



Awais Zeb Qarni¹, Dr. Jan Muhammad², Abuzar Ghaffari³, Shahsawar Khan⁴

¹Department of Tourism and Hospitality, Abdul Wali Khan, University, Mardan, Khyber Pakhtunkhwa, Pakistan.

Email: awaiszebqarni78@gmail.com

²Assistant Professor, The Institute of Archaeology, Tourism and Hospitality, University of Peshawar, Khyber Pakhtunkhwa, Pakistan. Email: janarch@uop.edu.pk

³The Institute of Archaeology, Tourism and Hospitality, University of Peshawar, Khyber Pakhtunkhwa, Pakistan. Email: abuzarghaffari741@gmail.com

⁴Department of Archaeology, University of Malakand, Khyber Pakhtunkhwa, Pakistan. Email: shahkhan42276@gmail.com

KEYWORDS	ABSTRACT
Tourism, Hospitality, Peshawar, Artificial Intelligence, Cultural Heritage, Preservation, Visitor	The tourism and hospitality sector are essential for economic growth, cultural preservation, and regional development. Globally, Artificial Intelligence (AI) is reshaping tourism by enhancing customer experiences, optimizing operations, and improving service quality. In Peshawar, however, AI adoption remains limited despite the city's cultural richness and significant tourism potential. This study examines how AI can support the development of Peshawar's tourism and hospitality industry by addressing major challenges such as weak digital infrastructure, inconsistent service standards, and security concerns. AI technologies, including machine learning, natural language processing, predictive analytics, and robotics, offer substantial benefits. Tools like chatbots, automated booking systems, and data-driven forecasting can improve efficiency and enrich visitor interaction. AI also assists in pricing, personalization, energy management, and sustainable tourism practices. Yet high implementation costs, limited training, low digital literacy, and inadequate institutional support hinder progress, especially for small businesses. The study recommends investments in infrastructure, workforce training, and supportive policies to facilitate AI adoption. Overall, AI holds strong potential to enhance operational efficiency, visitor satisfaction, and sustainable growth in Peshawar's tourism sector, provided that key stakeholders collaborate effectively.
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Correspondence	Dr. Jan Muhammad
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Introduction

The tourism and hospitality sector is vital for economic growth, cultural preservation, and regional development (Thommandru, Espinoza-Maguiña, Ramirez-Asis, Ray, Naved, & Guzman-Avalos, 2023: 2901-2904; Sihombing, Suastini, & Puja, 2024: 100-115). Globally, Artificial Intelligence (AI) is transforming this industry by enhancing customer experiences, streamlining operations, and enabling personalized services (Abbas, Khan, Omer, Ullah, & Yasir, 2024:147-180). AI-based technologies, such as machine learning, natural language processing, predictive analytics, and robotics, have improved service quality and visitor satisfaction worldwide (Hamcerencu, 2025: 1139-1151). However, in Peshawar, AI adoption in tourism and hospitality remains in its early stages. Considering the city's rich cultural heritage, historical significance, and untapped tourism potential, AI could help address existing challenges and support sustainable development (Nag, 2024: 160-190; Najjar, Amer, Charafeddine, & Raed, 2025: 65-84). AI applications in tourism are wide-ranging. Virtual assistants and AI-driven chatbots provide instant support, facilitate travel planning, and offer information on attractions (Gursoy, Li, & Song, 2023: 579-592). Smart algorithms optimize bookings, pricing, and resource allocation, while automated check-ins, housekeeping management, and demand forecasting reduce costs and enhance efficiency (Tariq, 2026: 415-446). Security is also improved through AI-driven facial recognition, predictive analytics, and anomaly detection, enhancing safety at hotels, airports, and tourist sites. Moreover, AI promotes sustainability by optimizing energy consumption, reducing food waste, and improving transportation efficiency, supporting eco-friendly tourism practices (Asif, Jamshed, & Shah, 2025: 140-161). Despite these advantages, Peshawar faces challenges in integrating AI into its tourism sector. Issues include inconsistent service quality, limited digital infrastructure, security concerns, and reliance on traditional service models (Shafique, Saeed, & Verma, 2026: 280-298). Furthermore, a lack of trained personnel in AI-related technologies hinders effective implementation. Overcoming these barriers requires investment in technology, workforce training, regulatory support, and culturally sensitive approaches (Campos Zabala, 2023: 85-110).

