

Shaping the Metaverse into Sustainable Travel: Opportunities and Challenges

Mahmoud Salah El-Din Heba Gaafar Marwa Fawzy Bassam Al-Romeedy

Tourism Studies Department, Faculty of Tourism and Hotels - University of Sadat City

Abstract

The metaverse, powered by augmented and virtual reality, can expand the physical world and facilitate seamless interaction between users in both real and virtual spaces. While early-stage research on sustainable tourism and the metaverse is ongoing, scholars have begun developing indicators and instruments to measure destination sustainability. The purpose of this paper is to identify factors that influence sustainable tourism and metaverse, Analysis The Opportunities and Challenges of metaverse technology, This paper applies the quantitative approach; 457 questionnaires were distributed both physically and electronically to employees in tourism field, IT Engineering and tourists in the Egyptian destination regarding the opportunities for using Metaverse technology in tourism destinations, The results revealed that the Metaverse would enhance their interaction with the real world rather than isolate them from it, also the Metaverse could present a significant opportunity to change how respondents live and a significant portion of the sample reported having experienced Virtual Reality (VR) A significant majority of respondents are in favor of integrating both realities into their lives, This research highlights the metaverse components and techniques that are applied in tourism as well as identified the importance of their implementation, which may help stakeholders to draw policies and visions to improve the visit experience and technological infrastructure, as well as apply the most beneficial AI tools in tourism destinations, This, in turn, enhances economic socio-culture and environmental sustainability in tourism destinations.

Keywords: Metaverse, Sustainable Tourism, Travel, opportunities, Threats

Introduction

Perhaps dreamed of something about living in a world where one could be whatever one wanted to be and do whatever one pleased, just like in a story, But in our technological age, it appears that this is not just a fantasy, This is seen in the modern era, in which metaverse technology is formally developed, Through the use of Metaverse, one will be able to fulfill the ambitions one had as a child, Since its initial appearance, the Metaverse has developed into a component of the future reality portrayed in numerous books and movies, The term refers to a 3D virtual shared environment in which all activities can be carried out using augmented and virtual reality services, The prefix "meta" (implying beyond) and the word "universe" were

used to create it (Damar, 2021; Gaafar, 2021; Jeon, 2021; Akour et al., 2022; Ramesh et al., 2022; Buana, 2023).

The metaverse was seen as nothing more than a social gathering spot where people could play games and pass the time, But in the Metaverse, a second universe for the future of society appeared, Our everyday lives, both offline and online, especially urban life, are fast incorporating the metaverse , Asian cities like Seoul and Shanghai are working swiftly to take advantage of the developing metaverse, They also made the decision to create a strategic plan and start investing in the metaverse as they thought that the virtual world would provide advantages including better information sharing, more accessible city services, closer ties between neighbors, and a new virtual economy (Pamungkas, 2022).

Besides a modern competitive environment drives businesses to come up with fresh concepts to keep tourists from becoming tired with conservative cultural sites, provides strong evidence that innovation is vital in strengthening the sustainability of destinations, attempt to address a vacuum in the literature on the sustainability of tourism destinations by demonstrating how destination managers accomplish destination sustainability, They accomplish this through resource optimization, innovation such as employing the metaverse to defend the destination, Previous research (Capriello et al. 2017; Zhang et al. 2020).

To go along with the tourism 2030 sustainable development goals (SDGs), metaverse and related research topics need to be investigated in order to enable sustainable and future tourism for the digital age of travelers However, also The Tourism destination sustainability awareness is critical for protecting the destination from harm and overexploitation, there is a lack of metaverse research in tourism and hospitality contexts, This study suggests that metaverse could be an innovative approach to enhance tourism destination sustainability, and prove it's well worth in maintaining sustainable destinations, controlling useful resource and enhance tourist experience, also It will be highlighted in this study at the exploration and significance of this technology in the tourism industry and what are the opportunities and challenges going through the utility of metaverse within the Tourism destinations sustainability Hence, the problem of the study lies in the lack of studies in general and Arab studies in particular that dealt with the Metaverse (Kaukab et al. 2020;Go & Kang, 2022).

The study emphasizes that The Metaverse offers a sustainable future for tourism, enhancing experiences, protecting destinations, and significantly reducing environmental impact (Calderón-Garcidueñas et al. 2015;Najmeddin et al. 2018; Taksibi et al. 2020;Allam et al.2022).

