Digital Empowerment Of Tourist Attractions: Strengthening Language Service Delivery

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This study examines how digital language support services improve communication, visitor interaction, and service quality at multilingual tourist attractions. A mixed-method approach was used, involving quantitative data from 200 respondents through structured questionnaires and qualitative insights from 30 participants using interviews and focus group discussions. Quantitative analysis included descriptive statistics, Cronbach's Alpha, Pearson correlation, and multiple regression, while qualitative data were analyzed through thematic coding and frequency mapping. The findings indicate moderate to high satisfaction with digital language services. Technology-related satisfaction recorded the highest mean score (3.14), whereas translation accuracy showed the lowest (3.01), suggesting a need for improvement. Correlation analysis revealed that language barriers negatively affect tourist satisfaction (r = -0.369), while effective digital language services positively influence satisfaction (r = 0.417). Regression analysis (R^2 = 0.712) showed that usability is the strongest predictor of tourist satisfaction. The study emphasizes the importance of accurate, user-friendly, and context-aware digital language systems in multilingual tourism environments.

Keywords: Digital Language Services; Tourist Satisfaction; Artificial Intelligence (AI); Language Barriers; Usability

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1. Introduction

The global tourism industry has experienced rapid growth because it creates connections between people who speak different languages and follow different cultural traditions [1]. Tourists and service providers face major difficulties because language barriers prevent them from achieving proper communication [2]. Many tourist attractions still rely on limited language support which provides access to only a few common languages [3]. The limitation hinders international tourists from fully experiencing the attraction because it makes certain parts of the experience less available and less interesting [4]. Digital technological advancements create more opportunities to improve communication and deliver better service in tourism environments [5]. Tourists in real-world situations experience problems when they try to understand information from signboards and guides and interactive displays because of their inability to understand different languages [6]. The difficulties become most apparent in areas which lack proper implementation of multilingual assistance [7]. The problem arises from three key factors which include the absence of trained multilingual personnel and the insufficient availability of translation materials and the use of fixed information systems [8]. Digital language tools enable multilingual communication; this study evaluates satisfaction, readiness, and effectiveness using mixed methods. Previous studies on digital language services in tourism have mainly focused on translation accuracy and basic usability evaluation. The current digital tools used in tourism are not completely connected to the entire tourism system, which results in different experiences for users [9]. Tourists end up experi-

encing three negative outcomes which include confusion about their surroundings and lower happiness levels and difficulties joining cultural and educational activities [10].

The tourism industry studies digital language tools for research purposes but existing studies focus only on technological capabilities which they measure through translation accuracy and they fail to assess important user-centered factors which include usability and satisfaction and communication success in actual tourism environments. The study addresses this research gap through its mixed-method approach which combines quantitative analysis of tourist perceptions with qualitative insights from user experiences. The research provides an all- encompassing framework which evaluates digital language solutions through their impact on communication efficiency and their effect on tourist contentment. The current research establishes a comprehensive understanding of how multilingual tourism environments affect digital tool adoption through its examination of both recommendation intention and actual usability and effectiveness results.

2. Literature review

2.1. Digital Empowerment and Community Development in Tourism

Digital platforms enhance tourism marketing, economy, skills, and language proficiency [3].

2.2. Digital Education and Workforce Development in Tourism

Research shows digital empowerment and education enhance human resources. Digital service-learning supports sustainability [4]. Training programs in digital literacy, AI tools, and communication enhance staff skills, enabling effective multilingual assistance and improving workforce readiness in tourism environments.

2.3. Language Proficiency and Multilingual Communication in Tourism

Multilingual education equips students with essential skills for tourism employment [5, 6].

2.4. Digital Innovation and Technology in Tourism Services

Technology improves satisfaction, but maintaining human interaction remains essential [7]. AI and NLP-based digital language tools using transformers, RNNs, chatbots, and voice assistants improve real-time multilingual communication, accuracy, personalization, and user satisfaction in tourism.

