 1989); (Akdim et al., 2022)
Willingness to pay	How much would you be willing to pay in a restaurant for this service?	(NewsMuseum, 2024); (Zero Latency VR, 2025); (The Park, 2025); (Pereira, 2024)
Dining frequency	How often do you dine at high-end restaurants?	N/A
Technologies familiarity	Are you familiar with Augmented Reality (AR) technology? Are you familiar with Virtual Reality (VR) technology?	N/A
Socio demographics	Gender? Age? Level of education? What district do you live in?	N/A

Source: Own elaboration, 2026.

Drawing on the literature review, a conceptual model (figure 1) was designed, supported by an existing model Technology Acceptance Model (TAM), mentioned before. The main purpose in defining this conceptual model was to study the different relations between constructs and fill the literature gap. It maintains TAM's key pillars and adds to them hedonic factors to fully represent the dining environment.

Figure 1: **Conceptual model**



Source: Own elaboration, 2026.

Regarding the Statistical tests used, several statistical analyses were conducted: i) descriptive analysis to summarize and present the data; ii) correlation analysis to examine the strength and direction of relationships between variables; iii) Cronbach's Alpha, KMO, and Bartlett's tests to assess the reliability, validity of the constructs, find the final factors; and iv) linear regression to test the hypotheses.

3. RESULTS

3.1. descriptive analysis

Before conducting more advanced analyses an initial overview of the data was done providing an overview of the collected information, beginning with a frequency distribution of sociodemographic variables to characterize the sample. Respondents were characterised on gender, age, education level, AR/VR familiarity, and district of residence.

The initial dataset comprised 161 participants; eight were excluded for not meeting pre-selection criteria mentioned before, and three additional cases were removed due to reporting "never" dining at high-end restaurants. The final sample size was N = 150. Table 2 presents the sociodemographic profile of the study population.

Table 2: **Sociodemographic data**

Variables	Coding	Frequency	Valid Percentage (%)
Gender	**Female**	102	**68**
	Male	44	29.3
	Prefer not to say	4	2.7
Age	18 – 24	39	26
	25 – 34	**77**	**51.3**
	35 – 44	17	11.3
	45 – 54	10	6.7
	55 – 64	6.7	4.7
	> 65	0	0
Level of Education	High School	26	17.3
	Bachelor's Degree	**74**	**49.3**
	Master's Degree	46	30.7
	Doctorate	4	2.7
Current residency	Aveiro	3	2
	Beja	1	0.7
	Braga	5	3.3
	Castelo Branco	2	1.3
	Coimbra	6	4
	Evora	3	2
	Lisboa	**71**	**47.3**
	Porto	**50**	**33.3**
	Santarém	1	0.7
	Setúbal	6	4
	Vila Real	2	1.3

Source: Own elaboration, 2026.

As showed in the table 2, the sample is predominantly female (68%), young consumers 51.3% from 25-34 age, and medium/ High educated 80% (bachelor's and master's degree), with most respondents residing in Lisbon and Porto (80.6%).
Regarding the sample profile in terms of dining frequency, attitudes toward AR/VR technologies, and willingness to pay for their integration into restaurant experiences, Table 3 summarizes the key findings.

Table 3: **Dinning frequency, Technological profile and Willingness to pay**

Variable		Coding	Frequency	Valid Percentage (%)
Dining frequency		Never	0	0
		Rarely	31	20.7
		Occasionally	**79**	**52.7**
		Frequently	**30**	**20**
		Very Frequently	10	6.7
Technological Profile	Augmented reality familiarity	**Yes**	**102**	**68**
		No	48	32
	Virtual reality familiarity	**Yes**	**122**	**81.3**
		No	28	18.7
WTP (Willingness to pay)		**7€**	**64**	**42.7**
		14€	25	16.7
		21€	18	12
		28€	22	14.7
		35€ or more	14	14

Source: Own elaboration, 2026.

The sample exhibits predominantly moderate dining frequency, with most respondents dining out occasionally (52.7%). It also demonstrates a high level of familiarity with immersive technologies, particularly VR (81.3%), followed by AR (68%). Regarding willingness to pay, respondents show a strong preference for lower price points, with the €7 option being the most frequently selected (42.7%), although a notable proportion is willing to pay higher amounts (14€ - 16.7%; 28€ - 14.7%). Regarding the central (Mean and Mode) and deviation (Standard Deviation) opinions from the respondents about the constructs, the following table shows the principals results obtained.

