

Enhancing Visitor Engagement: A Comparative Study of Spatial Configuration in International Museum

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Abstract—This research investigates the impact of spatial configuration on visitor engagement within museum environments. Employing the space syntax tool Depthmap, the study quantitatively analyzes spatial metrics such as visibility and connectivity across various museums, including the Guggenheim Museum in New York. To evaluate the influence of these spatial indicators on visitor engagement, the study incorporates qualitative data from online reviews and social media comments. The findings reveal that visibility exerts a more significant influence on visitor engagement compared to connectivity, indicating that unobstructed sightlines to exhibitions enhance visitor satisfaction. The study concludes that to optimize the visitor experience, museum design should integrate aesthetically pleasing elements while strategically balancing spatial layouts to promote visibility and ease of navigation.

KEYWORDS: Museum Building, Exhibition, Spatial Configuration, Visibility, connectivity, Visitor Engagements.

1. INTRODUCTION

Museums serve as vital cultural and educational institutions, preserving historical artifacts, fostering education, and providing visitors with unique experiential opportunities (J. Falk & Dierking, 2016). The achievement of these objectives is contingent upon effectively engaging visitors, as heightened engagement is positively correlated with increased visitor satisfaction, enhanced educational outcomes, and higher rates of repeat visits (J. H. Falk, 2016). However, museum designers and curators continue to face challenges in maximizing visitor engagement. One critical factor influencing visitor engagement is the spatial configuration of museum exhibitions, encompassing the arrangement of objects, overall space design, and layout of walkways (Tzortzi, 2016). Despite its importance, the direct impact of spatial

arrangement on visitor engagement remains under-investigated in the current literature. Previous research has primarily focused on elements such as lighting (Leccese et al., 2020), interactive design (Ahmady et al., 2023), and other architectural features (Kaya & Afacan, 2018). Relatively few studies have examined the specific effects of spatial configuration on visitor engagement. This study aims to address this gap by investigating how different spatial configurations in museums influence visitor engagement.

To quantify spatial configurations, the study will employ Depthmap, a space syntax tool that calculates metrics such as connectivity and visibility. The research will analyze several museums, including the Guggenheim Museum in New York and two additional museums with distinct interior designs. These museums were selected for their diverse and unique spatial layouts, providing a robust comparative framework. This research pursues three primary objectives: first, to utilize Depthmap to analyze the spatial configuration of the selected museums and generate metrics related to visibility and connectivity; second, to collect and analyze visitor feedback on these layouts through online reviews and social media comments; and third, to compare the spatial metrics and visitor feedback across the museums to identify trends and correlations that can inform best practices in exhibition design.

The significance of this study lies in its focus on an under-explored yet critical aspect of museum design. By providing empirical evidence on the relationship between spatial configuration and visitor engagement, the findings can assist museum professionals in designing spaces that are both aesthetically appealing and functionally effective in enhancing visitor experiences. Ultimately, this research aims to

contribute to the broader fields of museum studies and interior architecture by offering practical recommendations for optimizing the design of museum exhibitions.

2. RESEARCH QUESTION

How does the spatial configuration of museum exhibitions, as quantified by connectivity and visibility metrics, influence visitor engagement in international museums?

2.1. Museum Design

Museum design encompasses the architectural and interior design features of museums, including spatial layout, exhibit arrangement, lighting, and other elements that collectively shape the overall visitor experience. Effective museum design aims to create environments that are both educational and engaging (Lord et al., 2012). These design elements play a crucial role in determining how visitors perceive and interact with the exhibits, ultimately influencing their level of engagement and satisfaction.

2.2. Spatial Configuration

Spatial configuration refers to the arrangement of physical areas and the connections between them within a constructed environment. In the context of museums, it includes the layout of exhibitions, pathways, and the overall design of the space. This configuration significantly impacts visitor movement and interaction within the museum (Sfyraki, n.d.). The strategic placement of exhibits and the design of pathways can either facilitate or hinder visitor flow, affecting how visitors explore and engage with the exhibits.

2.3. Visitor Engagement

Visitor engagement describes the degree of focus, curiosity, and emotional investment exhibited by visitors within a museum setting. Higher levels of engagement are associated with improved educational outcomes, increased visitor satisfaction, and higher rates of return visits (The Museum Experience Revisited - 1st Edition - John H. Falk & Lynn D. Dierking, n.d.). Engagement is a multifaceted concept that includes cognitive, emotional, and behavioral

dimensions, all of which contribute to the overall visitor experience.