Integrating AI can provide strategic benefits for Peshawar. Predictive analytics enable personalized travel recommendations and targeted marketing strategies, while AI-driven insights allow businesses to forecast tourism trends and adjust services accordingly (Akbar, Ghutai, & Karamat, 2026: 256-274). Automated customer service, AI-based language translation, and immersive technologies like virtual reality (VR) and augmented reality (AR) can enhance visitor experiences and attract international tourists (Asif, Jamshed, & Shah, 2025: 140-161). Strengthening security through AI also improves Peshawar's image as a safe destination. Successful AI adoption requires collaboration among businesses, government bodies, and stakeholders to address infrastructure, training, and financial challenges (Shahzad, Khan, Ali, Ahmad, Aamir, Haq, & Zaman, 2026: 1-32). By embracing AI-driven innovations, Peshawar can enhance visitor experiences, improve operational efficiency, strengthen security, and promote sustainable tourism. Such initiatives would position the city as a technologically advanced and attractive tourist destination, fostering long-term growth in the hospitality industry (Chakraborty, 2024:195-230).

Statement of the Problem

Although AI is widely adopted in global tourism, its use in Peshawar remains limited due to poor digital infrastructure, security concerns, inconsistent service quality, high costs, and low stakeholder awareness. While leading destinations leverage AI to automate services, optimize bookings, and make data-driven decisions, Peshawar still relies on traditional methods, affecting visitor satisfaction and competitiveness. This study examines the current state of AI integration in Peshawar's tourism sector, identifies barriers, and explores strategies for implementing AI-based solutions to support sustainable tourism growth.

Significance of Study

This study is significant for Peshawar's tourism development as it explores how AI can enhance service efficiency, security, and customer experience. It provides insights from global AI applications tailored to the local context, offering policymakers guidance on digital infrastructure, workforce training, and incentives for AI adoption. For businesses, it highlights the benefits of AI in improving operations, customer engagement, and security, aiming to foster an AI-enabled tourism ecosystem that supports sustainable economic growth.

Theoretical Framework

This study uses two key frameworks: the Technology Acceptance Model (TAM) and the Innovation Diffusion Theory (IDT). TAM examines how perceived usefulness and ease of use influence stakeholders' willingness to adopt AI in Peshawar's tourism sector. IDT explains how innovations spread, considering factors like relative advantage, compatibility, complexity, trialability, and observability. Together, these models provide a framework to understand AI adoption dynamics and guide strategies for businesses and policymakers.

Literature Review

A literature review provides a critical summary and synthesis of previous research on a specific topic, offering a comprehensive analysis of existing studies and identifying gaps, key themes, and theoretical perspectives. It establishes the foundation for new research by evaluating relevant findings, methodologies, and contributions from past scholars. Artificial intelligence has revolutionized the global tourism and hospitality industry by enhancing customer experiences, improving operational efficiency, and facilitating personalized services. Studies by Buhalis and Amaranggana (2015) emphasize that AI-driven innovations, such as chatbots, recommendation systems, and predictive analytics, contribute to seamless and efficient travel planning. AI-powered booking engines analyze user preferences and optimize pricing strategies, significantly influencing consumer decision-making (Ivanov & Webster, 2019). AI-driven customer service applications, including virtual assistants and automated check-in systems, have transformed hotel operations (Tussyadiah & Park, 2018). These advancements not only enhance customer convenience but also

reduce labor costs, allowing businesses to allocate resources more effectively. AI has also enabled real-time data analysis, helping tourism operators anticipate demand fluctuations and adjust services accordingly (Gretzel, 2019).

