

ENHANCING MUSEUM CIRCULATION THROUGH EFFECTIVE WAYFINDING DESIGN: A CASE STUDY OF JALINGO

Okeke Daniel Chukwuma

Department of Architecture, Faculty of Architecture, Bingham University Karu, Nasarawa State.

DOI: <https://doi.org/10.5281/zenodo.17192635>

Abstract

This study investigated wayfinding as a critical component of museum design, focusing on its role in enhancing circulation, visitor experience, and inclusivity. Drawing on case studies across museums in North-Central and North-Eastern Nigeria, the research employed a mixed-methods approach involving built environment professionals, construction experts, curators, and tourists. A total sample of 674 respondents was derived using Taro Yamane's formula, ensuring representativeness across strata. Data collection involved questionnaires, structured interviews, and observational studies, while analytical tools such as Space Syntax, Agent-Based Modeling, and thematic coding were applied to evaluate spatial legibility, crowd flow, and cultural navigation elements. Findings reveal that museum wayfinding is most effective when supported by integrated design strategies including clear building layouts, multisensory cues, cultural wayfinding elements, and technological aids. The results underscore that intuitive navigation not only enhances visitor satisfaction and learning but also reduces congestion, improves accessibility for diverse groups, and supports the sustainability of museum operations.

Keywords: Accessibility, Circulation, Inclusive design, Museum, Wayfinding.

1.0 INTRODUCTION

Tourism is one of the fastest-growing industries globally, contributing significantly to economic growth, cultural exchange, and social development (Otusha, 2016; Sadiq et al., 2020). Defined as the movement of people to destinations outside their usual environment for purposes of leisure, education, or cultural enrichment (United Nations World Tourism Organization [UNWTO], 2011), tourism enhances local economies, fosters community development, and improves quality of life. Within this sector, museums play a central role by preserving cultural heritage, offering educational experiences, and serving as recreational attractions that strengthen cultural identity and promote sustainable tourism (Obiadi et al., 2020).

The effectiveness of museums, however, extends beyond the richness of their collections; it depends significantly on the quality of visitor experience. Wayfinding, the process of orienting and navigating within a physical environment, is a critical factor shaping how visitors interact with museum spaces. As Inalegwu (2015) and Odetoye et al., (2017) emphasize, museum design must prioritize accessibility, comfort, and spatial clarity to facilitate meaningful engagement. Poorly organized layouts often lead to congestion in some areas, underutilization of exhibits in others, and overall disjointed experiences, thereby undermining the educational and cultural mission of museums.

Central to wayfinding is the study of walk-flow patterns, which describe the natural paths visitors take as influenced by exhibit arrangement, signage, circulation routes, and architectural configuration (Bitgood, 2010). Optimizing these patterns ensures balanced visitor distribution, reduces bottlenecks, and enhances engagement with displays. Yet, many museums in Nigeria face challenges of inadequate spatial planning, limited use of visitorflow research, and insufficient integration of design strategies that promote intuitive navigation (Bomi-Daniels, 2022). Such limitations compromise accessibility and diminish the potential of museums as cultural and educational institutions.

Jalingo, the capital of Taraba State, is a city with rich historical and cultural heritage that provides an opportunity for museums to become vibrant hubs of tourism and education (Our Africa, 2015). However, the absence of evidence-based design approaches in the planning of museum facilities in the region has constrained their effectiveness. Poor wayfinding can result in overcrowded areas, unvisited exhibits, and reduced visitor satisfaction, ultimately weakening the museum's role in cultural preservation and tourism development (Bitgood, 2015). Addressing these shortcomings is critical to ensuring that museums in Jalingo and similar contexts achieve their full potential as inclusive, engaging, and accessible public spaces. This study is therefore justified by the need to integrate wayfinding principles into museum design in order to improve visitor experience, promote cultural learning, and optimize spatial use. By examining design elements that influence circulation and visitor interaction, the research seeks to generate evidence-based recommendations that will assist architects, planners, and curators in creating user-centered museum environments. The findings will not only benefit museums in Jalingo but will also contribute to broader discourse on cultural infrastructure in Nigeria, advancing sustainable cultural tourism and enhancing the role of museums in education, recreation, and community development.