2.5. Problem Statement

Digital language frameworks face accuracy, context issues, rely on quantitative methods, overlooking real user challenges and experiences [8].

2.6. Theoretical Framework

Framework combines satisfaction and smart tourism theories to assess impact [9] evaluates performance, linking usability, accuracy, service quality to satisfaction [10]

3. Experimental setup

3.1. Conceptual Framework and Hypothesis Development

3.1.1. Conceptual Framework

Fig. 1 shows satisfaction factors; H1 states language barriers reduce tourist satisfaction through signage, staff communication, and cultural differences.

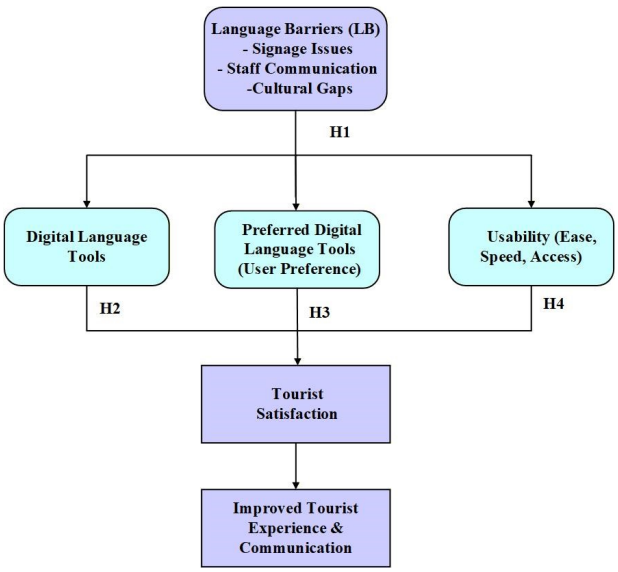

Fig. 1. Conceptual Framework for Evaluating the Impact of Digital Language Services on Tourist Satisfaction and Communication.

3.2. Hypothesis Development

H1: Language Barriers Impact Satisfaction (Poor language understanding reduces tourist satisfaction)

H2: Digital Solutions Enhance Satisfaction (Digital tools improve communication and visitor experience)

H3: Preference for Digital Tools (Tourists prefer AI apps for easy real-time translation)

H4: Staff Confidence Through Digital Tools (AI tools help staff communicate better and confidently)

3.3. Research Methodology

Fig. 2 shows problem identification, followed by mixed methods: interviews, focus groups (30) and surveys (200). Pipeline processes user queries using AI translation, semantic analysis, and delivers responses via apps or chatbots.

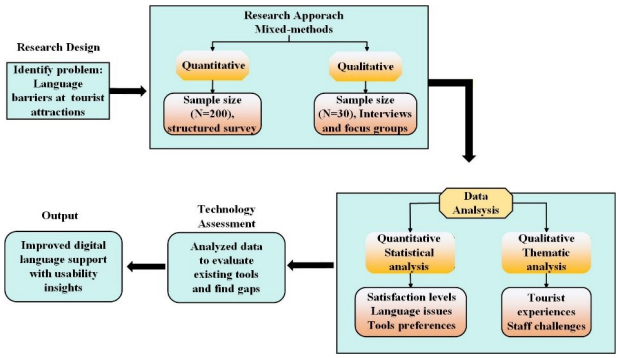

Fig. 2. Proposed Mixed-Method Workflow for Enhancing Digital Language Service Delivery in Tourist Attractions.

3.4. Research Design

Study identifies language barriers, sets objectives, designs framework. Research follows structured design: problem identification, data collection, preprocessing, statistical and thematic analysis, and integrated evaluation of digital language services.

3.5. Data Collection Procedure

Convenience sampling limits generalizability; future studies should use probability sampling, consider seasonal effects, and improve validity using Likert-based constructs. Mixed methods analyzed tourist satisfaction, barriers, usability, and preferences.

3.6. Study Variable

Independent variables (usability, accuracy, language barriers) and dependent variables (tourist satisfaction, communication effectiveness, experience) are analyzed to evaluate digital tool effectiveness.