Table 4: **Constructs analysis**

Variables	Mean	Mode	SD*
PEOU1 - I would find it easy to navigate the AR/VR system for food traceability and transparency in a restaurant.	3.59	3	1.100
PEOU2 - Using AR/VR to access food traceability and transparency information in a restaurant would be easy for me.	**3.61**	**3[a]**	**1.086**
PEOU3 - Learning to use AR/VR for food traceability and transparency in a restaurant would be a simple process.	3.60	4	1.123
PEOU4 - Overall, I would consider AR/VR for food traceability and transparency in a restaurant to be user-friendly	3.52	3	1.073
PU1 - Using AR/VR to access food traceability and transparency information in a restaurant would be useful.	3.72	4	1.017
PU2 - AR/VR would provide me with valuable information about the origin and quality of the food in a restaurant.	**3.97**	**5**	**1.010**
PU3 - Using AR/VR would enhance my understanding of food traceability and transparency in a restaurant.	3.81	4	0.999
PU4 - AR/VR would improve my overall dining experience in a restaurant.	3.43	4	1.083
PI1 - I think using AR/VR to access food traceability and transparency information in a restaurant is a cutting-edge idea.	**4.27**	**5**	**1.008**
PI2 - Using AR/VR for food traceability and transparency in a restaurant would make me feel innovative.	3.85	5	1.120
PI3 - I would perceive a restaurant that uses AR/VR for food traceability and transparency as being innovative.	**4.22**	**5**	**0.989**
PI4 - I would consider myself an early adopter if I used AR/VR for food traceability and transparency in a restaurant.	3.75	5	1.170
HM1 - Using AR/VR to access food traceability transparency information in a restaurant would be enjoyable.	3.70	4	1.079
HM2 - I would find using AR/VR for food traceability and transparency in a restaurant to be a fun experience.	**4.01**	**5**	**1.084**
HM3 - Using AR/VR in a restaurant would be exciting.	3.71	4	1.109
HM4 - I would find using AR/VR for food traceability and transparency in a restaurant to be entertaining.	**3.91**	**5**	**1.125**
ATT1 - Using AR/VR to access food traceability and transparency information in a restaurant is a good idea.	3.85	5	1.077
ATT2 - My opinion of using AR/VR for food traceability and transparency in a restaurant is favourable.	3.77	4	1.088
ATT3 - Overall, I like the idea of using AR/VR for food traceability and transparency in a restaurant.	**3.78**	**4**	**1.061**
ATT4 - Using AR/VR for food traceability and transparency in a restaurant is desirable.	3.44	3	1.065
ITU1 - If a restaurant offers AR/VR to access food traceability and transparency information I will intend to use it.	3.89	4	1.046
ITU2 - I will use AR/VR for food traceability and transparency in a restaurant if it is available.	3.88	4	1.074
ITU3 - I am likely to use AR/VR to access food traceability and transparency information in a restaurant.	3.79	4	1.137
ITU4 - I would be willing to use AR/VR to get traceability and transparency information.	**3.90**	**5**	**1.140**

Source: Own elaboration, 2026.
Note. [a] Multiple modes exist, the smallest value was shown. SD* - Standard deviation.

In the previous table, the data indicates that AR/VR in restaurants is perceived as highly innovative and useful, particularly for improving traceability and transparency. However, practical usability, experiential value, and adoption readiness remain less consistent, suggesting that wider acceptance may depend on improving user experience and perceived relevance.

3.2. Correlation analysis

Correlation analysis helped to identify the strength and direction of relationships between key variables, supported hypothesis testing and theoretical model, such as TAM. It also revealed patterns in user perceptions without implying causality and strengthened the overall validity and coherence of research findings.

Table 5: **Variable correlations**

Variables	WTP	Age	Level of Education	Dining Frequency
Age	-0.149			
Level of Education		0.338		
WTP			0.008	
WTP				.247
Sig.	0.068	<.001	0.925	.002

Source: Own elaboration, 2026.

There is only a significant predictor of WTP among the variables, which is dining frequency. The correlation results show that age is not significantly related to willingness to pay (WTP), indicating no meaningful influence. However, age is moderately and positively associated with education , suggesting that older respondents tend to have higher education levels. Education does not influence WTP , as no significant relationship is observed. In contrast, dining frequency is positively and significantly related to WTP , indicating that individuals who dine out more, frequently are more willing to pay.

Variables	AR familiarity		VR familiarity	
Coding	Yes	No	Yes	No
Female	59.8%	40.2%	77.5%	22.5%
Male	88.6%	11.4%	93.2%	6.8%
Prefer not to say	50%	50%	50%	50%
Chi-square	12.356[a]		7.668[a]	
Sig.	0.002		0.022	

Source: Own elaboration, 2026.