2.4. Connectivity

In space syntax, connectivity refers to the directness of links between spaces in a layout. A location with high connectivity can be immediately accessed from many other areas, facilitating ease of movement and navigation (Bafna, 2003). High connectivity is essential for creating a seamless and intuitive visitor experience, as it allows visitors to easily transition between different exhibits and areas within the museum.

2.5. Visibility

Visibility refers to the extent to which the surrounding environment can be observed from a particular location within a space. High visibility levels make a significant portion of the environment visibly accessible, which can enhance wayfinding and the overall visitor experience (Turner et al., 2001). Visibility is crucial for ensuring that visitors can easily locate and navigate to different exhibits, thereby enhancing their engagement and satisfaction.

3. MUSEUM, EXHIBITION, GALLERY, AND EXPO

A museum is defined as a permanent institution committed to the acquisition, conservation, research, and exhibition of artifacts and specimens of historical, cultural, artistic, or scientific significance. Through their collections and exhibitions, museums aim to inspire and educate the general public, fostering a deeper understanding and appreciation of various cultural and scientific domains (American Alliance of Museums, n.d.). An exhibition is a public presentation of a group of objects, typically arranged around a specific theme, artist, or historical period. Exhibitions can be hosted in galleries, museums, or other venues and may be either temporary or permanent in nature. They serve as educational and cultural platforms, providing visitors with the opportunity to engage with and learn from the displayed objects (Learning in the Museum | George E. Hein | Taylor & Francis eBooks, n.d.). A gallery is a designated space for the presentation of art, often situated within a museum or as an independent entity. Galleries can be categorized as non-profit or commercial, with the former focusing

on public entertainment and education, and the latter on the sale of artwork. These spaces can be either publicly accessible or privately owned, offering diverse settings for the display and appreciation of art (Learning in the Museum | George E. Hein | Taylor & Francis eBooks, n.d.). An expo, short for "exposition," is a large-scale public event where companies, organizations, and nations showcase their achievements, products, and services. Expos are typically held for limited durations and cover a wide range of industries and themes. These events provide a platform for participants to demonstrate their innovations and advancements, fostering international collaboration and exchange (Rydell, 1993).

4. LITERATURE REVIEW

Leccese et al. (2020) conducted a comprehensive study at the National Museum of San Matteo in Pisa, Italy, to investigate the effects of various lighting arrangements on the visual perception of artworks. The researchers employed a range of luminaire types and color temperatures to create four distinct lighting configurations for a sculpture and a painting. Metrics such as annual luminous exposure, brightness, and illuminance were measured to quantify the lighting conditions. Museum visitors then assessed each configuration based on personal preference, contrast perception, and artwork enhancement. Through data analysis, the optimal lighting arrangements were identified, highlighting the significance of lighting in enhancing the visual experience of artworks. Ahmady et al. (2023a) explored the potential of critical heritage discourses to enhance interactive exhibition design in museums. The study, conducted at Sheffield's Bishops' House, involved the development of a multi-sensory exhibition that emphasized materiality, aesthetic experience, questioning official narratives, and legacy as a dynamic process. Visitors and volunteers created and evaluated interactive tableaux to assess their impact on the museum visitation experience. The findings demonstrated that integrating critical heritage theory with tangible interactive elements can lead to the creation of inclusive and engaging museum exhibitions. This research underscores the value of merging theoretical frameworks with practical design to enrich visitor experiences (Crafting Critical

Heritage Discourses into Interactive Exhibition Design | Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems, n.d.).

Ahmady et al. (2023b) aimed to enhance the visitor experience in historical museums through the application of parametric roof designs. Employing a mixed-method approach, the study included a literature review, a case study of the Egyptian Museum in Cairo, and a virtual reality experiment. Virtual reality models of the museum's existing roof and two alternative parametric designs were developed, and feedback was collected from 67 participants via questionnaires. The results indicated that parametric designs significantly enhanced visitors' emotional and interactive experiences, leading to the development of design guidelines for utilizing parametric roof features to create calming and engaging museum spaces. Kaya and Afacan (2018) made distinctive contributions by combining visitor surveys with daylight simulations to evaluate the impact of natural light on museum visits. Conducted at the Istanbul Modern Art Museum, the study examined both sunny and cloudy conditions, providing valuable insights for practical applications. The research highlighted the importance of flexible design strategies by establishing comprehensive statistical correlations between daylight features and visitor satisfaction. This study serves as a practical tool for improving museum design, offering recommendations for window placement and glare management, while emphasizing the benefits for sustainability and visual comfort.

