

Applying User Experience (UX) Design in Interior Space for  
Art, Science Museums, and Learning Environments

by

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## Dedication

I dedicate this to my parents, who supported me through this process. It is also dedicated to my spouse for encouraging me with patience and love.

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## Abstract

This research study explores the role of user experience (UX) and user interface (UI) in educational spaces: museums, science centers, galleries, libraries, and classrooms. This study examines the effects of enhancing displays in learning spaces and focuses on users' interactions and experiences. This project observes the effectiveness of learning modes and styles applied in different museums and focuses on the users' experiences in an educational environment, which was measured through student users' impressions, behaviors, and performance. It was hypothesized that students would retain more information through the experience. The concepts covered included using UX/UI on websites and small devices. Results for hands-on learning showed that users benefit from the use of experiential devices and objects and are more engaged than the users in an environment with classic repetitive on-wall display. This study developed strategies that could be applied to enhance learning experience in educational displays.

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## Chapter 1: Introduction and Background

### Introduction

This study focuses on users and their interactions with space. It emphasizes educational spaces such as museums, science centers, and libraries, which are mainly identified as learning environment spaces. In fact, they are more than places to learn; they are places to communicate, interact, and enjoy. These buildings are designed to influence and inspire users. There are many techniques used in presenting elements greatly affect human interaction with objects. Design plays a significant role in manipulating sounds, visions, and technology, which make the space more experiential and attractive (Figure 1). Thus, as visitors are attracted and engaged, they will be able to gain more knowledge.

Learning styles have changed over time. Furthermore, the development of educational spaces has increased greatly. Learning styles in those environments intend not only to present the information but also to develop more engaging mediums that provide a communicational experience between users and objects. In many ways, the interaction between humans and space affects individuals physically and psychologically, which impacts on their attitudes, behaviors, and responses. Those designing such spaces should consider both people and their surroundings as one component that works together and interacts with each other. As a result, it is important to determine how the design of the environment could offer the most engaging and effective experience to enhance individuals' learning.



*Figure 1.* Development of technology in museums. Exploratorium, San Francisco, California (Hughes, 2010, p. 17).

Educational spaces are always recognized as spaces where people go to seek knowledge and gain experience. Educational spaces such as museums are not only to educate but also to preserve the history of the past as they defined by MacDonald (1996), as cited by Kong (2005): “Museums may be examined as social and cultural sites, as well as sites of power relations. In the former approach, the concern is with: what stories are told; what devices and technologies are employed to tell the stories; and the relationship of those stories to other sites” (p. 496–497). Moreover, Lord, Lord, and Martin (2012) described the benefits of museums, saying, “Museums collect, record, display, and interpret to their present, past, and future public the meanings of the material culture of our lives—of our arts, histories, and sciences” (p. 29).

Exhibits and displays mostly implicate “a storytelling” method to explain history, creature life, or artifacts (Kong, 2005). Through artworks, sculptures, and media, the

exhibits become attractive, although in many galleries, visitors need more an engaging atmosphere, especially in bodily participation (Kong, 2005). The design of space and display cases needs to adjust to the developments of the element presented. Kong (2005) stated, “Art is changing, but has the gallery changed with it? Art has changed, but it seems the gallery has not” (p. 1). As a result, this study aims to identify effective techniques and strategies that could be applied to enhance users’ learning in the educational environment.

One of the important studies about designing based on human communications and needs is user experiences. It is the process of enhancing user satisfaction by improving the usability, accessibility, and pleasure provided in the interaction between the user and the product. UX focuses mostly on products, web designs, graphics, and technology that people use. Although UX focuses on electronic products, space can also be considered a huge product that humans use and live in. Thus, the showcases are also considered a medium that individuals interact with. This study will address how to apply UX in interior spaces, especially in museums and learning environments.

### **Problem Statement**

With rapid technology advancement, people are exposed to extremely copious quantities of information regularly. The mode of learning has changed, while the learning environment has not. The current educational institutes, such as science centers, art galleries, and libraries, are lacking interactive designs. Hence, there is a need to embrace emerging technologies to facilitate new learning methods. Additionally, many studies have been performed and implemented to develop the UX with regard to technology; however, in learning environments, such studies and applications are fairly rare.

