

Visitors' Perception of the Importance and Performance of Multisensory Dimensions: The Case of the Philippine National Museum of Natural History

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Dated received: March 8, 2025

Date revised: May 23, 2025

Date accepted: June 22, 2025

Originality: 97%

Grammarly Score: 99%

Similarity: 3%

Recommended citation:

Murillo, A., & Williams, M. C. (2025). Visitors' perception of the importance and performance of multisensory dimensions: The case of the Philippine National Museum of Natural History. *Journal of Interdisciplinary Perspectives*, 3(7), 495-504. <https://doi.org/10.69569/jip.2025.149>

Abstract. Museums are vital in preserving cultural and historical heritage while offering immersive learning experiences. However, enhancing visitor engagement and satisfaction remains a challenge. This study examines the impact of multisensory dimensions in improving the museum experience at the National Museum of Natural History. Using a quantitative-descriptive approach and purposive sampling of 355 respondents, data were collected through structured questionnaires. The Importance-Performance Analysis Model was applied to assess the significance of visual, auditory, olfactory, and tactile stimuli in shaping visitor experiences. The hypothesis test rejected the null hypothesis, confirming a significant relationship between the perceived importance and the actual performance of multisensory dimensions. Findings indicate that integrating multiple sensory elements enhances visitor engagement, improves recollection of information, and fosters a deeper appreciation of exhibits. These results suggest that aligning sensory features with visitor expectations strengthens interpretation, making museum visits more meaningful and immersive.

Keywords: Multisensory dimensions; Visitor perception; Importance-performance analysis; Museum experience; National Museum of Natural History.

1.0 Introduction

Museums are essential institutions that preserve cultural heritage, educate visitors, and contribute to tourism. They serve as learning, reflection, and interaction spaces, offering tangible and intangible cultural experiences. Traditionally, museum exhibits have focused on visual displays, often limiting interaction to viewing artifacts enclosed in glass cases accompanied by textual descriptions. However, contemporary museum practices emphasize the importance of engaging multiple senses to enrich the visitor experience. Incorporating auditory, tactile, and olfactory elements fosters deeper emotional connections, improves memory retention, and accommodates diverse learning styles.

The introduction of multisensory features in museums can significantly enhance the tourism sector. By improving the experiences provided in museums, museums can reach out to different visitors, for instance, those with varying modalities of learning and those with sensory disabilities (Luo et al., 2024). An example of multisensory museum experiences enhancing accessibility for visually impaired visitors is demonstrated in the study by Vaz et al. (2020). Their research explores the experiences of blind and partially sighted individuals in museums, proposing a co-created multisensory framework to improve sensory, intellectual, and physical access.

Museums implementing multisensory accessibility features, such as tactile models, ambient soundscapes, and audio guides, significantly enhance visitor engagement. The study highlights how museums can move beyond visual exhibits, ensuring that cultural spaces remain inclusive. Additionally, Vaz et al.'s (2020) research emphasizes the importance of assistive technologies, advocating for tools like interactive audio descriptions and sensory-friendly pathways. By providing pre-visit accessibility planning and adaptive museum layouts, institutions can better accommodate visually impaired guests (Vaz, 2020). Similarly, the National Tile Museum (Museu Nacional do Azulejo) in Lisbon and the Community Museum of Batalha (Museu Municipal de Batalha) have incorporated multisensory elements into their collections. They have created tactile graphics and made architectural modifications to remove barriers, demonstrating how museums can enhance accessibility and cater to diverse needs (Eardley et al., 2016). These features enhance the overall experience, making museums more accessible and appealing to visitors with various learning styles and sensory limitations.

The National Museum of Natural History (NMNH) in the Philippines is vital in showcasing the country's biodiversity and cultural heritage. While some exhibits incorporate interactive components such as touchable exhibits or soundscapes, the museum has yet to adopt a holistic approach to multisensory design. Currently, there is a lack of studies assessing how the presence or absence of multisensory dimensions influences visitor satisfaction and engagement at the National Museum of Natural History. Therefore, this study aims to assess the perceived importance and performance of multisensory dimensions at the NMNH and evaluate their impact on the visitor experience. Grounded in current literature and international best practices, this research responds to the need for more inclusive, engaging, and accessible museum experiences in the Philippine context.