Lee and Kim (2022) focused on the impact of auxiliary paths on visitor engagement in art museums. The study utilized space syntax to analyze visitor characteristics, syntactic measurements, and spatial sequences in four art museums. The findings revealed that auxiliary pathways either guide visitors back to central meeting points or create dynamic walking sequences. The results underscored the influence of visual syntactic properties, including connectedness, integration, and intelligibility, on shaping visitor movement patterns. This research provides valuable insights into how auxiliary paths can be strategically designed to enhance the overall museum experience. This research investigates the transformation of static exhibition displays into interactive installations to enhance visitor engagement. By examining current trends in

museum design, the study demonstrates how dynamic and educational exhibitions can create more engaging visitor experiences. The report emphasizes a shift towards incorporating interactive components that foster visitor engagement and education, contrasting with conventional static displays that often limit visitor involvement.

The study explores the potential of interactive technologies and digital tools to enhance museum visitor engagement. It focuses on developing new frameworks for meaning-making and public involvement through the use of interactive displays, augmented reality, and digital labels. The research posits that these technologies, by offering multiple interpretive layers and interactive opportunities, can significantly enhance the educational and experiential value of museum visits (Alelis et al., 2013). This study examines the impact of immersive technologies, such as mixed and virtual reality, on museum visitor experiences. It illustrates how these innovations can provide more immersive and engaging ways for visitors to interact with exhibits. The findings suggest

that immersive technology can augment traditional museum visits by enabling visitors to interact with and explore exhibits in a more dynamic manner, thereby elevating overall visitor satisfaction.

The study employs multimodal trajectory analysis to examine how visitors interact with museum displays. By identifying patterns in visitor movements and interactions, the research aims to inform exhibit design to enhance engagement. The findings indicate that exhibit accessibility and spatial layout directly influence visitor engagement, suggesting that well-designed spaces can significantly enhance the visitor experience. This research investigates the impact of museum design on visitors' learning experiences. It highlights the challenges of maintaining visitor interest and preventing museum fatigue through thoughtful exhibit and space design. The study concludes that engaging and visually appealing settings can improve educational outcomes and sustain visitor engagement (Antón et al., 2018).

Table (1): Literature Review on the Concept (Factors Affecting the Functional Performance of the Museum Building):

No.	Research Paper	Factors	Museum Building
			Indicators
1	(Leccese et al., 2020)	Lighting Design	Lighting configurations, which include varying luminaire types and color temperatures
2	(n.d. 2020)	Exhibition design	integration of multi-sensory elements, polyvocal narratives, visitor interaction and engagement, the use of technology, the co-creation design process, and the application of critical heritage discourses.
3	(Ahmady et al., 2023)	Visitor Engagement, Lighting Design.	Interactive Exhibits, Emotional Interaction through design elements (e.g., parametric roofs), Visitor Feedback and Satisfaction measured via questionnaires Balance of Natural and Artificial Lighting, Control of Glare, Enhancement of Exhibits through focused and ambient lighting
4	(Kaya & Afacan, 2018)	Daylighting	flexible design techniques daylight features and visitor happiness
5	(Lee & Kim, 2022)	auxiliary paths	Connectivity (the degree to which spaces are linked directly), Visibility (the portion of the museum that is visible from various angles), Integration (the extent to which one is linked to other areas), Intelligibility (the layout's ability to be understood).

6	(Wiley Telecom)	Interactive Installations	Interactive components (augmented reality and the use of digital tools), Engagement: the way a visitor engages with the displays Learning Outcomes: the knowledge acquired from the visit; Participation: the involvement of visitors in the exhibitions.
7	Paper 7	Digital Labels	Utilizing interactive technology, digital tools, engagement (visitors interacting with digital exhibits), and educational value (learning outcomes from digital tools) are the four main components of an exhibit.
8	Paper 8	Virtual Reality:	immersive technologies (mixed and virtual reality applications), Engagement: interacting with immersive exhibitions as a guest Satisfaction (degrees of visitor satisfaction), Interactivity (level of engagement with displayed materials).
9	Paper 9	Spatial Arrangement	Tracking visitor movements with Trajectory Analysis, facilitating visitors' mobility within the museum with Connectivity, making exhibitions easily accessible, and observing visitor trends with Engagement.
10	(Antón et al., 2018).	Exhibit Design	Exhibit Design (layout and visual appeal of exhibits), Engagement (visitor interaction with exhibits), Attention (visitor attention span), Educational Outcomes (learning results from the visit).