3.7. Data Analysis

Study uses quantitative and qualitative analysis to identify usability, language barriers, and digital effectiveness affecting tourist satisfaction and communication issues.

3.8. Technology Assessment

Evaluation of digital tools shows moderate satisfaction, frequent language issues, and limitations in context, usability, accuracy, and responsiveness. Visitor flow impacts performance; scalability, reliability, interoperability ensure consistent multilingual tourism communication and translation quality.

4. Results and discussion

4.1. Quantitative analysis

4.1.1. Demographic Profile of Respondents

Table 1 shows 200 respondents: balanced age groups, slightly more males, diverse tourists, mostly Bachelor's degree holders, representing domestic and international visitors.

ANOVA shows satisfaction differences by nationality, visit purpose, and age; domestic and leisure tourists report higher satisfaction, confirming demographic variation and need for adaptive digital language services.

4.1.2. Tourist Satisfaction with Language Support Services

Fig. 3 show moderate satisfaction (mean 3.07). Usability and cultural understanding are moderate; users need assistance.

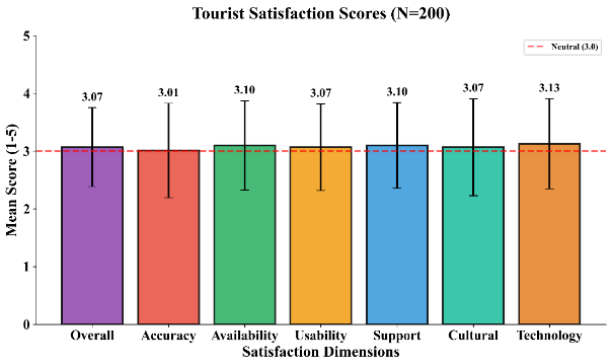

Fig. 3. Tourist Satisfaction Scores across Language Support Dimensions.

4.1.3. Preferred Language Support Methods

Table 2 shows mobile apps are most preferred translation devices for language assistance.

4.1.4. Perceived Impact of Digital Language Solutions

Table 3 shows high perceived improvement, engagement, and accessibility.

4.1.5. AI Adoption and Staff Readiness

Table 4 shows strong preference and interest in AI solutions. AI adoption depends on usefulness, ease, familiarity, improving communication efficiency in tourism.

4.1.6. Usability of Digital Language Tools

Table 5 shows high usability, ease of use, and interaction.

Table 1. Demographic Profile of Respondents.

Variable	Category	Frequency	Percentage (%)
Gender	Male	115	57.5
	Female	85	42.5
Age Group	18-30	58	29
	31-45	61	30.5
	46-60	59	29.5
	60+	22	11
Nationality	Domestic	78	39
	Asian	58	29
	Western	64	32
Education	Higher school or below	19	9.5
	Bachelor's Degree	90	45
	Master's Degree	63	31.5
	Doctorate	17	8.5
	Other	11	5.5
Visit Purpose	Leisure	103	51.5
	Business	30	15
	Education	38	19
	Other	29	14.5
Visit Frequency	First Time	91	45.5
	Repeat (2-5 times)	87	43.5
	Frequent (6+ times)	22	11

Table 2. Preferred Language Support Methods among Tourists.

Preferred Methods Frequencies				
		Responses		Percent of Cases
		N	Percent	
Preferred Methods	Q9a_MobileApp	145	55.1%	72.5%
	Q9b_MultilingualSign	45	17.1%	22.5%
	Q9c_HumanAssistance	35	13.3%	17.5%
	Q9d_TranslationDevice	38	14.4%	19.0%
Total		263	100.0%	131.5%

Table 3. Descriptive Statistics of Perceived Improvements in Digital Language Services.