This study aimed to; a) Discover The impact of the metaverse technology on tourism destination sustainability, b) Highlighting the Opportunities and challenges of

applying Metaverse technology in tourism destinations, c) Explore the Metaverse role in the process of digital transformation, To achieve the objective of the research the following hypotheses were derived.

H1: There is a significant difference between male and female respondents in their perceptions of study variables.

H2: There is a significant difference based on respondents' age in their perceptions of study variables.

H3: There is a significant difference based on respondents' educational level in their perceptions of study variables.

2.Literature review

The concept of Metaverse

The concept of Metaverse consists of The definitions and The foundation:

Foundation:

The metaverse, a virtual reality universe, has emerged as a significant technological frontier, This digital realm, enabled by advancements in virtual and augmented reality, offers immersive experiences where users can interact with each other and digital objects in real-time.

The concept of the metaverse, first introduced in Neal Stephenson's 1992 novel "Snow Crash," has evolved into a tangible reality, Companies like Meta (formerly Facebook) are investing heavily in developing this technology.(BUANA, 2023;Damar, 2021;Joshua, 2017; Gaafar, 2021; Laeeq, 2022).

Key Technologies

The metaverse relies on a combination of technologies:

Virtual Reality (VR): Immersive experiences where users are transported to digital worlds.

Augmented Reality (AR): Overlaying digital information onto the real world.

Blockchain: Secure and transparent digital ledger technology (Woodgate, 2021).

Artificial Intelligence (AI): Intelligent systems that can learn and adapt (Dhelim et al. 2022; Sriram, 2022)

Metaverse definitions:

The term "metaverse" refers to a parallel, virtual universe that employs ambient intelligence to improve actual locations, products, and services (Buhalis,2020)it is a metaverse has been defined as a new version of the internet that incorporates virtual reality headgear, blockchain technology, and avatars into a new integration of the actual and virtual worlds (Lee et al., 2021; The Verge, 2021).

Damar (2021) defines the metaverse as the layer between you and reality, with the metaverse referring to a 3D virtual shared world where all activities can be carried out with the assistance of augmented and virtual reality services.

Mark Zuckerberg's new metaverse concept describes an integrated immersive ecosystem in which the barriers between the virtual and real worlds are seamless to users, allowing them to work, interact, and socialise through simulated shared experiences (Dwivedi et al.2022).

Huynh-The (2023) Stated that The term Metaverse is a closed compound word made up of two words: Meta (Greek prefix meaning post, after, or beyond) and universe." To put it another way, the Metaverse is a beyond-reality universe, a permanent and persistent multiuser environment that combines physical reality and digital virtuality powered by a variety of emerging technologies, including fifth-generation networks and beyond, virtual reality, and artificial intelligence (AI).

Simply can conclude the metaverse as: integrated immersive environment in which Merging between the real and the virtual worlds to erase the physical obstacles and Facilitate people to communicate with each other using metaverse components (avatars, holograms& XR ..etc.) to work, engage and socialize through simulating shared experiences in real life.

Environmental impact

Choi (2022) claimed that researchers have commented on how increased adoption of the metaverse could affect sustainability by changing people's habits and potentially reducing emissions by doing more of their work and living in the virtual world, Field et al. (2021) cover sustainability viewpoints and emphasize how users can lessen their carbon footprint by doing more of their job and social networking via the metaverse, which eliminates the need for commuting and holding in-person meetings, If the necessary infrastructure is in place, working remotely will be possible anywhere, The main obstacle to the metaverse's sustainability is how to balance these important advantages with the increased energy needs and consumption that are directly related to widespread adoption of the metaverse.