## **Purpose of Study**

This study will focus on users and their responses to and interaction with the displays in museums and galleries. The overall purpose of the study is to (a) find out whether the UX design is applicable for interior spaces; (b) explore the needs of educational institutes that enhance learning through interactive design; (c) investigate individuals' experiences and information gained from the museums, science centers, and galleries; (d) explore what mostly encourages and attracts visitors to learn, observe, think, and interact; and (e) improve the learning methods.

## **Justification and Significance**

The findings of this study will provide more knowledge about how the exhibits changed over time. In addition, interactive design will transform learning environments into more fulfilling, engaging, and interesting spaces, enabling users to gain more knowledge and positive learning experience. Furthermore, UX incorporate modern technology and provides design professionals with modern design thinking and methods.

## **Research Questions**

Research Question 1: What is the pattern of human knowledge acquisition? How can the design of learning spaces enhance this pattern?

Research Question 2: What is UX/UI design? Is UX/UI design applicable to learning space design? If yes, how can UX/UI be applied in the interactive design?

Research Question 3: How does UX/UI design foster different modes of knowledge acquisition in art, science museums, and other learning environments?

## Chapter 2: Literature Review

This chapter presents a review of related literature for further understanding of the research problem by (a) providing a historical background of museums, (b) describing modern exhibition its status, (c) identifying improvement of educational display and attracting visitors, (d) understanding the learning modes and styles, (e) understanding how the human brain receives and sorts information, (f) and identifying the user experience and user interface design. This chapter provides beneficial theories and constructs for the study.

### History and Background of Museums and Displays

Many large museum buildings of the nineteenth century have a temple-like atmosphere (Hughes, 2010). Religious buildings such as churches, mosques, and temples are examples of how techniques of display in versatile atmospheres can be employed. The design used in the construction, architecture, interiors, and every element of the buildings “stimulates the senses (scents, music, visual stimulation, tactility) promoting spiritual contemplation” (Hughes, 2010, p. 10). The structure of those places was also used as a display for children: “... children were taken to a cathedral to view its stone carvings, stained glasses, frescos or mosaics for instruction in life’s mysteries” (O’Neill 1996, p. 191, cited by Kong, 2005, p. 496). In 1984 the Nature Exchange started, which means, when travelers bringing items, such as food sculptures, or goods, from other countries and sharing them with the public.

Buildings, bridges, and objects on streets are all considered displays. By walking through a city, individuals experience a live exhibition where they learn about culture, history, and artwork of the residents. In the past, museums and art galleries only existed



to display the collections of rich families and could be visited only by other wealthy families (Hughes, 2010), until the end of the eighteenth century, when they were opened to the public: travelers, scientists, children, and so on “In the nineteenth century, science museums evolved from being aristocrats’ private ‘cabinets of curiosities’ to public vehicles for the exposition of science” (Micklos, 2004, para. 1). Since that time, a number of techniques and multiple designs have been used to appeal to the appetite of visitors (Hughes, 2010).

There are many reasons to design exhibits and displays. The first is to house and protect the existing and remaining collection of objects. Second, those places provided multiple resources and opportunities for gaining knowledge and self-educating (Hughes, 2010, p. 11). Furthermore, according to Hughes (2010), museums “promote and celebrate these scientists’ growing industrial and technical accomplishments” (p. 12). According to Kim and Lee (2016), “While early exhibitions were for the collection and preservation of objects and limited to people of a particular class or to intellectuals, exhibitions became an effective tool for research and education and became popular with the general public” (p. 15).