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Q10_ImpOverall	200	2	5	4.04	0.785
Q11_ImpRealtime	200	2	5	3.93	0.871
Q12_ImpAI	200	1	5	3.98	0.835
Q13_ImpMultilingual	200	2	5	3.97	0.885
Q10b_ImpAccess	200	1	5	3.99	0.908
Q10c_ImpEngage	200	1	5	4.01	0.856

Table 4. Descriptive Statistics of AI Adoption and Staff Readiness for Digital Language.

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Q16_InterestedAI	200	1	2	1.20	0.401
Q17_StaffConfidence	200	1	5	3.30	1.169
Q18_StaffDigitalUse	200	1	5	3.31	1.179
Q19_StaffImproved	200	1	2	1.27	0.442

4.1.7. Data Quality and Reliability Analysis

Table 6 confirms strong reliability and internal consistency of constructs.

Strong reliability confirmed; CFA improved validity, with usability variations due to literacy and infrastructure factors.

Table 5. Descriptive Statistics of Usability Evaluation of Digital Language Tools.

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Q20_UsabilityRating	200	1	5	3.81	1.040
Q20b_UsabilityEase	200	1	5	3.87	0.926
Q20c_UsabilitySpeed	200	1	5	3.76	1.035

Table 6. Corrected Item-Total Statistics for Measurement Scales in Digital Language Service .

Construct	Item	Corrected ItemTotal Correlation	Decision
Satisfaction	Q1-Q5	0.81-0.90	Retained
Language Barriers	Q6-Q8	0.85-0.90	Retained
Digital Improvements	Q10Q13	0.79-0.89	Retained
Usability	Q20aQ20c	0.62-0.78	Improved
Staff Readiness	Q16Q19	0.60-0.75	Improved

4.1.8. Reliability Analysis

Table 7 shows excellent reliability with Cronbach's Alpha 0.951.

4.1.9. Correlation Analysis

Table 8 shows correlations between satisfaction, barriers, and digital services. Language barriers negatively affect satisfaction; Pearson assumptions met, supporting linear relationships and validating digital tools' role in improving tourism experience.

4.1.10. Regression Analysis

Table 9 shows regression coefficients indicating usability strongest predictor of tourist satisfaction. SEM models relationships; no multicollinearity ensures stable, reliable regression coefficients and robust validation. Table 10 confirms strong factor structure for all five constructs.

Table 11 shows good CFA model fit indices overall.

4.2. Qualitative Analysis

Qualitative analysis identified themes: language barriers, communication, and digital usage. Thematic analysis used coding, inter-coder reliability, and achieved data saturation with no new themes emerging.

4.2.1. Language Barriers Faced by Tourists

Fig. 4 shows signage and communication barriers affecting visitor experience.

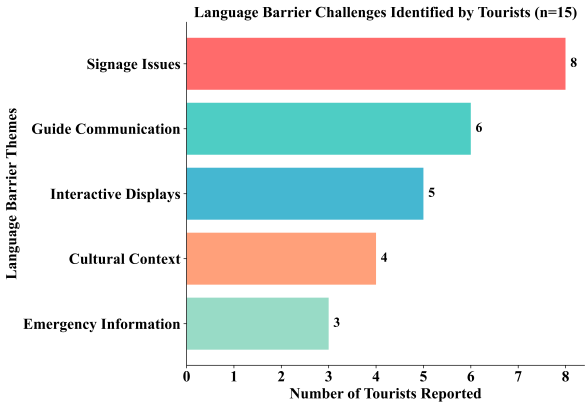

Fig. 4. Language Barrier Challenges Identified by Tourists.

4.2.2. Desired Digital Features

Fig. 5 shows real-time translation as the most desired feature among tourists. Voice technologies enhance real-time multilingual communication, improving accessibility and user engagement.