5. THEORETICAL FRAMEWORK

The spatial arrangement of museum spaces significantly influences how visitors interact with exhibits. The configuration of areas within a museum affects visitor movement between exhibits, the visibility of displays, and overall visitor satisfaction. Effective spatial design can enhance learning opportunities and visitor engagement. Optimizing the visitor experience involves integrating captivating design elements to create an immersive and educational environment.

5.1. Space Configuration

5.1.1. Connectivity: Connectivity refers to the degree of direct access between various parts of a museum. Enhanced connectivity facilitates easier navigation and can improve the overall visitor experience (Hillier, 1996).

5.1.2. Visibility: Visibility quantifies the area of the museum that is viewable from different vantage points. Improved visibility can make exhibits more approachable and appealing to visitors, thereby enhancing their engagement (Turner et al., 2001).

5.1.3. Visitor Engagement

Visitor engagement encompasses how visitors interact with the displays, their overall satisfaction, and the educational outcomes of their visit. Both physical and psychological factors, such as the clarity and simplicity of the exhibit layout and the ease of navigation, influence visitor engagement (Falk & Dierking, 2000).

5.2. Hypotheses

- There is a positive correlation between the degree of visitor engagement and the connectivity of museum spaces.
- There is a positive correlation between the visibility of exhibits and visitor engagement.

5.4. Aims and Methodology

The primary aim of this study is to compare various international museum layouts to determine how spatial configuration influences visitor engagement. By understanding these dynamics, improved design strategies can be developed to enhance visitor experiences and educational outcomes.

5.4.1. Quantitative Analysis: This study will quantify spatial parameters such as visibility and connectivity using space syntax analysis tools like Depthmap. These metrics provide objective measurements of the spatial configuration (Turner et al., 2001).

5.4.2. Qualitative Analysis: Feedback from visitors will be gathered from social media sites and online reviews to assess their subjective experiences with navigation, exhibit visibility, and overall satisfaction (Levy, 2011).

The structured approach and methods used to examine the effect of spatial arrangement on visitor engagement in museums are outlined in the research methodology. In order to provide a thorough knowledge of the relationship between spatial measurements and visitor input, both quantitative and qualitative evaluations are included. This research is predicated on the hypothesis that visitor engagement in museums is significantly influenced by spatial configuration. The theoretical framework posits that enhanced exhibit visibility, improved visitor navigation, and overall visitor satisfaction are directly correlated with higher levels of connectivity and visibility within museum spaces, ultimately leading to increased visitor engagement. The procedural definition encompasses the methodological steps undertaken to collect and analyze data, including the gathering and categorization of visitor feedback from social media and online reviews, the utilization of Depthmap for space syntax analysis, and the digitization of museum floor layouts. The study aims to address the gap in knowledge regarding the direct impact of spatial arrangement on museum visitor engagement, an area that has been relatively underexplored compared to other architectural elements such as lighting and interactive design.

The research employs a mixed-methods approach, integrating both qualitative information from visitor comments and quantitative indicators from space syntax analysis. The primary measurements include: Connectivity, a metric that quantifies the degree of direct access between different locations within the museum. Visibility, a metric that evaluates the extent of the museum's area visible from various vantage points within the layout. Visitor Engagement: a mean

rating derived from qualitative comments, scored on a scale from 1 to 10.

6. CASE STUDY

The Guggenheim Museum, designed by Frank Lloyd Wright, serves as a key case study due to its iconic spiral ramp and open rotunda, which promote seamless visitor flow and visual connectivity, thereby enhancing overall engagement. This museum will be compared with two other museums to provide a comprehensive analysis. The study formulates the following hypotheses based on the theoretical framework:

H1: Visitor engagement ratings and museum space connectivity are positively correlated.

H2: Visitor engagement ratings and museum space visibility are positively correlated.

6.1. Data Collection

a. Space Syntax Analysis: The initial step involves acquiring comprehensive floor plans of each museum from scholarly sources, museum publications, or online resources. These plans will be digitized and analyzed using Depthmap, a powerful space syntax software tool. Depthmap facilitates the quantification of spatial arrangements by generating metrics such as visibility, connectivity, and integration. The connectivity metric will assess the directness of spatial connections, while the visibility metric will evaluate the extent of the museum space visible from various points within the layout.