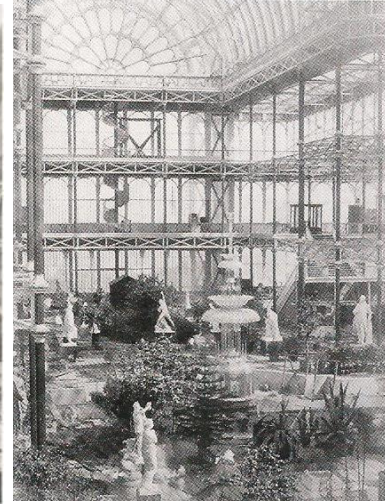
Enhancing the design of displays was a major issue in exhibition places. The display cases were made from glass and wood frames (Figure 2). The thick wooden frames were used to protect the items from damage and theft (Hughes, 2010). The items inside the glass might be difficult to see because of poor lighting and the distance between the viewer and the item (Hughes, 2010) stated, “In an era before electricity or reliable gaslights, designers relied on the clever infiltration of natural light into the

galleries usually from above so that as much wall area as possible could be used for display” (p. 13).

The Crystal Palace, a “giant glass-and-iron exhibition hall in Hyde Park, London” (Encyclopædia Britannica, 2016, para.1), is a remarkable example of a stately design of exhibition from 1851. The use of glass and iron in the exterior structure allowed skylight to access and light the area. There were over eight miles of display tables on the ground floor (Encyclopædia Britannica, 2016). Dulwich Picture Gallery is another example of one of the first art galleries in London, it was an important model for architects and designers “It famously showed how daylight could be introduced from above at a time when, in most buildings, the walls on which paintings were hung were pierced by windows” (Hughes, 2010, p. 11).



The reptile gallery of the Natural History Museum in 1851 London (Hughes, 2010, p. 12).



The great exhibition, London, 1851 (Hughes, 2010, p. 12).

*Figure 2. History and background of museums.*

### **Modern Exhibition and Improvement of Attracting Visitors**

The designs and techniques of the exhibits and displays continued to develop during the twentieth century (Micklos, 2004). The design of such spaces focused not only

on displaying objects but on attracting visitors. Exhibitions, which were object-based displays of artwork, galleries, and museums, developed into information-based exhibitions (Kim Lee, 2016). The features of logical science, and connecting them to the experimental touchable experience, started to be presented in the mid-twentieth century. As Micklos (2004) explained “This led, especially in the United States, to increased emphasis on hands-on experience with the process of science” (para. 2). People’s encounters with sounds, videos, and virtual reality technologically advanced at the end of the century (Micklos, 2004, para. 2). Media can range from film and cinema to photography and digital and web-based art (Paul, 2008, p. 54).

New media influenced and caused expansions in display methods. Paul (2008) described the new media as the “...dynamic, interactive, collaborative, customizable, and variable in theory and method” (p. 54). He also described the new media as “an experimental medium” that uses technology to attract and fulfill (p. 54). Johnson (2005) explained that “New Media art relies on the participant not only to document the experience, as in installation, but to filter and process images. The New Media artist uses the human body as a medium of artistic production” (p. 35).

The museums developed many experiential programs, such as workshops and science labs, to enhance the visitors’ education and knowledge. According to Ramshaw (2013) “In 2009, the Museum of Natural History began the process of renovating its galleries and updating its interpretative programs to better serve its visitors, and to better achieve its mandate” (p. 8). Those programs provide a direct interface between users and an element such as nature. Thus, touchable and experimental elements that have been developed in modern exhibitions displays encourage and interest users. As Hughes

(2010) stated “Generally we respond ever more enthusiastically to the highly artificial and constructed environment of the modern exhibition.” ( p. 7).

The development of the learning exhibitions started from Western Europe and the United States and extended to the Middle East, to areas such as Qatar, Dubai, Egypt, and Bahrain (Hughes, 2010). With the growing variety of exhibitions, the demand for different display techniques is increasing. According to Hughes (2010), “As visitor numbers increase, so do the demands on the exhibiting institutions and the designers to make these visits enjoyable and enlightening” (p. 9). The incorporation of active learning, such as “hands-on, experimental, and participatory activities,” has been found to attract more visitors (Ramshaw, 2013). That experimental method is effective especially on science museums as Micklos (2004) explained: “Science museums are responding by experimenting with ways to connect the public to scientific endeavor” (p. 2).