Air pollution in megacities and tourism destinations has increased the prevalence and severity of asthma, and allergic diseases, with a greater impact on children and young adults, In addition to air pollution, the growing population density in megacities creates various unsustainable environmental challenges, For example, high population density often results in water quality and quantity crises and unmanageable amounts of urban and industrial waste, The Metaverse A Potential Solution for Urban Environmental Challenges. It offers a promising avenue for addressing the escalating environmental issues in megacities and tourism destinations. It can create highly immersive virtual experiences of popular tourist destinations, reducing the physical presence of tourists and minimizing their carbon footprint. By offering virtual alternatives, fragile ecosystems can be protected from overuse and degradation. The metaverse can integrate with IoT internet of things devices and sensors to collect real-time data on air quality, water pollution, and waste levels, Additionally, people living in megacities suffer from high crime rates and

traffic congestion (Carlsten & Rider , 2017; Cruz et al., 2017; Lin et al., 2017 ; Ponte et al., 2018; Ardalan et al., 2019 ;Zhao & Hu, 2019; Wen et al., 2020).

Economic impact on tourism destinations

Tourists who has use Metaverse in visiting their destinations and wish to alter the outfit that the online avatar is wearing, they can purchase exclusive, digitally branded apparel that you choose from a virtual showroom. Alternatively, investors can start their small businesses, like an online exclusive club or an art gallery showcasing the most recent and best collections, part of this development can be attributed to brands purchasing space in order to create virtual storefronts and other digital souvenir stores in tourism destinations. One property parcel in Decentraland was sold for \$913,000 in June 2021, with the developer every realm converting it into a full commercial shopping district, Metajuku, the average cost of a virtual land lot doubled over a six-month period, between June and December, it increased from \$6,000 to \$12,000 across the four primary Metaverses in Web 3.0 (Morgan,2020; The Block, 2021; Republic Realm, 2022).

The metaverse will lead to an increase in digital commerce in tourism destinations, mostly because big-box stores like Walmart wants to sell products there, Adidas bought land on Sandbox VR, a virtual real estate company, and introduced NFTs. Fashion label Gucci and video game developer Roblox partnered to sell products in the metaverse, To offer virtual boutiques, Balenciaga has teamed up with Fortnite creator Epic Games. Nike purchased RTFKT, a well-known metaverse brand with a shoe collection less than seven minutes, an eighteen-year-old designer made more than \$3 million in virtual shoe sales, Nike is looking for virtual wear designers and has a field for trademark applications for its virtual footwear trademarks, among other things (Gadekallu et al., 2022).

Social impact on tourism destinations

The metaverse, according to Facebook founder Mark Zuckerberg, will be the next major computing platform after smartphones and mobile web and it appears to have the potential to be the leading social technology of the future in the context of society and destinations, They would allow tourists to interact with others without regard to location, time, race, or gender, it will improve communication and interaction among visitors of destination for collaborative activities such as adventure activities, shopping, learning, attending concerts, and doing almost anything else they could do in the physical real destination (Davis et al., 2009;A.S.Hovan George et al., 2021;Damar, 2021; Fernandez & Hui, 2022; Pamungkas,2022).

The current metaverse is attracting more attention than the previous one because it provides more social utility, it can certainly be beneficial for mental health for someone who has cancer and finds social support in an online context, Also Improved avatar movement and environment rendering performance allows users to better self-express themselves, build social identities, and even form online

communities with other users in the metaverse, resulting in increased user engagement in the metaverse (Fletcher-Brown et al., 2021; Dwivedi et al., 2022; Rauschnabel et al., 2022;).

Furthermore, virtual tourism may prevent overtourism in desirable destinations where real-life tourism may degrade the sustainability aspects of local cultures, historical icons, and frequently generate anti-tourist attitudes among host communities, Tourists may induce assimilation and, as a result, weaken the authenticity of indigenous cultures, causing a local culture to lose many of its core elements. Another issue is cultural commodification, which occurs when tourism turns local cultures into commodities. This culture is frequently commodified by changing the original meanings and values, Locals are forced to live and behave in specific ways in order to meet the expectations of tourists(Gegung et al., 2021).