2.0 Methodology

2.1 Research Design

This study employed a quantitative-descriptive research design to measure and analyze visitors' perceptions and experiences of multisensory dimensions at the National Museum of Natural History (NMNH). The descriptive method was chosen to obtain quantifiable data that could be subjected to statistical analysis, thereby identifying trends, patterns, and relationships among variables. A structured, self-administered questionnaire was utilized as the primary data collection tool. Data were gathered electronically via Google Forms, enabling efficient distribution and standardized response collection.

2.2 Research Participants

The study involved 355 visitors to the National Museum of Natural History, selected using purposive sampling based on average visitor counts and recent entry data provided by museum personnel. Inclusion criteria for participation included: (a) individuals aged 18 years or older, and (b) those who could engage their sensory and cognitive faculties during their museum visit. To ensure data integrity, the following exclusion criteria were applied: (a) individuals who had not physically visited the museum galleries, (b) individuals unable to read or write, as the survey required written responses, and (c) individuals who declined to participate voluntarily.

Purposive sampling included only participants with direct experiential exposure to the exhibits. While this approach enhanced the relevance and depth of the data collected, it is essential to acknowledge its limitations, particularly the potential for selection bias, which may affect the generalizability of the findings.

2.3 Research Instrument

Data were collected through a researcher-developed survey questionnaire, grounded in existing literature on multisensory learning, museum engagement, and visitor experience. The instrument was structured into three major sections: (a) Demographic Profile (including age, sex, and educational attainment), (b) Perceived Importance of Multisensory Dimensions, and (c) Perceived Performance of Multisensory Dimensions during the museum visit. Items in sections (b) and (c) were measured using a 5-point Likert scale to assess levels of importance and performance. The questionnaire was initially validated by a panel of experts, including a statistician and the research adviser, to ensure content validity and alignment with the study objectives. A pilot test was administered to 30 respondents not in the final study sample. Feedback from the pilot study prompted minor revisions to enhance the clarity and relevance of the items. Reliability testing using Cronbach's alpha was also performed to confirm the instrument's internal consistency.

2.4 Data Gathering Procedure and Analysis

Data collection was conducted onsite. Respondents completed the questionnaire after providing informed consent. The researcher was present to offer clarification when needed. All responses were automatically compiled via Google Forms. For data analysis, the study employed descriptive statistics such as frequency, percentage, and mean to summarize visitor responses. To examine relationships between variables, particularly between the importance and performance of multisensory dimensions, the study used Pearson's correlation coefficient (r) to assess the strength and direction of association. Incomplete or invalid responses were excluded to maintain data quality and reliability in statistical interpretation.

2.5 Ethical Considerations

The study adhered to ethical research standards. Participation was voluntary, and respondents were informed of their right to withdraw immediately. Informed consent was obtained before participation, ensuring all data collected were anonymous, confidential, and used solely for academic purposes. All data were securely stored and protected throughout the research process.

3.0 Results and Discussion

3.1 Perceived Importance of Multi-Sensory Dimensions at NMNH

Table 1 presents the descriptive measures of the Importance of the Visual dimensions for the National Museum of Natural History. Elements such as harmonious color, ample lighting, good spatial arrangement, use of media like videos, and accurate depiction of models were rated as "Very Important or Valuable" by the respondents. The item "Harmonious color shade as per gallery theme" garnered the highest mean of 3.73.

Table 1. *Perceived Importance of Visual Dimensions for the National Museum of Natural History*

Indicators	Mean	Std. dev.	Interpretation
1. Harmonious color shade as per gallery theme	3.73	.541	Very Important
2. Ample lighting in hallways and galleries	3.71	.603	Very Important
3. Good spatial arrangement of exhibits (no clutter)	3.72	.565	Very Important
4. The presence of moving objects creates more interest	3.57	.707	Very Important
5. Use of illustrative media (e.g., video presentation)	3.64	.660	Very Important
6. Accurate depiction of replicas and scale models	3.70	.599	Very Important
Overall Result	3.68	.467	Very Important

Hence, Bitgood (2010) supports that maintaining visual balance in exhibit design enhances the mind's way of organizing information, reduces eye strain, and improves visitor satisfaction. Incorporating color within thematic narratives can evoke emotional engagement, fostering deeper visitor participation and enhancing the interpretation. More so, the item "Presence of moving objects creates more interest" received the lowest mean score ($M = 3.57$). While visitors often find moving objects engaging, they may not necessarily view them as essential within the context of natural history exhibits. Yalowitz and Bronnenkant (2009) found that while motion can effectively capture visitors' attention, it does not necessarily result in prolonged engagement or more profound understanding.