This study aims to enhance wayfinding and visitor interaction through the design of a museum in Jalingo, Taraba State, Nigeria. Consequently, the objectives of the study are to: (i) identify design elements that support wayfinding and visitor interaction in museum spaces, (ii) appraise the influence of these design elements on circulation and engagement within museums and (iii) determine the significance of wayfinding principles in optimizing spatial organization for improved museum experience.

1.1 Relevance to Sustainable Development Goals (SDGs)

This study aligns with the United Nations Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), by improving museum accessibility as platforms for cultural learning, and SDG 11 (Sustainable Cities and Communities), which emphasizes the preservation of cultural heritage and the creation of inclusive, accessible public institutions. Indirectly, it contributes to SDG 3 (Good Health and Well-being) by reducing overcrowding and stress during museum visits, and SDG 8 (Decent Work and Economic Growth) by fostering cultural tourism as a driver of local economic development. By integrating wayfinding principles into museum design, this study offers evidence-based strategies to optimize circulation, enhance visitor interaction, and strengthen the role of museums as sustainable cultural and educational assets (United Nations [UN], 2015; World Health Organization [WHO], 2022).

2.0 LITERATURE REVIEW

Wayfinding is increasingly recognized as a core dimension of museum design, influencing how visitors navigate, interact with, and learn from exhibits. Studies have demonstrated that circulation strategies and spatial clarity significantly affect visitor satisfaction, engagement, and cultural experience (Bitgood, 2015; Al-Maiyah, 2020). This review synthesizes literature around the study objectives to highlight design elements, their influence on visitor interaction, and the significance of wayfinding principles in creating inclusive, navigable, and culturally enriching museum environments.

2.1 Design Elements that Enhance Wayfinding and Visitor Interaction

Effective wayfinding in museum environments relies on physical, sensory, and technological design interventions.

- i. **Building Layout:** A clear and legible spatial organization enables visitors to orient themselves without cognitive strain. Simple circulation strategies, such as looped or radial layouts, open sightlines, and clear spatial hierarchies, allow visitors to understand their location and anticipate possible routes (Marquez & Church, 2019). Poorly structured layouts, on the other hand, can create dead ends, bottlenecks, and confusion, reducing visitor engagement.
- ii. **Multi-Sensory Cues:** Museums increasingly integrate sensory signals to enhance orientation. Tactile surfaces, varied lighting, and auditory cues subtly direct circulation and provide inclusive navigation for visitors with visual or cognitive impairments (Ahmadpour & Wood, 2021). Such cues improve not only accessibility but also visitor comfort, promoting inclusive design in line with universal design principles.
- iii. **Technological Tools:** Digital innovations such as interactive kiosks, mobile apps, and augmented reality systems provide personalized navigation support. These tools suggest customized pathways, distribute visitor flow, and encourage active participation with exhibits, especially in large or complex museums (Kounavis & Kasimati, 2019). Technology thereby serves both as an orientation device and as an engagement tool, enriching learning outcomes.

2.2 Influence of Design Elements on Wayfinding and Visitor Interaction

The integration of spatial and interactive design elements influences how visitors experience museums both cognitively and emotionally.

Studies reveal that intuitive layouts reduce anxiety and enhance confidence, enabling visitors to devote more attention to exhibitions rather than navigation (Marquez & Church, 2019). Inclusive cues such as tactile pathways, visual contrasts, and auditory signals have been shown to empower diverse visitor groups, ensuring equitable access to cultural content (Ahmadpour & Wood, 2021). Meanwhile, interactive technologies provide not just orientation but deeper interpretive engagement, aligning wayfinding with educational objectives (Kounavis & Kasimati, 2019). When these elements are absent or poorly integrated, visitors often experience disorientation, congestion, and disengagement, limiting the museum's educational and cultural mission. Thus, design interventions serve a dual role: guiding circulation while facilitating interaction with exhibits.