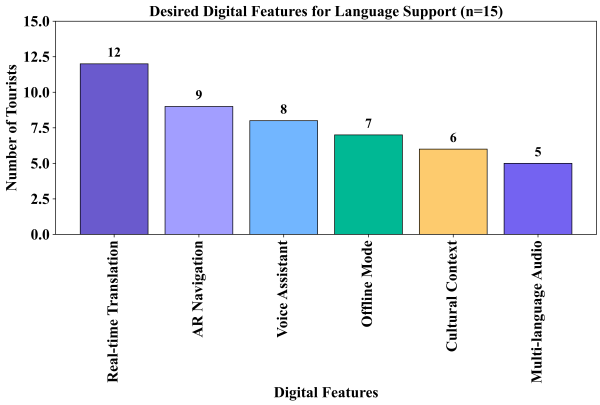

Fig. 5. Desired Digital Features for Language Support.

4.2.3. Staff Challenges in Communication

Fig. 6 shows staff communication challenges, especially technical terminology issues. Training and AI translation tools improve staff communication efficiency and tourism service delivery.

Table 7. Reliability Analysis of Measurement Scales Using Cronbach's Alpha.

Scale	Cronbach's Alpha	No. of Items
Overall Measurement Scale	0.951	7
Usability Scale	0.938	3
Digital Language Service Effectiveness Scale	0.942	6
Language Barrier Issues Scale	0.714	3
Staff Readiness & Digital Tool Usage Scale	0.920	4

Table 8. Pearson Correlation Analysis among Satisfaction, Language Barriers, Digital Improvements, and Recommendation.

Variables	Satisfaction (Q1)	Issues (Q6)	Improvement (Q10)	Recommendation (Q15)
Satisfaction (Q1)	1	-0.369	0.417	0.006
Issues (Q6)	-0.369	1	-0.185	0.028
Improvement (Q10)	0.417	-0.185	1	-0.103
Recommendation (Q15)	0.006	0.028	-0.103	1

Table 9. Regression Coefficients for Factors Influencing Tourist Satisfaction.

Coefficients [a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.724	0.213		3.398	0.001
	Q6_IssueOverall	-0.061	0.027	-0.094	-2.305	0.022
	Q10_ImpOverall	0.090	0.036	0.103	2.468	0.014
	Q14_UseDigital	0.033	0.080	0.016	0.409	0.683
	Q4_SatUsability	0.694	0.040	0.761	17.439	0.000

Table 10. Exploratory Factor Analysis.

Factor	Items	Factor Loadings	Eigenvalue	Variance Explained (%)
Satisfaction	Q1-Q5	0.72 0.88	4.21	28.4
Language Barriers	Q6-Q8	0.70 0.85	2.13	16.2
Digital Improvements	Q10-Q13	0.74 0.89	3.56	22.7
Usability	Q20a-Q20c	0.71 0.84	1.98	14.3
Staff Readiness	Q16-Q19	0.69 0.82	1.76	12.1

Table 11. Confirmatory Factor Analysis Model Fit Indices for the Measurement Model.

Fit Index	Value	Threshold	Status
CFI	0.931	> 0.90	Good
TLI	0.922	> 0.90	Good
RMSEA	0.061	< 0.08	Good
SRMR	0.049	< 0.08	Good
Chi-square/df	2.31	< 3	Acceptable

4.2.4. *Technology Implementation Challenges*

Fig. 7 improved algorithms, training, integration, and usability enhance digital language tools in tourism environments.

4.2.5. *Regional Differences in Language Barriers*

Fig. 8 shows Asian tourists report highest language barriers.

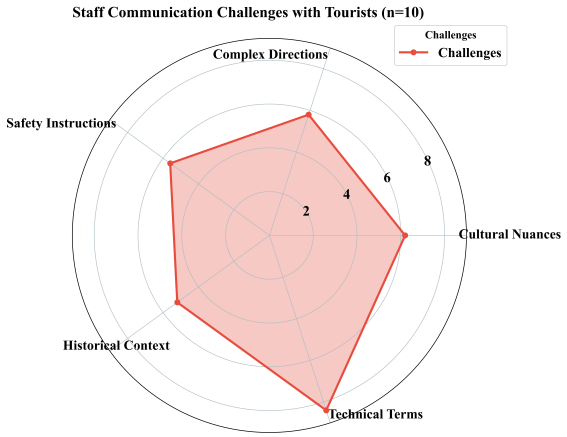

Fig. 6. Staff Communication Challenges with Tourists.