From the previous table the most important results are: i) significant association between gender and familiarity with AR and VR technologies, ii) for AR familiarity, males report higher familiarity (88.6%) compared to females (59.8%), with a significant difference ($\chi2$=12.356,p=0.002), iii) about VR familiarity, males again show higher familiarity (93.2%) than females (77.5%), also statistically significant ($\chi2$=7.668,p=0.022).
Overall, the findings indicate that gender significantly influences AR/VR familiarity, with males demonstrating higher familiarity levels.

To evaluate the internal consistency of the measurement scales, Cronbach's alpha coefficients were calculated for each construct. This coefficient ranges from 0 to 1, with values closer to 1 indicating higher reliability and stronger internal consistency (Mendes & Pereira, 2018). The results of this analysis are presented in Table 6.

Table 6: **Reliability Analysis**

Construct	Number of Items	Cronbach's Alpha	Strength
PEOU – Perceived Ease of Use	4	0.888	Very Good
PU – Perceived Usefulness	4	0.860	Very Good
PI – Perceived Innovativeness	4	0.840	Very Good
HM – Hedonic Motivation	4	0.891	Very Good
ATT – Depend Variable Attitude towards technologies	4	0.915	Excellent
ITU – Depend Variable *Intention to Use*	4	0.945	Excellent

Source: Own elaboration, 2026.

As shown in the above table all constructs in this study presented high levels of internal consistency, ranging from 0.840 (PI) to 0.945 (ITU). Remarkably, the dependent variables ATT and ITU demonstrated excellent results of reliability, proving a high robustness for explaining consumer behaviour regarding AR/VR in high-end dining settings.

Prior to testing the research model and its associated hypotheses, the multi-item measurement scales were subjected to validation procedures to confirm the underlying factor structure of the constructs. Factor analysis serves to reduce the complexity of multiple observed variables and enables researchers to assess the relationships among items through their respective factor loadings (Tavakol & Wetzel, 2020). The results of the factor loadings are presented in Table 8.

Table 7: **KMO and Bartlett's Test**

Factors	**Bartlett's tests – Sig.**	**KMO**	**Factor Analysis**
PEOU – Perceived Ease of Use	<.001	0.778	Average
PU – Perceived Usefulness	<.001	0.825	Good
PI – Perceived Innovativeness	<.001	0.784	Average
HM – Hedonic Motivation	<.001	0.828	Good
ATT – Attitude towards technologies	<.001	0.850	Good
ITU – *Intention to Use*	<.001	0.847	Good

Source: Own elaboration, 2026.

Table 8: **Factor Analysis**

Factors	**PEOU**	**PU**	**PI**	**HM**	**ATT**	**ITU**
PEOU1	0.784					
PEOU2 - Using AR/VR to access food traceability and transparency information in a restaurant would be easy for me.	**0.809**					
PEOU3	0.711					
PEOU4	0.710					
PU1		0.763				
PU2 - Using AR/VR would enhance my understanding of food traceability and transparency in a restaurant.		**0.771**				
PU3		0.688				
PU4		0.646				
PI1			0.740			
PI2			0.791			
PI3 - I would perceive a restaurant that uses AR/VR for food traceability and transparency as being innovative.			**0.796**			
PI4			0.476			
HM1				0.701		
HM2				0.789		
HM3				0.693		
HM4 - I would find using AR/VR for food traceability and transparency in a restaurant to be entertaining.				**0.842**		
ATT1					0.803	
ATT2					0.803	
ATT3 - Overall, I like the idea of using AR/VR for food traceability and transparency in a restaurant.					**0.806**	
ATT4					0.775	
ITU1 - If a restaurant offers AR/VR to access food traceability and transparency information I will intend to use it.						**0.884**
ITU2						0.859
ITU3						0.857
ITU4						0.863

Source: Own elaboration

Through the tables nr. 7 and 8, the results show that Bartlett's test is statistically significant across all constructs , confirming the suitability of the data for factor analysis. The KMO values range from 0.778 to 0.850, all exceeding the recommended threshold of 0.70, indicating acceptable to good sampling adequacy. Specifically, ITU, ATT, HM, and PU demonstrate good adequacy (KMO > 0.80), while PEOU and PI are classified as average (KMO > 0.70). Combined with previously reported high reliability levels, these results support the validity and robustness of the conceptual model for hypothesis testing.