2.3 Significance of Design Principles for Wayfinding and Visitor Interaction

The significance of wayfinding principles lies in their contribution to accessibility, inclusivity, and cultural sustainability. Well-designed circulation supports smooth visitor flow, equitable access to exhibits, and improved educational outcomes (Bitgood, 2015). Inclusive design emphasizing tactile, auditory, and visual signals ensures that all visitors, including those with disabilities, can meaningfully engage with museum spaces (Ahmadpour & Wood, 2021). Furthermore, integrating cultural markers into wayfinding design reinforces local identity and deepens emotional connection. Mwangi (2020), for instance, demonstrated that incorporating Maasai beading patterns into museum signage in Nairobi improved navigation effectiveness and cultural resonance. Such interventions not only enhance spatial orientation but also affirm museums as custodians of cultural identity.

Interactive digital tools expand this impact by encouraging active learning and distributing visitor density across galleries, reducing congestion and improving overall satisfaction (Park & Lee, 2021). In this sense, wayfinding principles are not merely functional; they are integral to museums' role as inclusive, educational, and culturally meaningful institutions.

2.4 Techniques for Evaluating Wayfinding

Evaluating circulation and wayfinding in museums increasingly draws upon computational and participatory tools:

- i. **Space Syntax Analysis:** Techniques such as Visibility Graph Analysis (VGA) and Depthmap software allow architects to quantify visibility, spatial integration, and connectivity. Al-Maiyah (2020) used VGA in the British Museum to identify natural gathering areas, while Essayed (2023) applied Depthmap to the Louvre Abu Dhabi, improving alignment and reducing backtracking by 20%.
- ii. **Agent-Based Modeling (ABM):** ABM simulates visitor behavior using programmed rules of attraction and movement. Bello (2024) demonstrated that redistributing popular exhibits across galleries in the Benin City Museum reduced congestion by 30%.
- iii. **Design Interventions:** Adaptive and culturally embedded approaches, such as dynamic pathways and culturally meaningful signage, have proven effective. Park & Lee (2021) highlighted the role of flexible partitions in Seoul's Dynamic Museum, while Mwangi (2020) illustrated how cultural motifs improved both navigation and visitor satisfaction.

2.5 Theoretical Framework

This study is anchored on **Space Syntax Theory** and **Cognitive Mapping Theory**, both of which provide the conceptual foundation for evaluating double skin façade (DSF) systems in enhancing energy efficiency.

2.5.1 Space Syntax Theory

Developed by Hillier and Hanson (1984), Space Syntax provides a quantitative framework for analyzing spatial configurations and their influence on human movement. It evaluates connectivity, visibility, and integration to predict circulation and interaction patterns (Hillier, 2007). Space Syntax has been widely applied in museum studies to assess visitor flows, optimize layouts, and identify high-value exhibit zones

(Al-Maiyah, 2020; Essayed, 2023). For this research, it offers a rigorous basis for examining how museum layouts in Jalingo can enhance wayfinding and circulation efficiency.

2.5.2 Cognitive Mapping Theory

Originally conceptualized by Tolman (1948) and later expanded by Lynch (1960), cognitive mapping explains how individuals form mental representations of spatial environments to navigate and make decisions. In museum contexts, cognitive mapping highlights the role of landmarks, paths, and nodes in aiding orientation (Kaplan, 2018). This framework is crucial for understanding how visitors perceive and interact with museum spaces, informing design strategies that reduce disorientation and improve engagement.

Together, Space Syntax Theory and Cognitive Mapping Theory provide complementary insights: the former analyzes spatial configurations objectively, while the latter captures subjective visitor perception, enabling a holistic understanding of wayfinding in museum design.

3.0 METHODOLOGY

This section describes the methodology used in this study. It describes the study location, the study area and methods chosen for this study.