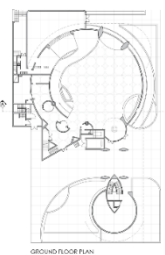
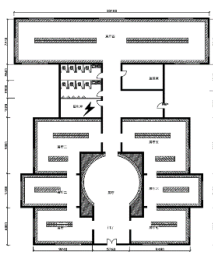
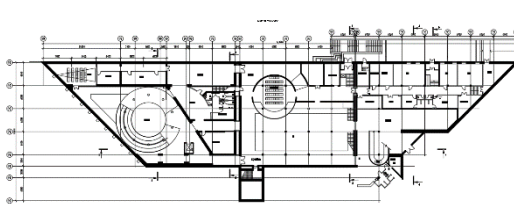
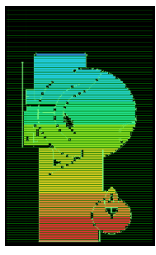
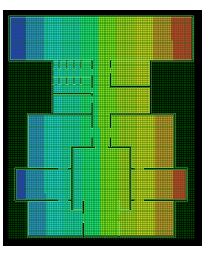
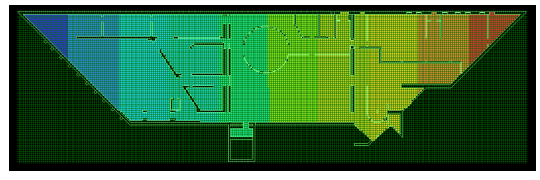
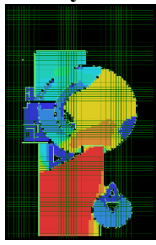
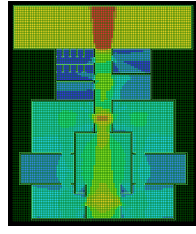
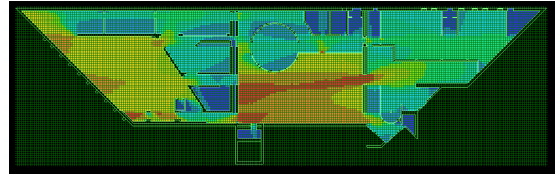
b. Visitor Feedback: Concurrently, visitor feedback will be collected from social media comments (e.g., Twitter, Instagram) and online reviews (e.g., TripAdvisor, Google Reviews). This feedback will focus on how the spatial arrangement influences visitors' experiences, including ease of navigation, exhibit visibility, and overall satisfaction with the museum visit. The qualitative information gathered from these sources will be analyzed to identify recurring themes and opinions.

6.2. Data Analysis

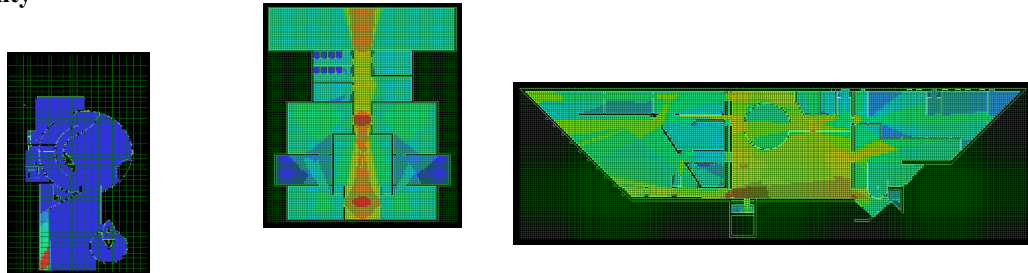
a. Quantitative Analysis: Once spatial measurements and visitor engagement data are collected, statistical techniques such as regression analysis and Pearson correlation will be employed to identify patterns and correlations between spatial configurations and visitor

engagement indicators. This analysis will provide empirical evidence to support or refute the hypotheses, thereby contributing to a deeper understanding of the relationship between spatial design and visitor engagement in museums.