Table 2 presents the descriptive measures of the Importance of the Auditory Dimensions for the National Museum of Natural History. Every element has a mean score of more than 3.5, which suggests that the respondents highly value it. The "Proper background music according to the gallery theme" and the "Placement of thematic sounds" garnered the highest means. This suggests that visitors value auditory elements that complement and enhance their overall experience of the exhibited art. On the other hand, the item "Deadening of external noise (e.g., traffic noise)" garnered the lowest mean of 3.51. This implies that people may not actively notice sound affecting their experience.

Table 2. *Perceived Importance of Auditory Dimensions for the National Museum of Natural History*

Indicators	Mean	Std. dev.	Interpretation
1. Proper background music as per the gallery theme	3.57	.719	Very Important
2. Placement of proper thematic sounds (e.g., nature) to feel the sense of space	3.66	.613	Very Important
3. Deadening of external noise (e.g., traffic noise)	3.51	.749	Very Important
4. Segmentation of background sound in galleries	3.60	.679	Very Important
5. Sound treatment for echo and reverberation	3.57	.686	Very Important
Overall Result	3.58	.556	Very Important

According to Bruner, as cited by Kokko (2019), people give emotional significance to music; they have affective reactions to music, which can elicit behavioral responses in consumers. They emphasize the emotional relevance of music and its capacity to generate feelings in visitors. Additionally, Groth (2020) examines the literary nature of soundscapes and how particular sonic textures frame narrative and experiential engagement. Furthermore, at the Tate Modern in London, soundscapes are carefully designed to enhance the visitor experience while reducing noise. For example, in Bruce Nauman's "Raw Materials" exhibit, the Sound Directions team managed the audio setup to create an immersive atmosphere without causing too much sound interference (Sound Directions, 2010). This example illustrates how crucial acoustic management is in cultural institutions and attractions. Poorly designed sound treatments may lead to conflicts with visitor experience, such as noise pollution, potentially causing disturbances or negative impacts. Spence (2020) highlights the importance of considering auditory design in experiential places to prevent conflicts from other auditory disturbances or noise pollution.

Table 3 shows the descriptive statistics for the Importance of Tactile Dimensions at the National Museum of Natural History. The mean scores indicate that respondents considered all five aspects of tactile experiences as essential. This highlights a consistent recognition of the value of touch in enhancing the museum visit. The highest-rated items were "Interaction between visitors and pieces of art," garnering a mean of 3.67, and "Provision to touch real or imitation art objects or artifacts," having a mean of 3.60. These results emphasize the importance of physical interaction with exhibits. While modern features like touch screens and AI are appreciated, visitors still place high value on traditional tactile experiences. Notably, "Use of robotics in dioramas and other exhibits" received the lowest mean score of 3.46, though it was still rated as necessary. This suggests that while technology is recognized, visitors prioritize hands-on engagement over automated or robotic features. Thus, tourists seek a tactile experience that blends traditional interaction and modern innovation.

Table 3. *Perceived Importance of Tactile Dimensions for the National Museum of Natural History*

Indicators	Mean	Std. dev.	Interpretation
1. Use of mechanical stimulation in exhibits (e.g., trigger buttons)	3.57	.723	Very Important
2. Interaction between visitors and pieces of art	3.67	.632	Very Important
3. Provision to touch real or imitation art objects or artifacts	3.60	.711	Very Important
4. Availability of a touch screen for information	3.49	.787	Important
5. Use of robotics in dioramas and other exhibits	3.46	.824	Important
Overall Result	3.56	.584	Very Important

In addition, tactile elements play a vital role in how visitors interact with the exhibits. Several studies have revealed that physical connection helps improve understanding and engagement when learning hands-on (Antle et al., 2023; Hayhoe et al., 2022). They enhance the emotional experience for each visitor and make it easier for visitors with visual impairments to enjoy the artwork. While modern features like touch screens, robotics, and AI are appreciated, traditional hands-on experiences are still more highly valued. This is reflected in the lower rating for "Use of robotics in dioramas and other exhibits" ($M = 3.46$), suggesting that although technology is welcomed, visitors prioritize direct, tactile engagement. Hence, these findings indicate a preference for a balanced mix of traditional interaction and modern innovation to enrich the museum experience. Christidou and Pierroux (2018) further emphasize that touch enables people to experience concepts physically, making them easier to understand. Through direct interaction, touch strengthens connections between thoughts and reality. This reinforces the importance of "Interaction between visitors and art pieces" and "Provision to touch real or imitation art objects or artifacts." A practical example of this can be seen at Museo Pambata in the Philippines, where visitors engage their haptic senses through interactive exhibits, supporting kinesthetic learning experiences.