In learning spaces, especially museums and galleries, a huge number of displays and a variety of subjects are presented. However, visitors usually spend a limited amount of time, and “However many exhibits they observe, there are limits to how much any human can absorb” (Hughes, 2010, p.10). A part of the designer’s job is to create the most meaningful and effective experience to the visitors (Hughes, 2010). The design of the exhibitions is not only to provide information but also to engage the audiences. According to Nilsson et al. (2016), “Designers are today increasingly empowered to shape the way we interact with our physical surroundings and thus build entirely new experiences” (p. 1).

Many viewers travel to a location to experience and learn. In 1984, the Nature Exchange started. This is “where visitors trade natural items and share information about

these items” (Ramshaw, 2013, p. 10). Exhibitions exposing artwork and objects to people been developed. “Public art was concerned with bringing art to the participant. It was also an attempt to merge art into the everyday rather than confining it to a singular location” (Johnson, 2005, p. 29). Public art in the subway of New York Underground (Figure 3) is an example of a living museum (Fitzpatrick, 2009).



*Figure 3.* Subway art; Mr. Muniz himself makes an appearance in a Rockwellesque scene at the 72nd Street station. New York Times (2016).

### **Modes of Learning and Transferring Information**

There are multiple ways to learn and receive information, including from sources such as images, audio guides, lectures, and videos. The learning pyramid made by the National Training Laboratories (Lalley & Miller, 2007) presents the estimated percentages of learning from each type of source (Figure 4). This pyramid presents seven types of learning modes and is organized from the most effective source to the least:

teaching others, practice by doing, discussion group, demonstration, audio, reading, and lecture. Even though the learning pyramid is more applicable in schools, it could be used in many spaces. In fact, those sources could be more effective in museums and galleries.

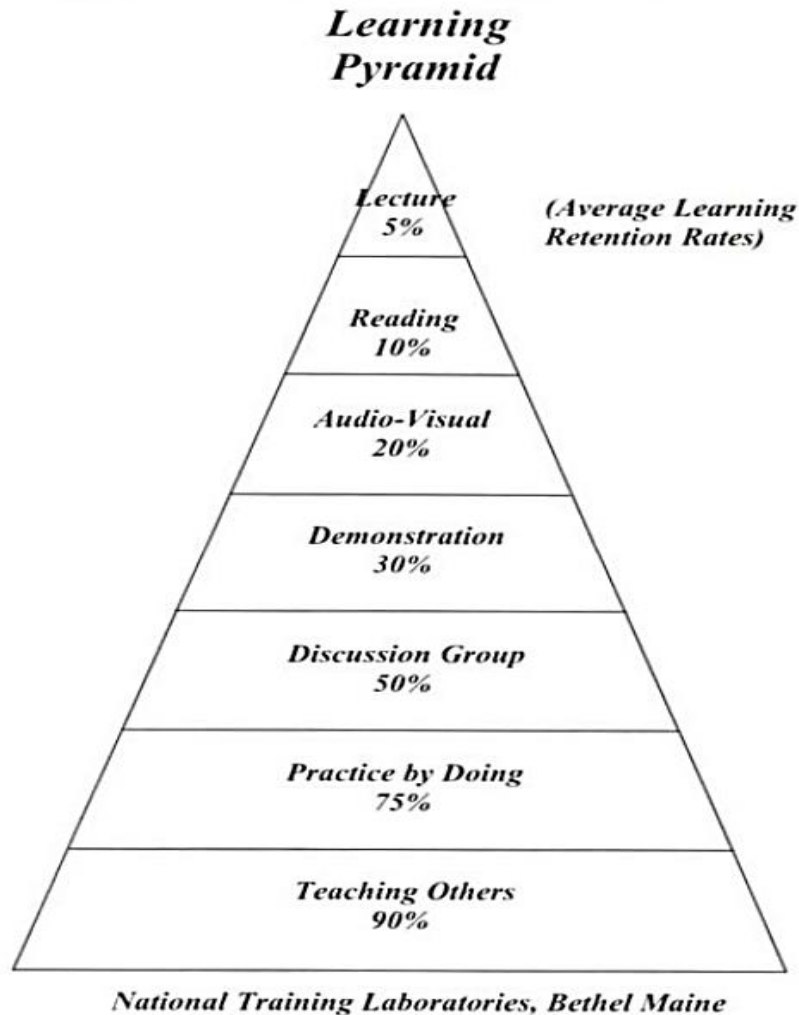
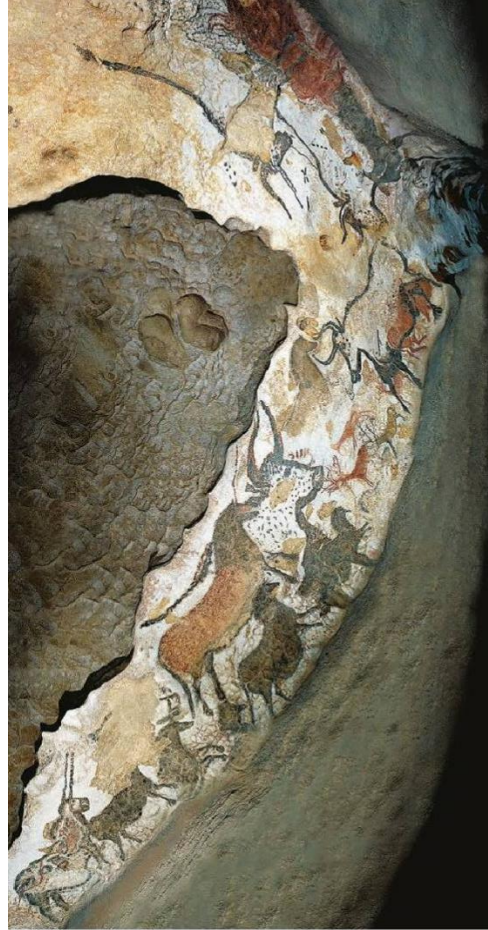