A major advantage of AI in tourism is its capacity to deliver personalized experiences. Research has shown that AI-driven recommendation systems can analyze users' preferences, browsing patterns, and previous interactions to offer tailored travel suggestions, improving customer satisfaction and boosting engagement. Additionally, AI applications such as voice recognition, sentiment analysis, and facial recognition further refine service personalization (Huang & Rust, 2018). Hotels and airlines use AI to tailor promotions, upgrade offers, and predict customer preferences, which enhances customer experience, brand loyalty, and revenue generation. Despite these advantages, AI adoption in tourism faces several challenges. High implementation costs remain a significant barrier, particularly for small and medium-sized enterprises (SMEs) (Lu, Kasahara, & Sugimoto, 2020). Limited digital infrastructure, especially in developing regions such as Peshawar, further restricts AI adoption (Zsarnoczky, 2018). Workforce readiness is another critical issue, as AI systems require specialized skills, yet many tourism professionals lack technical expertise (Ivanov, Webster, & Berezina, 2019). Ethical concerns, including data privacy and job displacement, also need to be addressed, requiring stringent data protection measures and reskilling programs (Tussyadiah, 2020).

Security is a major concern in tourism, and AI plays a vital role in enhancing risk management strategies. AI-based surveillance, predictive analytics, and anomaly detection systems improve security at airports, hotels, and tourist sites (Kose, 2017). Facial recognition technology helps identify potential threats and streamline border control procedures (Sharma, 2019). AI-driven analytics also support crisis management by assessing risks, predicting potential disasters, and guiding effective responses (Gretzel & Fesenmaier, 2020), which is particularly relevant for destinations like Peshawar with historical security concerns. Looking forward, AI is expected to offer highly personalized travel experiences, automated planning, real-time itinerary adjustments, and immersive visitor experiences through augmented reality (AR) and virtual reality (VR). For Peshawar to fully benefit, investment in digital infrastructure, workforce training, and supportive policies is essential. Collaboration among government, educational institutions, and private sectors, along with ethical AI use and transparency in data handling, will be key to fostering AI-driven innovations and building consumer trust in the tourism industry.

Research Methodology

Data Collection

The study used primary data, which was collected through a questionnaire. A point-by-point questionnaire was designed for data collection. Each questionnaire contains twenty-five (25) questions, each with different options.

Population of the Study

The study used the students at Peshawar University and the public of Peshawar as the target population.

Sample Size

The sample size for this research study is 100, obtained through the following formula: $n = N / (1 + N e^2)$, where N = Total population (number of students at Peshawar University and the public), e = Margin of error (typically set to 0.05). Information was collected from the respondents using the questionnaire.

Sampling Method

This research study used a simple random sampling technique for selecting the respondents. One hundred respondents were randomly selected from different departments at Peshawar University, with 43 males, 42 females, and 15 others.

Study Design

The responses to the questionnaire were coded, tabulated, and analyzed using SPSS version 27.

Statistical Methods of Data Analysis

For statistical evaluation of the data, various statistical techniques are used, such as the chi-square test of independence and the independent-samples t-test. Descriptive statistics, i.e., simple bar charts, frequency and percentage distributions, and multiple and component bar charts, were also used.

Descriptive Statistics.

Descriptive statistics summarize and highlight the main features of a dataset through numerical measures, graphs, and tables. Measures of central tendency include mean, median, and mode, while variability is captured by standard deviation, variance, skewness, and kurtosis. Unlike inferential statistics, descriptive statistics focus on describing the data at hand rather than making predictions about a larger population. Graphs like bar charts and pie charts help visualize relationships in categorical or continuous data, with the mean and standard deviation commonly used for normally distributed continuous data.

Chi-Square (χ^2) Test.