The results indicate a strong and reliable measurement model, with Intention to Use (ITU) emerging as the most robust construct (loadings: 0.857–0.884), reflecting a strong behavioural predisposition toward AR/VR adoption. Attitude (ATT) also demonstrates high and consistent loadings (0.775–0.806), confirming its role as a key determinant of action-oriented intention, while Hedonic Motivation (HM) (0.693–0.842) underscores the central importance of enjoyment and experiential value.

In contrast, Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) exhibit moderate yet acceptable loadings, indicating secondary influence relative to affective factors. Perceived Innovativeness (PI) is the weakest construct, with a low-loading item (0.476) suggesting the need for refinement. Overall, the findings highlight the predominance of affective and experiential drivers over cognitive factors in explaining AR/VR adoption.

Linear regression is a widely used method in Technology Acceptance Model (TAM) studies (Panduwiyasa & Wibowo, 2025), as it enables the prediction of a dependent variable based on one or more independent variables (Anandhi & Nathiya, 2023). A simple linear regression is applied when there is a single independent variable, whereas a multiple linear regression is used when multiple predictors are involved. Both approaches were employed in this study to test the proposed hypotheses, as presented in the following tables.

Table 9: **Simple Linear Regression H1**

	R value	**R^2 value**	**Sig.**
H1 (PEOU → PU)	.672	.452	< .001

Source: Own elaboration

The regression analyses provide strong support for most of the proposed relationships within the model.
H1 is confirmed, as perceived ease of use (PEOU) has a significant positive effect on perceived usefulness (PU) , explaining 45.2% of its variance.

Table 10**: Multiple Linear Regression H2 to H5**

	Value	**Standardized coefficients β**	**Sig.**
H2 (PEOU → ATT)		.034	.520
H3 (PU → ATT)		.300	< .001
H4 (PI → ATT)		.040	.531
H5 (HM → ATT)		.596	< .001
R	.885		
R^2	.783		

Source: Own elaboration

In the multiple regression model (H2–H5), the overall explanatory power is high , indicating that 78.3% of the variance in attitude (ATT) is explained by the predictors. However, only PU and hedonic motivation (HM) significantly influence ATT, with HM emerging as the strongest predictor. In contrast, PEOU and perceived innovativeness (PI) are not significant, leading to the rejection of H2 and H4.

Table 11: **Simple Linear Regressions H6 and H7**

	R value	**R^2 value**	**Sig.**
H6 (PU → ITU)	.711	.506	< .001
H7 (ATT → ITU)	.845	.714	< .001

Source: Own elaboration

For H6 and H7, both relationships are strongly supported. PU significantly influences intention to use (ITU) , while ATT shows an even stronger effect , explaining 71.4% of the variance in ITU.

The findings confirm that usefulness and enjoyment are key drivers of attitude, while attitude is the strongest predictor of behavioural intention. Ease of use plays an indirect role, and innovativeness alone does not significantly influence acceptance. Taken collectively, the results illuminate a nuanced and multidimensional pattern of consumer acceptance. While fine dining

patrons expect technological solutions to exhibit innovation, intuitiveness, and aesthetic sophistication, their attitudes and behavioural intentions are shaped primarily by two overarching factors: the perceived usefulness of the technology in delivering credible traceability and transparency information and the hedonic value derived from engaging with immersive digital tools. In summary, the study demonstrates that successful implementation of AR/VR in fine dining settings requires a balanced alignment between technological sophistication, experiential value, and strategic price positioning. By meeting these expectations, immersive traceability tools can contribute meaningfully to the transformation of contemporary gastronomic experiences.

CONCLUSIONS

The present study offers a set of substantive and theoretically meaningful contributions to the growing body of research examining how advanced digital technologies - most notably Augmented Reality (AR) and Virtual Reality (VR) - may be strategically incorporated into finedining environments to foster enhanced transparency, traceability, and consumer engagement.

Through the analysis of the psychological, perceptual, and motivational antecedents that shape consumer acceptance, this research provides a comprehensive and empirically grounded understanding of the factors that highend gastronomic establishments must prioritize when implementing such innovative technological solutions. Collectively, the findings serve both as a conceptual advancement and as a practical managerial framework for hospitality professionals seeking to introduce AR/VRbased traceability tools in ways that optimize consumer receptivity, perceived value, and behavioral intention to use.

A central conclusion emerging from the empirical analysis is that AR/VR technologies, when applied to the domain of food traceability and gastronomic transparency, are perceived by consumers as simultaneously highly useful and inherently enjoyable. This dual perception - capturing both utilitarian and hedonic evaluations - aligns with, while also extending, the existing literature on technologyenhanced dining experiences. For instance, although Karimun et al. (2023) argue that technological novelty alone is insufficient to guarantee positive consumer evaluations, the present study demonstrates that AR/VR systems can indeed be operationalized as compelling experiential tools that enrich the dining experience while simultaneously providing meaningful, credible, and contextually relevant information. These results offer an important extension to contemporary research by highlighting that AR/VR is capable of transcending the novelty effect, becoming instead a valueadding component of the dining experience.