Figure 4. Learning pyramid, Lalley & Miller(2007)

The display of images was and still is an effective method. In order to communicate, people have always used images to understand each other. Coates & Ellison (2014) explained, “Well before early versions of writing originated in Mesopotamia around 3000

BCE, images had been used as a way of communicating for thousands of years. Markings and drawings have been found all over the world, often carved into stones or drawn on rock faces” (p. 13; Figure 5). Images, items, and objects are always used as ways to



*Figure 5. The Lascaux caves in France (Coates & Ellison, 2014, p.14)*

transform information and learn about history, civilizations, countries, people, and science.

In addition to graphics, people learn more in the physical environment, either the large-scale elements such as atmosphere, space, and light or small objects such as displays, Falk and Storksdieck (2005), explained “learning always occurs within the

physical environment” (p. 746). Freedom and confidence are other main facts of learning. Educational institute are places where learning is voluntary (Falk and Storksdieck, 2005). Studies suggest that there is a relationship between visitor learning and their ability to confidently navigate and orient within the space (Falk and Storksdieck, 2005).

The role of the body in learning is important. According to Hansen as cited by Johnson (2005), “The body cannot exist without the brain’s cognitive function. Therefore, the role of the body in New Media, is it as a filter for processing images presented by the artist” (p. 37). The philosophy Henri Bergson originated the concept of affection in the early twentieth century, which explained the role of the body in processing information as following:

Therefore, the affect—body, able to accept and process information, differs from the affect—image, which solely receives information. The affect—image brings forward expression, yet will not result in an action. The affect—body is considered the centre of determination, making connections between the body and the digital realm, drawing conclusions and translating information presented by the image (Hansen, 2004, cited by Johnson, 2005, p. 42; Figure 6).