Table 4 presents the descriptive measures of the *Importance of the Olfactory Dimensions for the National Museum of Natural History*. The mean scores indicate that respondents rated all olfactory dimensions as important or valuable, demonstrating strong consensus regarding the importance of olfactory components in shaping their museum experience. This underscores the importance of maintaining a pleasant and acceptable olfactory environment for visitor satisfaction and engagement. Museums can capitalize on scents to enhance engagement, such as in the case of Tate Sensorium in London, where scents were used to increase the interaction of the visitors with the exhibit. The aspects with the highest mean values are "No foul smell in a gallery or hallway" ($M = 3.67$) and "No pervading scent of artifacts relating to zoological, biological, and geological specimens" ($M = 3.61$). Thus, it is evident that the absence of foul odors within galleries or halls receives high ratings, indicating that visitors value a pleasant and clean olfactory environment. This highlights the significance of maintaining cleanliness and addressing any possible causes of unpleasant scents within the museum environment.

Table 4. *Perceived Importance of Olfactory Dimensions for the National Museum of Natural History*

Indicators	Mean	Std. dev.	Interpretation
1. No pervading scent throughout the museum	3.50	.758	Very Important
2. No pervading scent of artifacts relating to zoological, biological, and geological specimens	3.61	.673	Very Important
3. Appropriate scent of the gallery as per theme (e.g., trees, sea water)	3.60	.692	Very Important
4. No foul smell in a gallery or hallway	3.67	.660	Very Important
5. Indistinct smell of chemicals for preservation	3.56	.817	Very Important
Overall Result	3.59	.575	Very Important

According to Nieuwhof (2016), one key curatorial issue is determining the level of odor concentration. Heavy and unpleasant odors might make people physically uncomfortable and drive them away. This underscores the importance of the two highest mean values, signifying the need for a clean and subtle olfactory environment. Among the listed indicators, the lowest mean value is associated with the absence of a pervading scent throughout the museum ($M = 3.50$), which is still interpreted as "Very Important." While this score is slightly lower, visitors still value a neutral olfactory environment to avoid distractions or discomfort.

Furthermore, Pallasmaa (2014) suggests that smell has a minimal but significant role in spatial memory and perception. The absence of excessive odors allows visitors to concentrate on the visual and intellectual aspects of the exhibitions without being distracted by overwhelming smells. This is aligned with the data results, which show that people prefer controlled, minimal olfactory surroundings.

3.2 Perceived Performance of the Multi-Sensory at the NMNH

Table 5 presents the performance of the visual dimension at the National Museum of Natural History. The item "Harmonious color shade as per gallery theme" garnered the highest mean of 3.71, indicating that the galleries are highly effective in choosing color shades that harmonize with their themes. In line with the features of the National Museum of Natural History gallery, the museum utilizes a color scheme in its galleries. For example, aqua blue is used in the entire exhibit at the Marine Realm Gallery to create an immersive atmosphere and experience. Green and brown colors and lighting create a relevant and ambient atmosphere in the Tropical Lowland Evergreen Rainforest.

Table 5. *Perceived Performance of Visual Dimensions at the National Museum of Natural History*

Indicators	Mean	Std. dev.	Interpretation
1. Harmonious color shade as per gallery theme	3.71	.600	High Performance
2. Ample lighting in hallways and galleries	3.63	.639	High Performance
3. Good spatial arrangement of exhibits (no clutter).	3.65	.639	High Performance
4. The presence of moving objects creates more interest	3.54	.725	High Performance
5. Use of illustrative media (e.g., video presentation)	3.59	.693	High Performance
6. Accurate depiction of replicas and scale models	3.67	.603	High Performance
Overall Result	3.63	.500	High Performance

However, "Presence of moving objects to create more interest" scored the lowest among the evaluated aspects, with a mean of 3.54. The use of moving objects to engage visitors shows the most significant variability in opinions, as indicated by the highest standard deviation. Moving objects in the museum are typically associated with audio and visuals. For example, in the Symphony of Nature exhibit, the boxes that incorporate sounds and images of species are triggered by a timer. The image projected in the Marine Realm Gallery moves when a sensor is triggered.