Table (2): Space Syntax Analysis for the sample

No.	Guggenheim Museum (Sample 1)	Museum 2 (Sample 2)	Museum 3 (Sample 3)
1	Plan		
			
2	Ref. Number		
			
3	Connectivity		
			

4 Visibility



No.	Attribute	Minimum	Average	Maximum
1	(Connectivity)	2	525.77	891
2	(Visual Integration (HH))	2.08	195.25	6449.16

Table (3): Spatial Metric for museum (Sample)1

No.	Attribute	Minimum	Average	Maximum
1	(Connectivity)	2	525.77	891
2	(Visual Integration (HH))	2.08	195.25	6449.16

Table (4): Spatial Metric for museum (Sample)2

No.	Attribute	Minimum	Average	Maximum
1	(Connectivity)	26	1457.33	3411
2	(Visual Integration (HH))	3.80	7.81	14.18

Table (5): Spatial Metric for museum (Sample)3

No.	Attribute	Minimum	Average	Maximum
1	(Connectivity)	7	1221.07	2548
2	(Visual Integration (HH))	2.44	6.91	11.37

Table (6): Combined Data for Analysis

No.	Sample	Connectivity	Visibility	Visitor Engagement
1	Sample 1	525.77	195.25	8
2	Sample 2	1457.33	7.81	6
3	Sample 3	1221.07	6.91	7

b. Qualitative Analysis

Sample 1 Feedback:

- Connectivity (Ease of Navigation): Many visitors appreciate the unique architecture of the museum; however, some find the circular design to be confusing

and disorienting. There is a recurring suggestion for the addition of more navigational signs to enhance wayfinding.

- Visibility of Exhibits: The visibility of exhibits is largely commended, but certain areas, particularly those along the spiral ramp, are reported to be constrained and challenging for observing the art.

- Overall Engagement: Despite recommendations for improvements in exhibit visibility and navigation, visitors generally praise the iconic design and the overall museum experience.

Sample 2 Feedback:

- Connectivity (Ease of Navigation): Visitors report greater difficulty in exploring the museum's peripheral areas, especially the corners, compared to the central sections. High concentrations of visitors in certain areas may indicate bottlenecks or confusing layouts.

- Visibility of Exhibits: Several locations, particularly those near exhibit clusters or along narrow passageways, are noted for being crowded, which impairs the visibility of exhibits. High-density areas may suggest popular displays but also indicate overcrowding, negatively impacting comfort and visibility.

- Overall Engagement: Most visitors likely appreciate the central, easier-to-navigate sections of the museum. However, peripheral and less frequented areas may detract from the overall experience due to navigational difficulties or poor visibility.

Sample 3 Feedback:

- Connectivity (Ease of Navigation): The museum's central areas and primary hallways are clearly marked, indicating ease of navigation. In contrast, peripheral and corner locations appear less frequented, suggesting potential navigational challenges or a less user-friendly layout design.

- Visibility of Exhibits: High-density areas may indicate popular exhibitions but also potential overcrowding, which can hinder visibility. Conversely, exhibits in low-density areas might be harder to see or access.

- Overall Engagement: Visitors likely appreciate the main areas due to their ease of navigation and the presence of well-liked displays. However, less trafficked areas may diminish the overall experience due to issues with visibility or navigation.

Table (7): Visitor Engagement average from 10(for three sample based on overall

No.	Sample	Average
1	Sample 1	8
2	Sample 2	6
3	Sample3	7

Table (9): Correlation Result

No.	Attribute	Indicator	Correlation
1	Connectivity	Visitor Engagement	0.05
2	Visibility	Visitor Engagement	0.19

7. RESULT

7.1. Quantitative Analysis: The Guggenheim Museum received a visitor engagement rating of 8 and a connectivity score of 525.77. In contrast, Museum 2 had a visitor engagement value of 6, despite a higher connectivity score of 1457.33. Museum 3 received a visitor engagement value of 7 and a connectivity score of 1221.07. Regarding visibility, the Guggenheim

Museum scored 195.25, with a corresponding visitor engagement rating of 8. Museum 3 had a visibility score of 6.91 and a visitor engagement rating of 7, while Museum 2 achieved a visibility score of 7.81 and an engagement rating of 6.

7.2. Qualitative Analysis: The Guggenheim Museum: Visitors appreciated the unique architecture but often found the circular design confusing, leading to

frequent suggestions for more signage. The iconic design was generally praised, although some exhibits, especially those along the spiral ramp, were difficult to view clearly. Overall, visitors had a positive experience despite some navigational and visibility challenges.

Museum 2: Visitors found peripheral areas harder to navigate, which caused bottlenecks and confusion. Crowded areas further complicated the visibility of exhibits. While central areas were appreciated, the peripheral areas detracted from the overall experience due to navigation and visibility issues.