3.1 The Study Area: Abuja

Abuja is the study area located in the central part of Nigeria north of the confluence of the Niger and Benue Rivers. This city lies between the latitude of 8°25'N to 9°25'N and longitude 6°45'E to 7°45'E and has a land area of 8000 km² which makes it almost two and a half times the size of Lagos State. It is bounded by Kaduna State to the North, Kogi State to the south, and Niger State to the West and Nasarawa State to the East (Isma'il, & Abubakar, 2024). Abuja has a population of about 8 million as projected from 2006 National Population Commission Census (NPC, 2019) (Figure 1).

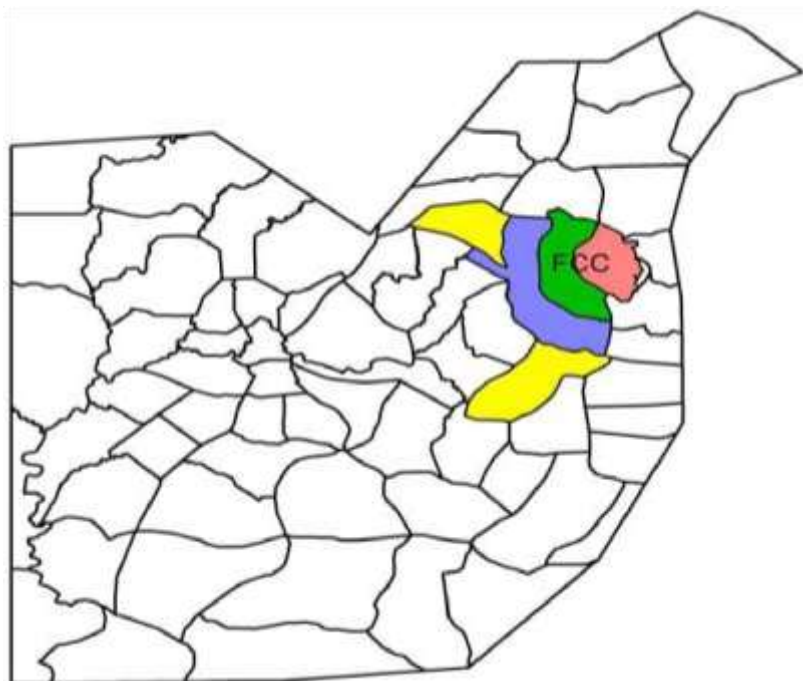


Figure 1: Map of FCT, showing Area Councils (not to scale).

Source: Department of Geography and Planning, University of Jos, 2024.

3.2 Population of the Study

The study population comprised selected museums across the North-Central and North-Eastern geopolitical zones of Nigeria. Four museums were purposively chosen: National Museum Jos, National Museum Kaduna, Gidan Makama Museum Kano, and Discovery Museum Abuja. The target population included:

1. Built environment professionals (architects and engineers registered with ARCON and COREN) who influence spatial design and integration of wayfinding systems?
2. Other construction professionals (quantity surveyors and builders) who affect the feasibility and implementation of these designs.
3. Tourists and visitors who provide essential feedback on the clarity and usability of circulation systems.
4. Curators and cultural policymakers who shape operational strategies and long-term management of circulation in museums.

3.3 Sample Size

The sample size was determined using Taro Yamane's (1967) formula at a 5% margin of error. Calculations were performed separately for each stratum, yielding a total sample size of 674 respondents (Table 1).

The sample size for this study was calculated using the Taro Yamane's formula (1967) for sample size was used. The formula is expressed below:

$n = N / [1 + N (e)^2]$ - - - Equation 1 Where:

n = sample size N = population size (63)

e = margin of error (typically 0.05 for 95% confidence level)

Table 1: Proportional Sample Distribution for Questionnaire Survey

Category	Population (N _i)	Sample Size (n _i)
Architects/Engineers	200	134
Quantity Surveyors/Builders	150	110
Tourists	10,000	385
Curators/Stakeholders	50	45
Total	10,400	674

Source: Field work, 2025.