An example of an international museum that utilizes these qualities is the Smithsonian National Museum of Natural History in Washington, D. C. The museum employs moving objects and dynamic displays to improve visitors' experience. The museum's "Ocean Hall" is a life-sized model of a North Atlantic right whale that seems to swim across the gallery, as well as other projections of moving sea creatures and water currents. Integrating the physical models with dynamic digital parts assists in developing a more effective way of engaging the visitors through the simulation of the mobility and liveliness of the ocean environments (Smithsonian National Museum of Natural History, 2020). Hence, while still ranked as highly important, incorporating dynamic elements into exhibitions is a more challenging feature to execute consistently and successfully, potentially due to higher costs or specialized maintenance requirements.

Table 6 presents the Performance of the Auditory Dimension at the National Museum of Natural History. The item "Placement of proper thematic sounds (e.g., nature) to evoke the sense of space" garnered the highest mean of 3.61. The sounds designed to evoke a specific atmosphere or sense of place in the museum are particularly effective in enhancing visitor engagement and immersion. For example, the Tropical Lowland Evergreen Rainforest Gallery of the museum incorporates sounds of the forest, such as the sounds of flora and fauna present in the gallery, creating a sense of space and immersion; the Geology of the Philippines Gallery incorporates the sound of volcanic rumbles and earthquakes, evoking awareness among the visitors. Research supports that sounds aligned with the exhibition context can enhance attention and engagement, leading to a more immersive visitor experience (Bem et al., 2023).

Additionally, museums increasingly recognize the capabilities of audio elements, such as sound design, in creating immersive experiences that enhance interpretation and visitor engagement (Cliffe et al., 2024). Furthermore, the lowest mean score among the auditory elements is related to "Deadening of external noise (e.g., traffic noise)," with a mean of 3.41. This implies that although visitors acknowledge attempts to reduce external noise, they place slightly less importance on these efforts than auditory enhancements like thematic background music or sounds that enhance the immersive quality of the gallery environment. Research indicates high external noise levels can interfere with and reduce visitor engagement. Mansell (2017) highlights historical attempts to regulate sound within museum settings, underscoring the role of effective sound management in influencing how visitors perceive their experience. Additionally, sound masking strategies have proven effective in minimizing distractions and fostering deeper engagement with exhibits, ultimately enhancing the immersive quality of museum visits (Mu et al., 2022). Thus, the overall mean of 3.51 suggests that visitors had a highly positive experience with the auditory elements present in the museum, and the museum performed well in providing these elements.

Table 6. *Perceived Performance of Auditory Dimensions at the National Museum of Natural History*

Indicators	Mean	Std. dev.	Interpretation
1. Proper background music as per the gallery theme	3.56	.720	High Performance
2. Placement of proper thematic sounds (e.g., nature) to feel the sense of space	3.61	.647	High Performance
3. Deadening of external noise (e.g., traffic noise)	3.46	.774	Average Performance
4. Segmentation of background sound in galleries	3.54	.717	High Performance
5. Sound treatment for echo and reverberation	3.52	.722	High Performance
Overall Result	3.54	.571	High Performance

The Natural History Museum in London uses soundscapes to involve its visitors fully in its exhibitions. In Hintze Hall, the museum has set up audio recordings of birds singing and leaves rustling. The soundscapes are carefully crafted to establish a link between the exhibits and their original habitats, reinforcing the sense of space and enriching the visitor experience through immersive auditory design (Coda to Coda, 2023).

Table 7 presents the Performance of the Tactile Dimension at the National Museum of Natural History. The tactile dimension of the museum obtained an overall mean rating of 3.48, indicating that visitors experienced its performance on average. The item 'Interaction with the visitor and piece of art' received the highest mean score of 3.61. In line with this, the museum encourages visitor engagement through interactive learning experiences, allowing visitors to interact with specific exhibits, such as those in the Life Through Time Gallery. Visitors are encouraged to explore and interact with microscopes, calipers, and other scientific tools researchers use. These results suggest that visitors had a highly positive experience engaging with the exhibits on display, indicating a strong connection between the audience and the exhibits. However, "Availability of touch screens for information" garnered the lowest mean of 3.40. In line with this, only limited galleries provide touch-screen information. The museum mainly uses sound domes and text panels to convey information to visitors.