3.Methodology

To accomplish the objectives of this research, a quantitative approach was applied, as an online questionnaire was designed on Microsoft Forms to investigate the implementation of metaverse in tourism destinations in Egypt and to explore the effect of using it. The participants were asked to answer the questionnaire after reading a scenario informing them about the benefits of using metaverse in some tourism destinations, A stratified random sampling method was applied, The selection of participants relied on their nearness to the researcher and the ease to contact them. The questionnaire has an introduction, in which the aim of the research was stated, Also, respondents were informed of their right to complete the survey or withdraw, the questionnaire consists of 4 parts (A) Demographic information (B) Metaverse (which consists of 3 parts Opportunities, Awareness ,Threat) (c) Metaverse and tourism destinations sustainability (which contains 3 parts (environmental impact, economic impact, social impact) (D) challenges, The questionnaire was distributed to participants between February 28th and July 13th, 2024, A pilot study was conducted to assess the feasibility and effectiveness of the questionnaire, The data was confidentially gathered tourists in and outside Egypt and suitable sample of employee in the tourism sector and I.T Engineering in tourism field, The sample consists of 457 respondents, with a nearly equal split between males and females. Specifically, 50.1% of the respondents are male, while 49.9% are female. This balanced gender representation ensures that the perspectives of both males and females are equally considered in the analysis, reducing potential bias related to gender (Hemmati, 2022; Sriram, 2022; Murray, 2022; Anderson & Rainie 2022)

Validity and Reliability

The study instrument's validity and reliability were thoroughly evaluated to ensure its effectiveness.

Table (1): Cronbach’s alpha for study variable

No. of items	The Cronbach’s alpha
25	0.736

1. Validity:

The questionnaire was reviewed by tourism studies academics to assess its validity. These experts provided feedback, and their consensus largely supported the appropriateness of the questionnaire items for the study. This step was essential in confirming that the instrument would collect relevant and accurate data.

2. Reliability:

The reliability of the questionnaire was measured using Cronbach’s alpha coefficient, a commonly employed statistical tool for assessing the internal consistency of a scale. According to Taber (2018), Cronbach's alpha is a key indicator that validates the consistency and suitability of scales designed to measure study variables. The findings revealed that the Cronbach’s alpha coefficient for the scale was above 0.7, as shown in Table (1).

These results indicate good internal consistency and reliability of the questionnaire used in the study, so the questionnaire was distributed without any modifications.

4.Results

This chapter includes statistical analyzes of data collected from the study tool, the findings of the study and hypotheses tests.

Table (2): Descriptive statistics for the opportunities for using Metaverse technology in tourist destinations' sustainability

Items		Frequencies*					Mean	SD	
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree			
1	The metaverse will enhance my interaction with the real world rather than cut me out of it.	Freq.	27	73	3	156	128	3.62	1.213
		%	5.9	16	16	34.1	28		
2	Metaverse will support my accessibility of visiting tourist destinations especially sensitive and natural reserves.	Freq.	8	32	72	218	127	3.93	0.933
		%	1.8	7	15.9	47.7	27.8		
3	Metaverse will facilitate the Scientific studies on Tourism destinations sustainability.	Freq.	6	31	34	218	168	4.12	0.905
		%	1.3	6.8	7.4	47.7	36.8		

4	Using metaverse will present a significant chance to alter the way i live, interact, and visit tourism destinations to be more sustainable.	Freq.	49	89	103	160	56	3.19	1.197
		%	10.7	19.5	22.5	35	12.3		
Total mean								3.71	0.608

Results of the opportunities for using Metaverse technology in tourist destinations' sustainability

The table (2) presents descriptive statistics regarding respondents' perceptions of the opportunities for using Metaverse technology in promoting sustainability at tourist destinations. The table summarizes the frequency distribution, mean scores, and standard deviations (SD) for four key statements, reflecting how respondents agree or disagree with these potential opportunities as following:

Interaction with the Real World, Respondents were asked whether they believe the Metaverse would enhance their interaction with the real world rather than isolate them from it. The results show a mean score of 3.62 with a standard deviation of 1.213, indicating moderate agreement. Specifically, 34.1% of respondents agreed, and 28% strongly agreed with the statement, while 16% remained neutral. A smaller portion, 16%, disagreed, and 5.9% strongly disagreed, indicating some concerns about the Metaverse's impact on real-world interactions.

Accessibility to Tourist Destination The second item examined whether the Metaverse would support accessibility to tourist destinations, especially sensitive and natural reserves. The mean score for this item was 3.93, with a standard deviation of 0.933, suggesting a strong level of agreement. Nearly half of the respondents (47.7%) agreed, and 27.8% strongly agreed, indicating that many believe the Metaverse could enhance access to otherwise difficult-to-reach locations. Only a small fraction of respondents disagreed (7%) or strongly disagreed (1.8%).