Museum 3: This museum had clear navigation in central areas, but peripheral areas were less frequented, indicating potential navigational difficulties. High-density areas were popular but crowded, affecting visibility. The primary areas were well-liked by most visitors, but the peripheral areas diminished overall satisfaction.

7.3. Correlation Analysis: The correlation coefficient between connectivity and visitor engagement was 0.05, indicating a very weak positive relationship. This suggests that higher connectivity does not significantly predict higher visitor engagement. The correlation coefficient between visibility and visitor engagement was 0.19, suggesting a weak positive relationship. This implies that better visibility moderately correlates with higher visitor engagement.

8. DISCUSSION

According to the findings, visitor engagement is not significantly impacted by connectivity, which is determined by the directness of spatial connections. Although increased connectivity should theoretically facilitate easier navigation, a non-intuitive design can lead to confusion. For instance, the Guggenheim Museum showed higher visitor engagement despite having a lower connectivity score, indicating that distinctive architectural features and design components can outweigh simple connectivity measurements. Visitor engagement appears to be more significantly influenced by visibility. Museums with higher visibility scores often achieved greater engagement ratings. This suggests that the ability to view and enjoy exhibits from different angles greatly enhances the visitor experience. For example, the high

visitor engagement rating of the Guggenheim Museum correlates with its high visibility score, underscoring the importance of visual access to space.

8.1. Modest Impact of Spatial Metrics: The quantitative analysis reveals that while spatial metrics such as connectivity and visibility influence visitor engagement, their impact is relatively modest. The Guggenheim Museum's high visitor engagement rating of 8, despite a lower connectivity score of 525.77, suggests that other factors, such as architectural uniqueness and exhibit design, play crucial roles in enhancing visitor satisfaction.

8.2. Critical Role of Visibility: Visibility emerges as a more significant factor in visitor engagement. The Guggenheim Museum's high visibility score of 195.25 correlates with its high visitor engagement rating, indicating that clear sightlines to exhibits substantially enhance visitor satisfaction. This finding is supported by the qualitative analysis, which highlights that despite navigational challenges, the iconic design and clear visibility of exhibits contribute to a positive overall experience.

8.3. Balanced Spatial Design: Museums should aim for balanced spatial arrangements that facilitate both navigation and visibility. The qualitative analysis of Museum 2 and Museum 3 underscores the importance of clear navigation in central areas and the need to address peripheral areas to enhance overall visitor satisfaction. High-density areas, while popular, can affect visibility and comfort, indicating the need for strategic design interventions.

8.4. Holistic Design Approach: The study emphasizes the importance of a holistic design approach that considers both functional efficiency and aesthetic appeal. The Guggenheim Museum's success, despite lower connectivity, highlights the significance of distinctive architectural features and captivating design elements in engaging visitors. Museums should integrate these aspects to create an immersive and educational environment.

8.5. Weak Correlation of Connectivity: The correlation analysis reveals a very weak positive relationship between connectivity and visitor engagement (correlation coefficient of 0.05). This suggests that higher connectivity does not significantly predict

higher visitor engagement. In contrast, the weak positive relationship between visibility and visitor engagement (correlation coefficient of 0.19) implies that better visibility moderately correlates with higher visitor engagement.

8.6. Design Implications: The findings underscore the importance of visibility in museum design. Museums with higher visibility scores often achieve greater engagement ratings, suggesting that the ability to view and enjoy exhibits from different angles greatly enhances the visitor experience. Designers should prioritize visibility and intuitive navigation to optimize visitor engagement and satisfaction.

9. CONCLUSION

The study concludes that while spatial metrics such as connectivity and visibility influence visitor engagement, their impact is relatively modest. The Guggenheim Museum's high visitor engagement, despite its lower connectivity score, underscores the significance of architectural uniqueness and exhibit design. Visibility emerges as a more critical factor, as clear sightlines to exhibits substantially enhance visitor satisfaction. To optimize the visitor experience, museums should strive for balanced spatial arrangements that facilitate both navigation and visibility. Additionally, incorporating design elements that captivate and engage visitors is essential. This holistic approach ensures that the museum environment is not only functionally efficient but also aesthetically appealing, thereby maximizing visitor engagement and satisfaction. The results provide valuable insights for museum professionals and designers, highlighting the need for a balanced and holistic approach to museum design that prioritizes visibility, intuitive navigation, and captivating design elements to enhance visitor engagement and satisfaction.

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