Table 7. *Perceived Performance of Tactile Dimensions at the National Museum of Natural History*

Indicators	Mean	Std. dev.	Interpretation
1. Use of mechanical stimulation in exhibits (e.g., trigger buttons)	3.47	.768	Average Performance
2. Interaction between visitors and pieces of art	3.61	.673	High Performance
3. Provision to touch real or imitation art objects or artifacts	3.50	.777	High Performance
4. Availability of a touch screen for information	3.40	.810	Average Performance
5. Use of robotics in dioramas and other exhibits	3.41	.850	Average Performance
Overall	3.48	.623	Average Performance

Additionally, the Exploratorium in San Francisco is known for providing interactive and touch-based experiences that fully immerse visitors. One feature that stands out in the museum is the Tactile Dome, where guests move through interconnected chambers in complete darkness, fostering their sense of touch and hearing for a uniquely immersive encounter. This sensory engagement approach parallels the tactile strategies implemented at the National Museum of Natural History, where interactive elements like microscopes and specimen stations encourage deeper visitor participation with the exhibits (Exploratorium, n.d.).

Table 8 presents the descriptive measures of the Olfactory Dimension at the National Museum of Natural History. The olfactory dimension obtained an overall mean rating of 3.53, suggesting that visitors evaluated high performance with olfactory elements within the museum. This indicates that the museum has successfully regulated odors and scents to improve the tourist experience. The items "No foul smell in a gallery or hallway" and "No pervading scent of artifacts relating to zoological, biological, and geological specimens" garnered the highest mean ratings of 3.59 and 3.57, respectively, implying that visitors had a high experience or positive performance in terms of the absence of certain scents connected with these types of displays, as well as indicating that visitors greatly valued the absence of any unpleasant odors in the museum setting. The museum ensures order and cleanliness in the hallways; the specimens and artifacts are well-enclosed.

Table 8. *Perceived Performance of Olfactory Dimensions at the National Museum of Natural History*

Indicators	Mean	Std. dev.	Interpretation
1. No pervading scent throughout the museum	3.48	.746	Average Performance
2. No pervading scent of artifacts relating to zoological, biological, and geological specimens	3.57	.691	High Performance
3. Appropriate scent of the gallery as per theme (e.g., trees, sea water)	3.54	.745	High Performance
4. No foul smell in a gallery or hallway	3.59	.722	High Performance
5. Indistinct smell of chemicals for preservation	3.48	.812	Average Performance
Overall Result	3.53	.579	High Performance

Both "No pervading scent throughout the museum" and "Indistinct smell of chemicals for preservation" had a mean rating of 3.48, or highly significant, suggesting that visitors place a high value on a neutral or subtle olfactory environment and thus indicating a preference for a clean scent profile. As observed by the researcher, the museum has a specific area for specimens not yet on exhibit, such as specimens for taxidermy, which are well-kept, enclosed, and away from the galleries. While these mean scores are not necessarily low, they indicate that visitors experienced the performance of these olfactory characteristics, but not to the same extent as the other evaluated components. Hence, scent-free spaces reduce possible distractions and improve visitor comfort. According to Bishop (2017), museums purposefully control the usage of fragrances to enhance the whole experience while steering clear of overpowering smells that can deter visitors. Similarly, Ehrich (2024) emphasizes that a properly controlled olfactory environment frees visitors from needless sensory interruptions so they may focus on the exhibits. Olfactory management in museums can be observed at the Jorvik Viking Centre in York, where the curators use the scents to create the environment of the Viking age settlement. Some controlled olfactory stimuli include wood smoke, tar, and natural smells, which make the visitors feel the place's historical context, thus improving their experience (Classen, Howes, & Synnott, 1994). The Jorvik Centre shows that while using smells can be beneficial in a museum context, they can significantly impact the sensory and learning experience incorrectly.

3.3 Relationship between the Perceived Importance of Multi-Sensory Dimensions and the Performance of the National Museum of Natural History

Table 9 presents the relationship between the importance of multi-sensory dimensions and performance at the National Museum of Natural History. All presented p-values in the table are 0.000, indicating strong evidence against the null hypothesis. Thus, a strong positive relationship exists between the importance and value of the multi-sensory dimensions, general exhibit features, and the museum's experience or performance.

Regarding the Visual Dimension, the correlation coefficient of 0.862 between the value placed on visual aspects and the reported visual experience indicates a powerful positive relationship. The more visitors value visual elements, the better their visual experience at the museum will be. This could relate to the enjoyment and the educational value they derive from their visit. A strong correlation between these dimensions highlights the importance of visual design in instilling memorable and successful museum displays. Visitors' appreciation and comprehension of the exhibits rise when museums invest in high-quality visual presentations, creating a more positive and satisfying experience. Thus, the significant correlations between visual elements and other sensory

dimensions (auditory, tactile, olfactory) and general features indicate that the impact of visual aspects goes beyond just the visual experience, underscoring the claim of Ye and Tussyadiah (2011) that “tourists seek a one-of-a-kind experience when they travel. Visual stimuli that engage the imagination and connect with potential visitors personally are the most effective approach to communicate the concept of a tourism experience at a destination.”