The chi-square (χ^2) distribution is a key tool in statistical inference, used primarily to analyze relationships between categorical variables. Introduced by F.R. Helmert in 1876 and popularized by Karl Pearson, the chi-square test is a non-parametric method applied when parametric assumptions, such as equal variances, are not met. It compares observed frequencies with expected frequencies under a null hypothesis to determine if a significant association exists. The test is commonly used for assessing independence between variables, goodness-of-fit to an expected distribution, and homogeneity across groups. Degrees of freedom (d.f.), typically the number of categories minus estimated parameters, indicate the number of values free to vary in the analysis. Contingency tables are often employed to organize data, allowing researchers to test whether two categorical variables are independent or significantly related.

T-Test

The T-test is a statistical method used to determine whether the difference between the means of two groups is significant. It includes the Independent Samples T-test for comparing separate groups and the Paired Samples T-test for the same subjects under different conditions. By calculating a T-value and comparing it to a critical threshold, researchers assess significance, assuming normal distribution and equal variances. Significant results indicate a real difference, while non-significant results suggest random variation.

Analysis

Descriptive statistics

Table 1: Frequency Distribution of Age Group

Age Group	Frequency	%	Valid %	Cumulative %
18-25 years	81	81.0%	81.0%	81.0%
26-35 years	19	19.0%	19.0%	100.0%
Total	100	100.0%		

Interpretation of Age Group

The age distribution of respondents shows that 81% are aged 18–25, while 19% are 26–35. No respondents belong to other age groups, with the total sample size being 100. Cumulatively, 81% are 18–25, and including the 26–35 group brings the total to 100%, indicating the sample consists solely of these two age groups.

Table 2: Frequency Distribution of Occupation

Occupation	Frequency	%	Valid %	Cumulative %
Tourist	30	30.0%	30.0%	30.0%
Hospitality Business Owner	26	26.0%	26.0%	56.0%
Employee in the Tourism Sector	4	4.0%	4.0%	60.0%
Government Official	4	4.0%	4.0%	64.0%
Other (please specify)	36	36.0%	36.0%	100.0%
Total	100	100%		

Interpretation of the Frequency Distribution of Occupation

Table 2 shows respondents' occupations in the tourism and hospitality industry. Tourists form the largest group (30%), followed by Hospitality Business Owners/Managers (26%). Employees and Government Officials each account for 4%, while 36% fall under Other. The cumulative total reaches 100%, representing all respondents.

Table 3 Gender

What is your Gender					
		Frequency	%	Valid %	Cumulative %
Valid	Male	43	42.6	43.0	43.0
	Female	42	41.6	42.0	85.0
	Other	15	14.9	15.0	100.0
	Total	100	99.0	100.0	
Missing	System	1	1.0		
Total		101	100.0		

Interpretation of the table

The gender distribution of 101 respondents shows 43% male, 42% female, and 15% identifying as "Other," with one missing response (1%). The sample is fairly balanced between male and female respondents, while a smaller proportion falls under the "Other" category, totaling 100% of valid responses.

Table 4: Frequency Distribution of Travel Frequency Within Pakistan for Tourism

Travel Frequency	Frequency	%	Valid %	Cumulative Percent
Rarely (Once a year or less)	43	43.0%	43.0%	43.0%

Occasionally (Two to three times a year)	32	32.0%	32.0%	75.0%
Frequently (More than three times a year)	22	22.0%	22.0%	97.0%
4	2	2.0%	2.0%	99.0%
5	1	1.0%	1.0%	100.0%
Total	100	100%		

Interpretation of the Frequency Distribution of Travel Frequency Within Pakistan for Tourism

The table shows respondents’ travel frequency within Pakistan for tourism. Most travel rarely (43%), followed by occasionally (32%) and frequently (22%). Small proportions selected Option 4 (2%) and Option 5 (1%). Cumulatively, the responses account for 100% of the sample, highlighting that most respondents travel infrequently or moderately.