Facilitating Scientific Studies on Tourism Sustainability Respondents were also asked if they think the Metaverse will facilitate scientific studies on the sustainability of tourism destinations. This item received the highest mean score of 4.12 and a standard deviation of 0.905, reflecting a high level of agreement. A significant 47.7% of respondents agreed, and 36.8% strongly agreed, indicating strong support for the Metaverse as a tool for advancing scientific research in tourism sustainability. Minimal disagreement was observed, with only 6.8% disagreeing and 1.3% strongly disagreeing.

Impact on Lifestyle, Interaction, and Sustainability The final item explored whether using the Metaverse could present a significant opportunity to change how respondents live, interact, and visit tourism destinations in a more sustainable way. The mean score was 3.19, with a standard deviation of 1.197, showing more mixed responses. While 35% agreed,

and 12.3% strongly agreed, a notable portion remained neutral (22.5%). Additionally, 19.5% disagreed, and 10.7% strongly disagreed, indicating some skepticism about the Metaverse's impact on sustainable living and interactions.

Overall, the opportunities for using Metaverse technology in enhancing sustainability at tourist destinations received a positive response, with an overall mean score of 3.71 and a standard deviation of 0.608. The strongest support was seen for the role of the Metaverse in facilitating scientific studies and improving accessibility to sensitive areas. However, opinions were more divided regarding its impact on real-world interactions and its potential to alter lifestyles toward greater sustainability.

Table (3): Descriptive analysis and Mean of the threats associated with using of Metaverse in tourist destinations' sustainability

Items		Frequencies*					Mean	SD	
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree			
1	I'll use the metaverse without all the necessary safeguards.	Freq.	137	149	27	92	52	2.50	1.39
		%	30	32.6	5.9	20.1	11.4		
2	The metaverse could be a nice place to visit, but not to live there.	Freq.	31	7	81	175	163	3.95	1.09
		%	6.8	1.5	17.7	38.3	35.7		
3	I don't have a problem to let metaverse access my biometric information "like camera, and know the precise location of me, and "store details about me".	Freq.	95	69	60	139	94	3.15	1.44
		%	20.8	15.1	13.1	30.4	20.6		
4	The existence of regulations and rules important for implementing the metaverse.	Freq.	4	2	53	233	165	4.21	0.72
		%	0.9	0.4	11.6	51	36.1		
5	I will no longer be able to distinguish between virtual elements and real objects after using the metaverse.	Freq.	21	99	105	141	91	3.40	1.16
		%	4.6	21.7	23	30.9	19.9		
Total mean							3.44	0.59	

Results of the threats associated with using Metaverse technology in tourist destinations' sustainability

The table (3) provides descriptive statistics on respondents' perceptions of the threats associated with using Metaverse technology in relation to the sustainability of tourist destinations. The data includes frequency distributions, mean scores, and standard deviations (SD) for five specific concerns as following:

1. Using the Metaverse Without Necessary Safeguards

The concern that users might engage with the Metaverse without appropriate safeguards had a mean score of 2.50, with a standard deviation of 1.39. A significant portion of respondents, 30% strongly disagreed, and 32.6% disagreed with the statement, suggesting that many believe they would take precautions. However, 20.1% agreed, and 11.4% strongly agreed, indicating that some respondents acknowledge a potential risk of using the Metaverse without safeguards.

2. The Metaverse as a Place to Visit, Not to Live

This item, which suggests that the Metaverse could be appealing to visit but not to live in, received a higher mean score of 3.95 and a standard deviation of 1.09. A strong majority of respondents, 38.3% agreed, and 35.7% strongly agreed with this statement, reflecting widespread concern about the limitations of living within a virtual environment. Only a small portion strongly disagreed (6.8%) or disagreed (1.5%), highlighting a general consensus on this issue.

3. Comfort with the Metaverse Accessing Biometric Information

When asked about their comfort with the Metaverse accessing biometric data, the mean score was 3.15, with a higher standard deviation of 1.44, indicating varied responses. While 30.4% agreed, and 20.6% strongly agreed to share such data, a significant portion remained cautious, with 20.8% strongly disagreeing, and 15.1% disagreeing. This split reflects differing levels of trust in the Metaverse's handling of sensitive personal information.