3.4 Sampling Techniques

A combination of sampling strategies was employed. **Purposive sampling** guided the selection of case study museums and expert respondents, focusing on individuals and institutions directly involved with museum wayfinding. For tourists, **stratified random sampling** was used across the four museums, ensuring diversity by capturing responses over multiple weeks and varying visitation days. Additionally, **snowball sampling** facilitated access to additional respondents through professional and stakeholder networks.

3.5 Data Collection and Analysis

Primary data were collected using structured questionnaires, interviews, and observational surveys within the selected museums. Quantitative data were analyzed using descriptive statistics to identify wayfinding trends, while qualitative responses were thematically coded to capture expert insights.

4.0 RESULTS AND DISCUSSION

4.1 Objective 1: To examine the demographic and professional composition of museum visitors and stakeholders in relation to wayfinding

Variable	Category	Frequency	Percentage (%)
Age	≤20	76	11.3
		151	22.4
		133	19.7
		128	18.9
			27.8
Profession	Architects/Designers		
	Engineers		23.2
	QS & Builders		21.1
	Museum Managers		
	Policy Makers	123	18.1

Table 2: Demographic and professional distribution of respondents

21-30			
31-40			
41-50			
	≥51	188	
		124	18.4
157			
143		127	18.7
Work Category	Government Workers	151	22.4
	Private Workers	128	18.9
	Museum Workers	143	21.3
	Policy Makers	142	21.1
	Others	110	16.3

Source: Field work, 2025.

Findings in Table 2, show a balanced representation across age groups, with the majority between 21–30 years (22.4%). Professionally, engineers (23.2%) and quantity surveyors (21.1%) were the largest groups, alongside architects (18.4%) and museum managers (18.7%), ensuring both technical and operational expertise were captured. The work categories also reflect diversity, with nearly equal shares among government, museum, and policy professionals. This demographic and professional spread validates the inclusivity of the sampled population and ensures reliability of insights into wayfinding experiences.

4.2 Objective 2: To assess the effectiveness of spatial layouts and circulation systems in supporting museum wayfinding

Table 3: Respondents' evaluation of spatial layout and circulation

Indicator		Agree (%)	Neutral (%)	Disagree (%)
Clarity	of spatial layout	28.5	12.5	59.0
Visibility	of landmarks/sightlines	26.0	12.9	61.1
Adequacy of lighting	for circulation	27.3	13.5	59.2
Ceiling height	for spatial definition	26.5	14.0	59.5

Circulation pattern effectiveness	25.7	13.2	61.1
-----------------------------------	------	------	------

Source: Field work, 2025.

From Table 3, majority of respondents rated the spatial layouts poorly, with 59% disagreeing that the arrangement was clear. Visibility of landmarks (61.1%) and ceiling heights (59.5%) were also judged inadequate. Similarly, circulation patterns including linear, hub, and thematic systems were ineffective, as reported by over 61% of respondents. These findings underscore the absence of spatial clarity and orientation cues in existing museums, suggesting that design improvements are crucial to enhance circulation.

4.3 Objective 3: To evaluate the role of signage, maps, and wayfinding aids in enhancing navigation within museums

Table 4: Respondents' assessment of signage and wayfinding aids

Indicator		Agree (%)	Neutral (%)	Disagree (%)
Directional clarity	signage	28.7	11.3	60.0
Identification visibility	signage	29.0	12.3	58.7
Maps at points	decision	27.5	11.5	61.0
Consistency of icons/colours/fonts		31.2	13.3	55.5
Multilingual information		26.7	12.5	60.8
Digital apps	navigation	27.1	12.6	60.3
Availability of human guides		25.9	13.3	60.8

Source: Field work, 2025.