4.3. Discussion

Qualitative findings support quantitative results, strengthening mixed-method study contribution. Integrated tick-

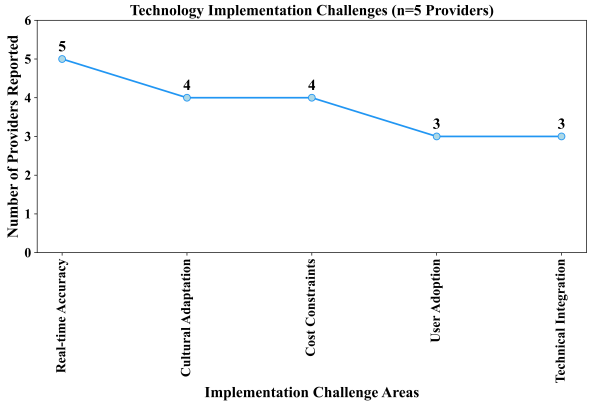

Fig. 7. Technology Implementation Challenges (n=5 Providers).

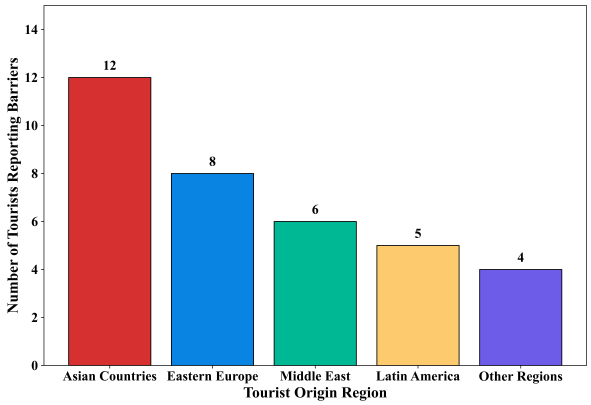

Fig. 8. Language Barrier Frequency by Tourist Origin Region.

eting and multilingual systems improve accessibility and visitor flow. Findings show strong usability impact on satisfaction. Results are valid but limited by geography; future research should expand cross-regional samples. The study shows relationships among usability, staff confidence, and satisfaction, but lacks causal modeling, with possible mediation, moderation, translation issues, infrastructure constraints, and scalability challenges in real-world deployment.

5. Conclusion

This study evaluated four factors—usability, accuracy, availability, and technological efficacy—to assess the impact of digital language support services on visitor satisfaction in multilingual tourism environments. The findings revealed an overall average satisfaction score of 3.07, indicating moderate effectiveness of digital language tools. Technology-related satisfaction achieved the highest mean score (3.14), while translation accuracy received the lowest score (3.01), highlighting challenges in contextual understanding and precise translation.Prioritize user-friendly design, AI translation, staff training, and offline functionality for improved tourism services systems. Reliability analysis showed strong internal consistency for most constructs, although usability and staff readiness displayed weaker correlations. Correlation analysis indicated that language barriers negatively affect visitor satisfaction (r = -0.369), whereas digital service improvements positively influence satisfaction (r = 0.417). Regression analysis demonstrated a strong predictive model (R^2 = 0.712), identifying usability as the most significant factor influencing satisfaction. The study recommends improving translation accuracy, contextual intelligence, staff digital training, and adopting advanced technologies such as AI translation, voice assistants, and augmented reality to enhance multilingual tourism experiences.

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Author contribution

Lin Mei conceptualized the study, designed the research framework, and led the investigation. She was primarily responsible for data collection, analysis, and interpretation, as well as drafting the original manuscript.

Wangping Zou contributed to the methodology development, provided technical and analytical support, and assisted in data validation. He also participated in reviewing and editing the manuscript for important intellectual content.

Both authors read and approved the final manuscript and agree to be accountable for all aspects of the work.

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