4. Importance of Regulations and Rules for the Metaverse

The belief in the necessity of regulations and rules for the Metaverse garnered the highest mean score of 4.21, with a standard deviation of 0.72. An overwhelming majority of respondents agreed (51%) or strongly agreed (36.1%) on the importance of regulatory frameworks, indicating a strong consensus on the need for oversight in the Metaverse. Very few respondents disagreed, with only 0.9% strongly disagreeing and 0.4% disagreeing.

5. Difficulty in Distinguishing Virtual and Real Elements

The final concern focused on the potential difficulty in distinguishing between virtual and real objects after using the Metaverse, with a mean score of 3.40 and a standard deviation of 1.16. Responses were mixed, with 30.9% agreeing and 19.9% strongly agreeing that this could be a threat. However, a significant number of respondents were neutral (23%), disagreed (21.7%), or strongly disagreed (4.6%), showing a varied perception of this potential risk.

Overall, the mean score for the perceived threats associated with using Metaverse technology in tourism sustainability is 3.44, with a standard deviation of 0.59. While there is strong agreement on the necessity of regulations and some concerns about the risks of living in the Metaverse or sharing biometric information, opinions are more divided on the risks of using the Metaverse without safeguards and the potential for confusion between

virtual and real elements. These findings underscore the mixed perceptions of the risks involved, with a general consensus on the need for regulatory oversight.

Table (4): what are the threats that metaverse can cause

No.	Item	Frequency
1	Users' privacy and safety violation	145
2	Raising cyberbullying	139
3	Causing user addiction	138
4	Increasing Energy consumption	142
5	Boost e-waste	74
6	Growing cyberattacks	125

Note: Multiple answer question.

The data in table (4) suggests that the Metaverse, while promising new opportunities, also introduces considerable risks that need to be carefully managed. The most frequently mentioned threats revolve around privacy and safety violations, cyberbullying (145), and increased energy consumption (142), all of which could have widespread and long-term impacts. Additionally, the potential for user addiction (138), the environmental toll from e-waste (74), and the growing risk of cyberattacks (125) are critical issues that stakeholders must address to ensure a safe and sustainable digital future.

Table (5): Mann-Whitney test for the difference among respondents based on gender towards study variables

Variables	Gender	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
The opportunities for using Metaverse technology in tourist destinations' sustainability	Male	229.32	52515.00	2.603	0.958
	Female	228.68	52138.00		
The threats associated with using Metaverse technology in tourist destinations' sustainability	Male	208.42	47727.50	2.139	0.001
	Female	249.67	56925.50		
The environmental impact of using Metaverse technology in the sustainability of tourist destinations	Male	202.88	46460.50	2.013	0.000
	Female	255.23	58192.50		
The economic impact of using Metaverse technology in the sustainability of tourist destinations	Male	209.71	48022.50	2.169	0.001
	Female	248.38	56630.50		
The social impact of using Metaverse technology in the sustainability of tourist destinations	Male	221.24	50665.00	2.433	0.203
	Female	236.79	53988.00		
The challenges facing using Metaverse technology in the sustainability of tourist destinations	Male	227.75	52155.50	2.582	0.838
	Female	230.25	52497.50		

Differences among Respondents Regard to the Study Variables based on (Gender- Age- Education)

Differences among respondents regard to the study variables based on gender

The Mann-Whitney test results in table (5) provide insights into the differences in perceptions between male and female respondents regarding various aspects of Metaverse technology in the sustainability of tourist destinations. For the opportunities of using Metaverse technology, there is no significant difference between genders, as indicated by the high p-value (Sig. = 0.958). However, significant gender differences exist in perceptions of the threats, environmental impact, and economic impact associated with Metaverse technology, with females consistently having higher mean ranks than males, indicating greater concern in these areas (p-values of 0.001, 0.000, and 0.001, respectively). For social impact and challenges, the differences between genders are not statistically significant (p-values of 0.203 and 0.838, respectively). This suggests that while both genders view the opportunities and challenges similarly, females tend to perceive higher risks and impacts in the environmental, economic, and threat-related aspects of Metaverse technology in tourism sustainability. So, Hypothesis 1 was partially supported. This means that there is a significant difference between male and female respondents in their perceptions of study variables (Threats, environmental and economic impact).