Table 5 Chi-square test

Case Processing Summary						
	Cases					
	Valid		Missing		Total	
	N	%	N	%	N	%
What is your age group?	100	100.0%	0	0.0%	100	100.0%
* Have you ever used AI-powered services such as chatbots, smart booking systems, or virtual assistants while traveling?						

Interpretation of the table

The case processing summary shows that all 100 respondents answered the questions on age group and AI-powered service usage, with no missing responses. The dataset is complete and reliable for further analysis.

Table 6: Chi-Square Test of Independence.

What is your age group? * Have you ever used AI-powered services such as chatbots, smart booking systems, or virtual assistants while traveling? Crosstabulation			
Count	Have you ever used AI-powered services such as chatbots, smart booking systems, or virtual assistants while traveling?		
	Yes	No	Total
			3

What is your age group?	18-25 years	50	30	1	81
	26-35 years	6	13	0	19
Total		56	43	1	100

Interpretation of the table

The table shows that younger respondents are more likely to use AI-powered travel services. Among 18–25-year-olds (81 respondents), 62% have used such services, while 37% have not. In the 26–35 age group (19 respondents), only 32% have used them, and 68% have not, indicating lower adoption among older participants.

Table 7 Chi-Square Test

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.258 ^a	2	.044
Likelihood Ratio	6.406	2	.041
Linear-by-Linear Association	4.762	1	.029
N of Valid Cases	100		
a. 2 cells (33.3%) have expected counts less than 5. The minimum expected count is .19.			

Interpretation of the table

The table shows that younger travelers are more likely to use AI-powered services. Among 18–25-year-olds (81 respondents), 62% have used such services, while 37% have not. In the 26–35 age group (19 respondents), only 32% have used them, indicating lower adoption among older participants.

Table 8 T-test

Group		Statistics			
	What is your occupation?	N	Mean	Std. Deviation	Std. Error Mean
Do you believe AI can improve the tourism experience in Peshawar?	Tourist,	30	2.83	1.341	.245
	Hospitality Business	26	2.65	1.018	.200
	Owner or Manager				

Interpretation of the table

The table shows that both tourists and hospitality business owners/managers believe AI can improve tourism in Peshawar. Tourists (n=30) are slightly more optimistic, with a mean score of 2.83 and moderate variation (SD=1.341), while business owners/managers (n=26) have a mean of 2.65 with less variation (SD=1.018).

Table 9 T-test for Equality of Means:

	F	Sig.	t	df	Sig. (2tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference
Levene's Test for Equality of Variances								
Do you believe AI can improve the tourism experience in Peshawar?	Equal variances assumed	1.999	0.163	0.557	54	0.580	0.179	0.322
	Equal variances not assumed		0.568	53.128	0.572	0.179	0.316	[-0.454, 0.813]

Interpretation of the table

Levene's Test and the Independent Samples T-test show no significant difference between tourists and hospitality professionals regarding AI's impact on tourism in Peshawar. Equal variances were confirmed (F = 1.999, p = 0.163), and the T-test indicated a non-significant mean difference (t = 0.557, p = 0.580), showing similar opinions across both groups.

Discussion

Peshawar's tourism sector has strong potential due to its cultural heritage and historical sites, but AI adoption remains limited. Globally, AI tools like machine learning, predictive analytics, chatbots, and robotics have enhanced customer satisfaction, optimized operations, and improved security, yet Peshawar has yet to fully utilize these technologies. Incorporating AI can streamline customer service through chatbots and virtual assistants, personalize travel experiences, optimize pricing and resource allocation via predictive analytics, and strengthen safety with AI-based security systems such as facial recognition and behavioral analysis. These technologies can also support sustainability by reducing energy consumption, minimizing food waste, and improving transportation efficiency. Barriers to adoption include inadequate digital infrastructure, cultural resistance to technological change, and a skills gap in the workforce. Many businesses still follow traditional models, and employees often lack the training to use AI effectively. Despite these challenges, the study indicates that AI can significantly enhance service quality, operational

efficiency, and security in Peshawar's tourism sector while promoting sustainable practices, offering a clear opportunity for long-term development and modernization.