This study provides a comprehensive examination of consumer acceptance of AR/VR technologies for food traceability in fine dining contexts, grounded in the Technology Acceptance Model (TAM). The findings reveal a coherent and robust model supported by strong reliability (Cronbach's $\alpha = 0.840–0.945$) and validity (KMO = 0.778–0.850; Bartlett's test), confirming the adequacy of the measurement scales and data for hypothesis testing.

The results demonstrate that perceived ease of use (PEOU) significantly influences perceived usefulness (PU) supporting its indirect role within TAM. However, PEOU does not directly affect attitude (ATT), nor does perceived innovativeness (PI), leading to the rejection of H2 and H4. In contrast, both perceived usefulness (PU) and hedonic motivation (HM) significantly and positively influence ATT, with HM emerging as the strongest predictor. The model explains a substantial proportion of variance in attitude . This dual emphasis on utility and experiential enjoyment offers valuable implications for stakeholders in the gastronomy and hospitality sectors. For restaurant managers and technology developers, the findings highlight the importance of designing AR/VR applications that effectively communicate traceability information while simultaneously enriching the sensory and emotional dimensions of the dining experience. For policymakers, the results reinforce the potential of immersive technologies as instruments for promoting transparency, sustainability, and consumer trust across the foodservice industry.

Furthermore, behavioural intention (ITU) is strongly driven by both PU and particularly ATT, confirming attitude as the most influential determinant of adoption. Additional findings indicate that dining frequency, rather than demographic variables, influences willingness to pay, and that gender is significantly associated with AR/VR familiarity, with males reporting higher familiarity levels.

Regarding the theoretical contributions, this study contributes to the literature by extending TAM into the context of AR/VR-enabled food traceability, highlighting the dual importance of utilitarian (usefulness) and hedonic (enjoyment) drivers. Notably, the results challenge traditional assumptions by demonstrating that ease of use and innovativeness do not directly affect attitudes, suggesting that in advanced or experiential settings, usability may be taken for granted and innovation alone is insufficient to drive acceptance.

In other hand, from a managerial perspective, the findings emphasize that successful implementation of AR/VR technologies in restaurants could depends on: i) delivering reliable and transparent information (functional value); ii) creating engaging and enjoyable experiences (experiential value); iii) designing a strong and true product/dish storytelling (communication strategy) and iv) ensuring a balanced pricing strategy, as most consumers show sensitivity to cost. Restaurant managers and technology developers should therefore prioritize user experience design and meaningful content, rather than focusing solely on technological novelty. It is important to highlight that these results also reveal, in a way, the crucial need to ensure that AR/VR applications do not become intrusive in fine dining environments. Exquisite dining experiences are traditionally characterized by atmosphere, social interaction, and sensory engagement with the food; thus, excessive or poorly integrated technological

interventions can disrupt immersion, reduce perceived authenticity, and ultimately diminish customer satisfaction. Managers must carefully balance innovation with discretion, ensuring that AR/VR enhances - rather than overwhelms - the dining experience, remaining optional, context-sensitive, and seamlessly integrated into the service.

Despite its contributions, this study presents some limitations. The sample is predominantly young, highly educated, and geographically concentrated (Lisbon and Porto), which may limit generalizability. Additionally, the use of self-reported data may introduce response bias, and the cross-sectional design restricts causal inference.

Future research could address these limitations by: i) expanding to more diverse and international samples, ii) using experimental or longitudinal designs, iii) exploring additional variables such as trust, perceived risk, or sustainability perceptions
Overall, the study demonstrates that the adoption of AR/VR in fine dining is driven primarily by perceived usefulness and hedonic value, with attitude acting as the central mediator of behavioural intention. These insights provide a solid foundation for both academic advancement and practical implementation in technology-enhanced gastronomic experiences.

In conclusion, this research demonstrates that AR/VR technologies possess significant potential to enhance traceability and transparency, engagement, and consumer trust within finedining environments. By identifying the psychological and perceptual drivers of acceptance, as well as clarifying the contextual conditions under which these technologies are most effective, the study provides valuable theoretical advancements and pragmatic guidance for the future development of immersive gastronomic experiences. As fine dining continues to evolve, AR/VR technologies stand poised to play a transformative role in shaping how consumers interact with, understand, and appreciate the complex narratives behind their food.

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