Table (6): Kruskal-Wallis test for the difference among respondents based on experience towards study variables

Variables	Age	Mean Rank	Chi-Square	Sig.
The opportunities for using Metaverse technology in tourist destinations' sustainability	24 years or less	225.50	5.049	0.282
	25-34 years	235.47		
	35-44 years	217.34		
	45-59 years	266.06		
	60 years and above	211.10		
The threats associated with using Metaverse technology in tourist destinations' sustainability	24 years or less	225.87	39.922	0.000
	25-34 years	186.62		
	35-44 years	239.20		
	45-59 years	283.60		
	60 years and above	295.25		
The environmental impact of using Metaverse technology in the sustainability of tourist destinations	24 years or less	229.64	64.011	0.000
	25-34 years	173.47		
	35-44 years	237.79		
	45-59 years	297.33		
	60 years and above	310.58		
The economic impact of using Metaverse technology in the	24 years or less	241.91	28.046	0.000
	25-34 years	201.22		
	35-44 years	187.67		

sustainability of tourist destinations	45-59 years	251.46		
	60 years and above	282.92		
The social impact of using Metaverse technology in the sustainability of tourist destinations	24 years or less	227.50	19.150	0.001
	25-34 years	200.43		
	35-44 years	230.66		
	45-59 years	265.97		
	60 years and above	276.17		
The challenges facing using Metaverse technology in the sustainability of tourist destinations	24 years or less	235.61	12.989	0.011
	25-34 years	206.08		
	35-44 years	212.03		
	45-59 years	251.04		
	60 years and above	267.59		

Differences among respondents regard to the study variables based on age

The Kruskal-Wallis test results reveal significant differences in perceptions across different age groups regarding various aspects of Metaverse technology in the sustainability of tourist destinations. The Kruskal-Wallis test reveals significant age-related differences in perceptions of Metaverse technology's impact on the sustainability of tourist destinations. Older respondents, particularly those aged 45 and above, tend to perceive higher threats, greater environmental, economic, and social impacts, as well as more challenges associated with Metaverse technology. These differences are statistically significant, especially in the areas of threats ($p = 0.000$), environmental impact ($p = 0.000$), economic impact ($p = 0.000$), social impact ($p = 0.001$), and challenges ($p = 0.011$). However, no significant age-related differences were found in perceptions of the opportunities provided by Metaverse technology ($p = 0.282$). Hence, Hypothesis 2 was partially accepted. This means that there is a significant difference based on respondents' age in their perceptions of study variables (Threats, environmental, economic and social impact and challenges).

Table (7): Kruskal-Wallis test for the difference among respondents based on education towards study variables

Variables	Education	Mean Rank	Chi-Square	Sig.
The opportunities for using Metaverse technology in tourist destinations' sustainability	High school	234.36	3.561	0.469
	Bachelor	226.46		
	Master	238.54		
	PhD	204.89		
	Other	289.68		
The threats associated with using Metaverse technology in tourist destinations' sustainability	High school	204.59	8.020	0.091
	Bachelor	237.84		
	Master	190.68		
	PhD	214.11		
	Other	261.95		

The environmental impact of using Metaverse technology in the sustainability of tourist destinations	High school	205.37	9.277	0.055
	Bachelor	236.14		
	Master	197.32		
	PhD	204.89		
	Other	300.82		
The economic impact of using Metaverse technology in the sustainability of tourist destinations	High school	232.33	9.663	0.046
	Bachelor	226.95		
	Master	228.31		
	PhD	198.77		
	Other	338.45		
The social impact of using Metaverse technology in the sustainability of tourist destinations	High school	212.80	5.961	0.202
	Bachelor	228.21		
	Master	248.02		
	PhD	202.70		
	Other	300.91		
The challenges facing using Metaverse technology in the sustainability of tourist destinations	High school	242.85	8.450	0.076
	Bachelor	232.14		
	Master	191.26		
	PhD	196.41		
	Other	291.77		

Differences among respondents regard to the study variables based on education

The Kruskal-Wallis test in table (7) shows that educational background generally does not result in significant differences in perceptions of Metaverse technology's impact on the sustainability of tourist destinations, with most p-values indicating non-significance. The only exception is in the economic impact, where those with "Other" educational backgrounds perceive a significantly higher impact ($p = 0.046$). While there are near-significant trends in how education influences perceptions of threats, environmental impact, and challenges, these differences are not strong enough to be statistically significant, suggesting that education level has a limited influence on these perceptions. Therefore, Hypothesis 3 was partially not proved. This means that there is no a significant difference based on respondents' education level in their perceptions of study variables.