Table 9. *Relationship of the Perceived Importance of the Multi-Sensory Dimensions and Performance of the National Museum of Natural History*

Importance	Performance					
		Visual	Auditory	Tactile	Olfactory	General Features
Visual	r	.862**	.642**	.591**	.533**	.692**
	V.I.	High Relationship	Marked Relationship	Substantial Relationship	Substantial Relationship	Marked Relationship
	p-value	.000	.000	.000	.000	.000
	Sig	S	S	S	S	S
Auditory	r	.634**	.813**	.568**	.516**	.670**
	V.I.	Marked Relationship	High Relationship	Substantial Relationship	Substantial Relationship	Marked Relationship
	p-value	.000	.000	.000	.000	.000
	Sig	S	S	S	S	S
Tactile	r	.609**	.587**	.819**	.574**	.676**
	V.I.	Marked Relationship	Substantial Relationship	High Relationship	Substantial Relationship	Substantial Relationship
	p-value	.000	.000	.000	.000	.000
	Sig	S	S	S	S	S
Olfactory	r	.564**	.534**	.549**	.843**	.611**
	V.I.	Substantial Relationship	Substantial Relationship	Substantial Relationship	High Relationship	Marked Relationship
	p-value	.000	.000	.000	.000	.000
	Sig	S	S	S	S	S

Regarding Auditory Dimensions, the correlation coefficient of 0.813 signifies a strong positive relationship between the value visitors place on auditory elements and their auditory experience at the museum. Visitors are more likely to have a satisfying auditory experience when they regard sound as a significant aspect of their visit to the museum. The ambient noises of a particular exhibit, background music, or audio guides with stories to tell significantly impact how visitors view and interact with museum exhibits. This underscores the study of Bruner (as cited by Kokko, 2019) that people give emotional significance to music, have affective reactions to music, and music can elicit affective and behavioral responses in consumers. Thus, the significant correlations between auditory and other sensory dimensions (visual, tactile, olfactory) add to a multi-sensory experience that can improve how an exhibit is perceived. The tactile Dimension has a positive correlation of 0.819 within its domain. This shows its significance to the museum visitor. Rugowski (2016) states, "Tactile sensations are often viewed as the most basic way of learning about and experiencing the immediate surroundings." The perceived importance or value of the tactile dimension shows a positive relationship with visual, auditory, and overall exhibit features. Therefore, respondents who value tactile exhibits also generally value visual, auditory, and other exhibit features.

Regarding the Olfactory Dimension, the correlation coefficient of 0.843 suggests an influential association between the perceived importance or value of olfactory items and the olfactory experience in the museum. The perceived relevance or value of the olfactory dimension is strongly related to tactile and overall display aspects as well as visual and aural dimensions. This shows that respondents who favor olfactory dimensions also highly emphasize tactile and overall exhibit elements. According to Elangovan and Padma (2017), “scent is also related to the emotions we feel during those experiences. Because of this, the capability to connect scent with emotions is greater than any other sense. Customers can recall a product's attributes when exposed to scent." This suggests that incorporating or giving value to the olfactory dimensions in museums can enhance their engagement and satisfaction, creating more memorable and meaningful experiences.

3.4 Proposed Measures to Improve the Multi-Sensory Dimensions at the NMNH

Numerous museum studies recognized the need to include multisensory dimensions for visitors. According to Levent and Pascual-Leone (2017), it is essential to point out that using multiple senses improves the overall visitor

experience and, therefore, makes the museum visit more fulfilling. The IPA chart (see Figure 1) reflects this by showing the Visual Dimension as crucial, as it complements other research, which has indicated that visual aspects are the most prominent in museum visits.