Results

The results of the study provide insight into AI's current status and potential impact on Peshawar's tourism industry, based on responses from 100 participants, including students and professionals from various sectors of tourism. The data show a clear generational divide in the use of AI-powered services. Among respondents aged 18 -25, 61.73% reported using AI services such as chatbots and virtual assistants while traveling, whereas only 31.58% of the 26-35 age group reported the same. This indicates that younger individuals are more likely to embrace technological innovations like AI, while older respondents tend to rely on traditional methods. The study also revealed differences in perception of AI between tourists and hospitality business owners. Tourists were slightly more optimistic about AI's potential to enhance tourism experiences in Peshawar, with an average belief score of 2.83, compared to hospitality business owners, whose score was 2.65. Nonetheless, both groups recognized AI's value in improving operational efficiency and customer service. A chi-square test for independence confirmed a statistically significant relationship between age and the use of AI-powered services ($\chi^2 = 6.258$, $p = 0.044$), indicating that younger individuals are more likely to adopt AI while traveling. Meanwhile, an independent samples t-test comparing tourists and hospitality business owners found no significant difference in their belief that AI could enhance the tourism experience in Peshawar ($p = 0.580$), showing that both groups hold similar views regarding the benefits of AI.

Recommendations

Based on the study's findings, several recommendations are proposed to facilitate the integration of AI into Peshawar's tourism and hospitality sector. Successful implementation of AI requires significant investment in digital infrastructure, including expanding high-speed internet access, improving computing hardware, and ensuring secure data management systems. Public-private partnerships could provide a viable approach for funding and executing these infrastructure projects. Equally important is workforce training and capacity building. The local tourism workforce needs to be equipped with the skills to operate and maintain AI technologies effectively. Specialized training programs should be implemented to enhance digital literacy and technical expertise, with collaboration among government agencies, academic institutions, and private businesses to offer AI-focused sessions tailored to the tourism industry.

Government support and financial incentives are also essential to encourage AI adoption, particularly among small and medium-sized enterprises (SMEs). Tax incentives, technology adoption subsidies, and low-interest loans can help offset implementation costs. Additionally, policies ensuring data privacy, security, and ethical AI use are critical to foster responsible adoption in line with cultural and societal standards. Public awareness and engagement campaigns should educate both tourists and business owners about the potential benefits of AI, including

improved customer experiences, enhanced security, and operational efficiency. Building trust and overcoming cultural resistance are vital for widespread acceptance. Finally, fostering collaboration between government bodies, the private sector, and academic institutions is crucial to accelerating AI integration. Public-private partnerships can drive the development of AI solutions tailored to the unique needs of Peshawar's tourism sector, ensuring sustainable growth and modernization.

Conclusion

Artificial Intelligence (AI) offers transformative potential for Peshawar's tourism and hospitality sector by enhancing visitor experiences, improving operational efficiency, and strengthening security measures. Globally, AI applications such as predictive analytics, chatbots, virtual assistants, and facial recognition have proven effective in streamlining operations, personalizing services, and ensuring tourist safety. Despite these benefits, adoption in Peshawar remains limited due to gaps in digital infrastructure, high implementation costs, cultural resistance, and a shortage of skilled workforce. AI can address these challenges by providing personalized travel recommendations, automated booking and check-in systems, efficient housekeeping management, and AI-driven translation tools to overcome language barriers. To achieve this, strategic investments in high-speed internet, computing infrastructure, workforce training, government incentives, and public awareness campaigns are essential. Collaboration between government, private businesses, and academic institutions will ensure sustainable, culturally aligned AI solutions. By embracing AI, Peshawar can modernize its tourism sector, attract more visitors, enhance competitiveness, and achieve long-term economic growth while promoting innovation and sustainable development.

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