5. Conclusion

The purpose of this paper is to identify factors that influence sustainable tourism and metaverse, This paper applies the quantitative approach; the results revealed that the Metaverse would enhance their interaction with the real world rather than isolate them from it, also the Metaverse could present a significant opportunity to change how respondents live, this research shows the metaverse components and techniques that are applied in tourism as well as identifies the importance of their implementation, which may help

stakeholders and visitors to draw policies and visions to improve the visit experience and technological infrastructure, as well as apply the most beneficial AI tools in tourism destinations. This, in turn, enhances economic socio-culture and environmental sustainability in tourism destinations. this research can provide policymakers with valuable insights into the potential benefits and risks of Metaverse tourism, like Metaverse will support my accessibility of visiting tourist destinations especially sensitive and natural reserves, or The metaverse could be a nice place to visit, but not to live there, Governments can leverage the findings to promote their destinations in the Metaverse, attracting new visitors and boosting local economies, this research can inspire tourism businesses to explore innovative ways to incorporate the Metaverse into their offerings, staying competitive in a rapidly evolving market, The analysis shows a significant variation in opinions regarding the readiness of Egypt's infrastructure for metaverse technology in tourism. Some participants believe that substantial development is needed, while others think it is initially suitable. The general consensus is that implementing the metaverse could contribute to economic and environmental sustainability of tourist destinations, but there are concerns about high costs and excessive reliance on technology. For optimal results, a comprehensive planning approach for infrastructure and technology is recommended, with a focus on using the metaverse as a complementary tool to traditional tourism rather than a replacement.

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تشكيل الميتافيرس نحو السفر المستدام: الفرص والتحديات

محمود صلاح الدين هبة الله جعفر مروة عبدالوارث بسام الرميدي
قسم الدراسات السياحية – كلية السياحة والفنادق – جامعة مدينة السادات

الملخص

يمكن للميتافيرس، المدعوم بالواقع المعزز والافتراضي، توسيع العالم المادي وتسهيل التفاعل بين المستخدمين في كل من المساحات الحقيقية والافتراضية. وبينما لا تزال الأبحاث في مرحلة مبكرة حول السياحة المستدامة و الميتافيرس مستمرة، بدأ العلماء في تطوير مؤشرات وأدوات لقياس استدامة الوجهة، والغرض من هذه الورقة هو تحديد العوامل التي تؤثر على السياحة المستدامة و الميتافيرس، وتحليل الفرص والتحديات التي تواجه تكنولوجيا الميتافيرس، وتطبق هذه الورقة النهج الكمي؛ تم توزيع 457 استبياناً بشكل مادي وإلكتروني على العاملين في مجال السياحة وهندسة تكنولوجيا المعلومات السائحين في الوجهة المصرية بشأن فرص استخدام تقنية الميتافيرس في الوجهات السياحية، وكشفت النتائج أن الميتافيرس من شأنه أن يعزز تفاعلهم مع العالم الحقيقي بدلاً من عزلهم عنه، كما يمكن أن تقدم الميتافيرس فرصة كبيرة لتغيير طريقة تفاعل المشاركين وأفاد جزء كبير من العينة أنهم جربوا الواقع الافتراضي (VR) وتؤيد الغالبية العظمى من المشاركين دمج كلا الواقعين في حياتهم، ويسلط هذا البحث الضوء على مكونات وتقنيات الميتافيرس التي يتم تطبيقها في السياحة بالإضافة إلى تحديد أهمية تنفيذها، مما قد يساعد أصحاب المصلحة على رسم السياسات والرؤى لتحسين تجربة الزيارة والبنية التحتية التكنولوجية، فضلاً عن تطبيق أدوات الذكاء الاصطناعي الأكثر فائدة في الوجهات السياحية، وهذا بدوره يعزز الاستدامة الثقافية الاجتماعية والاقتصادية والبيئية في الوجهات السياحية.

الكلمات المفتاحية: ميتافيرس، السياحة المستدامة، السفر، الفرص، التهديدات