Signage and maps were consistently rated ineffective, with 60% of respondents dissatisfied with directional cues and 61% noting poor placement of maps. Inconsistencies in icons and fonts (55.5%) and the absence of multilingual content (60.8%) further weakened legibility. Even digital aids and human guides were considered inadequate, indicating a lack of integrated wayfinding strategies (Table 4). These results reveal that both traditional and modern tools are fragmented, reducing their effectiveness in aiding navigation.

4.4 Objective 4: To analyze the implications of wayfinding systems on visitor experiences and satisfaction

Table 5: Implications of ineffective wayfinding on visitor experience

Indicator	Agree (%)	Neutral (%)	Disagree (%)
Wasted time due to poor navigation	61.1	13.5	25.4
Missed exhibits	54.7	14.2	31.1
Physical fatigue	62.9	13.1	24.0
Anxiety and confusion	56.3	15.4	28.3
Early departure from museum	58.2	14.5	27.3

Source: Field work, 2025.

Poor wayfinding had severe consequences for visitor experience. Over 61% reported wasted time, while 54.7% missed exhibits entirely, undermining cultural and educational objectives. Physical fatigue (62.9%) and psychological stress such as anxiety and confusion (56.3%) were widespread, with some visitors leaving earlier than intended (58.2%). These outcomes highlight how ineffective wayfinding compromises not only functional circulation but also visitor satisfaction, learning, and cultural appreciation (Table 5).

4.5 Summary of Findings

The results reveal critical shortcomings in current museum wayfinding systems. Demographic diversity among respondents provided balanced perspectives, reinforcing reliability of findings. Across objectives, spatial layouts and circulation patterns lacked clarity, while signage and wayfinding aids were inconsistent, fragmented, and linguistically limited. These weaknesses negatively impacted visitor experience, leading to wasted time, missed exhibits, fatigue, and frustration. Collectively, the findings emphasize the urgent need for holistic, user-centered wayfinding strategies that integrate spatial design, clear signage, digital tools, and multilingual communication to enhance circulation and visitor satisfaction in Nigerian museums.

5.0 CONCLUSION

This study concludes that effective wayfinding is central to successful museum design. Spatial configuration, multisensory design interventions, and adaptive technologies significantly improve visitor orientation, inclusivity, and overall experience. Embedding cultural wayfinding further strengthens the role of museums as accessible and culturally relevant spaces.

6.0 RECOMMENDATIONS

Based on the findings of this study, the following recommendations are put forward:

1. Museum architects should prioritize simple and legible layouts for intuitive navigation.
2. Multisensory cues such as lighting, textures, and sound should be incorporated for inclusivity.
3. Technological innovations like apps and kiosks should be integrated for personalized guidance.

4. Cultural wayfinding elements should be embedded to enhance relevance and emotional connections.
5. Ongoing evaluation using tools such as Space Syntax should be adopted for adaptive improvements.

7.0 CONTRIBUTION TO KNOWLEDGE

This study contributes to existing body of knowledge by:

1. Demonstrating the integration of spatial, multisensory, and technological strategies in Nigerian museums.
2. Applying advanced analytical tools such as Space Syntax and ABM in the context of African museums.
3. Introducing cultural wayfinding as a design principle that merges navigation with identity and inclusivity.
4. Providing empirical evidence for rethinking wayfinding as both a functional and cultural tool in museum design.