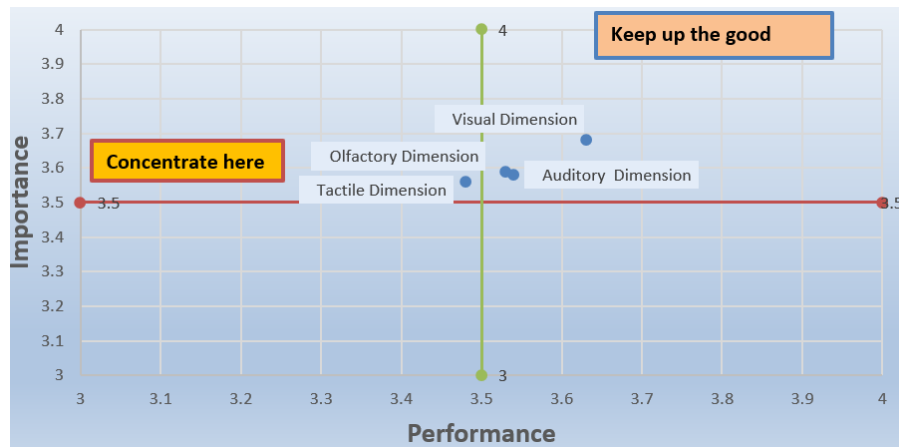


Figure 1. IPA Chart of Visitors' Perceptions on the Importance and Performance of Multisensory Dimensions

However, Tactile experiences, while being significant, are underutilized – a concern that has been highlighted in the literature regarding the difficulties of incorporating touch in museums because of preservation concerns (Wang, 2020). The chart also directs to “Concentrate here” for the Tactile Dimension and the findings of prior researchers that stress the need to engage the tactile sense for learning in museums. The poor performance of the tactile elements in the analysis may suggest an area that could be filled by more creative or touch-based exhibits, which have been recommended as a possible way to increase the perceived value of the experience by the visitors. The placement of the Olfactory and Auditory Dimensions in the middle of the IPA chart indicates that they are of moderate significance and moderate effectiveness. Literature also shows that despite being described as secondary to vision, these senses are essential in constructing experiences. Furthermore, the chart indicates that increasing these dimensions could add more value to the visitors.

4.0 Conclusion

The study's findings confirm a significant relationship between the perceived importance and performance of multisensory elements at the National Museum of Natural History (NMNH). Furthermore, visual elements ranked highest in importance and performance, underscoring their significant role in fostering visitor engagement. Although tactile and auditory experiences are valued, their performance showed gaps that must be addressed to maximize the museum offerings. Meanwhile, although traditionally less prominent in exhibit design, olfactory elements were positively associated with an improved visitor experience, particularly in enhancing comfort and ambiance. Additionally, the Importance-Performance Analysis (IPA) underscores key areas needing targeted enhancement, particularly tactile engagement, which remains underdeveloped due to preservation constraints. Auditory elements, including thematic soundscapes and optimized noise control, also present avenues for further refinement. These findings emphasize that multisensory dimensions complement fostering inclusive, immersive, and educational museum experiences. Hence, integrating sensory design improvements that enhance tactile and auditory elements, the NMNH can significantly boost visitor satisfaction, accessibility, and educational value. Future efforts should explore innovative yet sustainable ways to incorporate these features while maintaining artifact preservation. Further research into the diverse sensory preferences of different visitor groups could also refine and personalize the museum experience.

5.0 Contributions of Authors

Alvin P. Murillo collaborated on data collection, analysis, and drafting key manuscript sections. At the same time, Dr. Ma. Cristina R. Williams provided expert advice on the manuscript's construction and made essential revisions.

6.0 Funding

The researchers shouldered the expenses for the study conducted.

7.0 Conflict of Interests

The authors state that there is no conflict of interest related to the publishing of this paper.

8.0 Acknowledgment

The researchers would like to express their heartfelt gratitude to the following people for their contributions to the completion of this thesis. Dr. Maria Cristina R. Williams, Thesis Adviser, for her tireless guidance and constant clarification of timely ideas to improve this manuscript; Dr. Maricar W. Ching, Research Subject Facilitator, for her assistance and clarifications on constructing the manuscript; Dr. Serena C. Gomez, for imparting her expertise and knowledge, as well as her valuable advice regarding statistical approaches for this study; To the National Museum of Natural History for assisting the researcher's request to conduct this study; To the members of the defense panel, Dr. Miguela M. Mena, Dr. Lilibeth C. Aragon, Dr. Maricar W. Ching, and Prof. Jun Poloyapoy, for imparting their knowledge to strengthen this study through their comments and suggestions, To Ms. Roselle Lopez, for her continuous assistance during the process of the study. To the researcher's family, close friends, participants, and other exceptional individuals for their kindness, encouragement, and support. Above all, to the Almighty God for his unfailing love and guidance, for imparting strength, wisdom, and knowledge.

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