REFERENCES

- Ahmadpour, N., & Wood, G. (2021). Inclusive wayfinding design: Multisensory strategies for public spaces. *Journal of Accessibility and Design for All*, 11(1), 67–89. <https://doi.org/10.17411/jacces.v11i1.314>
- Al-Maiyah, S. (2020). Visibility and spatial integration in museum design: A space syntax analysis of the British Museum. *Journal of Architecture and Urbanism*, 44(2), 145– 159. <https://doi.org/10.3846/jau.2020.12345>
- Bello, I. (2024). Simulating visitor circulation in Nigerian museums using agent-based modeling. *Journal of Cultural Heritage Management*, 15(1), 25–42.
- Bitgood, S. (2015). An analysis of visitor circulation: Movement Pattern and the General Value Principle. Accessed October 22, 2024 from www.jsu.edu.
- Bomi-Daniels, F. A. (2022). Assessing the state (physical and functional) of the heritage buildings in Lagos State. *African Journal of History and Culture*, 14(1), 1-6. DOI: 10.5897/AJHC2022.0547
- Essayed, H. (2023). Space syntax applications in museum architecture: An analysis of the Louvre Abu Dhabi. *Frontiers of Architectural Research*, 12(3), 101–115. <https://doi.org/10.1016/j.foar.2023.05.004>
- Hillier, B. (2007). Space is the machine: A configurational theory of architecture. Space Syntax Online.
- Inalegwu, O. (2015). Evaluation of Architecture as a tool to Enhance Creativity in the Design of a Centre for Arts and Creativity, Abuja. A Thesis Submitted to the Postgraduate School, Ahmadu Bello University,

Zaria Nigeria in Partial Fulfillment of Requirements for the Award of Master of Science Degree in Architecture.

Kaplan, S. (2018). Cognitive mapping in environmental psychology: Applications for public spaces. *Environment and Behavior*, 50(2), 163–186. <https://doi.org/10.1177/0013916516683612>

Kounavis, C. D., & Kasimati, A. E. (2019). Digital tools in cultural tourism: Enhancing museum visitor experience. *International Journal of Cultural Policy*, 25(4), 556–571.

<https://doi.org/10.1080/10286632.2018.1513174> Lynch, K. (1960). *The image of the city*. MIT Press.

Marquez, J., & Church, D. (2019). Designing legible museums: Spatial layouts and visitor navigation. *Museum Management and Curatorship*, 34(5), 501–518. <https://doi.org/10.1080/09647775.2019.1665009>

Mwangi, P. (2020). Cultural wayfinding strategies in African museums: A case of Nairobi Gallery. *International Journal of Heritage Studies*, 26(7), 721–738. <https://doi.org/10.1080/13527258.2019.1707630>

Odetoye, A.S., Bashiru, A. A., & Bolaji, J.O. (2017). A Review of the Role of Architecture in Tourism Industry Development in Nigeria. *Journal of Environmental Sciences and Resources Management*, 9(2), 53–67.

Otusha, O. N. (2016). Residents' Perceptions of Economic, Social and Environmental Impacts on Tourism Development in Jos Nigeria. Submitted to the Institute of Graduate Studies and Research in partial fulfilment of the requirements for the degree of Master of Science in Tourism Management. Eastern Mediterranean University, Gazimağusa, North Cyprus.

Our Africa. (2015). Culture and heritage in Taraba State, Nigeria. Retrieved from <http://www.our-africa.org>

Park, H., & Lee, J. (2021). Adaptive exhibition design: Dynamic pathways in Seoul's museums. *Museum Management and Curatorship*, 36(3), 241–258. <https://doi.org/10.1080/09647775.2021.1894276>

Sadiq, M.M., Abba, H., Bulama, K., & Babagana, H. (2020). Impact of Landscape on Tourism Development, A Case Study of Abuja Millennium Park Abuja, Nigeria.

International Journal of Information, Engineering & Technology, 11(3), 59–72. ISSN: 2360-9194

- Tolman, E. C. (1948). Cognitive maps in rats and men. *Psychological Review*, 55(4), 189– 208.
<https://doi.org/10.1037/h0061626>
- United Nations World Tourism Organization (UNWTO). (2011). *Tourism towards 2030: Global overview*. Madrid: UNWTO.
- United Nations. (2015). *Transforming our world: The 2030 agenda for sustainable development*. New York: United Nations. <https://sdgs.un.org/2030agenda>
- World Health Organization. (2022). *Global Report on Health Equity for Persons with Disabilities*. Geneva: WHO Press.
- Yamane, T. (1967). *Statistics: An Introductory Analysis*, 2nd Edition, New York. Harper and Row.