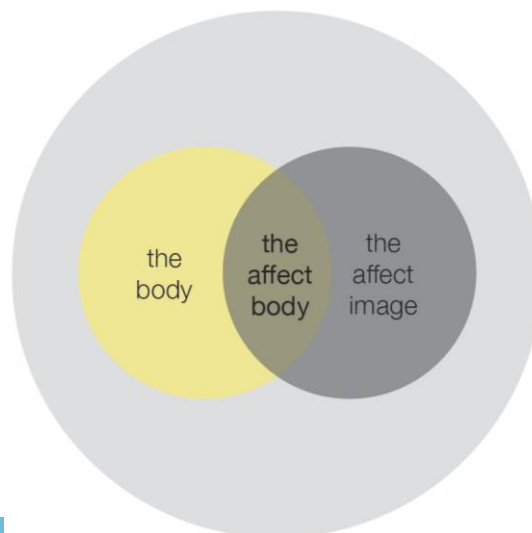


Figure 6. Theory of embodied perception (bodily experience; Johnson, 2005, p. 42)



## Knowledge Acquisition

The human brain is exposed to much information from various sources. Knowledge acquisition (KA) is how the brain captures that information. KA was defined by Beveren (2002) as “the process of capturing and absorbing knowledge from direct or indirect contact or interaction” (p. 21). Waterman (1985) cited by Akhavan & Dehghani, (2015) defined KA as “the process of extracting, structuring and organizing knowledge from several sources, usually human domain experts, so it can be used in a program” (p. 18). The human brain has the ability and skill to transform or create the captured information to new knowledge. As explained by Milton (2007), “Knowledge is an active thing that manipulates, transforms or creates something out of something else. It is a machine in someone’s head that takes in data and information at one end and spurts out decisions and actions at the other end” ( p. 3).

The knowledge acquisition theory is a set of development for how knowledge is created, made, held, conveyed, and used. *Modifying data, information, and knowledge* are important terms in developing such a theory (Beveren, 2002). According to Beveren, “Data are raw facts information is data within a context, where data are raw facts that can be shaped and formed to create information ... new knowledge is created from processing information” (p. 19). Since the brain transforms information into new knowledge, Nonaka (1991) suggested that this could be beneficial in creating new knowledge as solutions to unfamiliar problems. Beveren agreed that “people seek new valuable information to create new knowledge within their own brain to solve unfamiliar problems” (p. 21).

## UX/UI Design

*User experiences* and *user interfaces* are terms that are commonly used and applied in technology devices, websites, video games, and other digital products. UX design is defined as the process of enhancing user satisfaction by focusing on creating experiences that improve the usability, accessibility, and pleasure provided in the interaction between the user and the product (Nichols & Chesnut, 2014). Don Norman (2016) said of UX design: “It’s everything, the way you experience the world, ... it’s a system that everything” (NN/g People). Marsh (2016), defined UX: “UX Design is the practice of creating nonrandom effects in people to solve a problem. In other words, you make them feel, think, and do stuff—on purpose. Therefore, the more you understand your users’ feelings, thoughts, and actions, the better designer you are” (p. 27). In business firms, UX practices understanding how the products or brands are experienced by customers through digital media (Nichols & Chesnut, 2014).

Effective UX/UI design is centered on the users. According to Lupton (2014), “In the words of Bill Moggridge, engineers start with the technology and look for a use for it; business people start with a business proposition and then look for the technology and the people. Designers start with people, coming towards a solution from the point of view of people” (p. 1). Understanding users’ characteristics (persona) is essential how they see, understand, and think about the medium they interact with (Rosenzweig, 2015). The medium, such as a product, website, or graph, must present the information in an understandable way that meets users’ physical limitations and abilities (Galitz, 2002). As cited by Johnson (2005), “The work is centered on the experience of the participant with

the medium. A process-oriented, experience-based methodology formulates a unique relationship between the artwork, the participant and the spatial container” (p. 33).

User Interface (UI) is a part of UX and is a study of interaction between a human and an object (Galitz, 2002). The different between the UX and UI is that the UX is the user experience through the entire system, while UI is the user interface or interact of a certain graph or product. The graphical user interface (GUI), as Coates and Ellison defined it, is “the representation of information and actions available to a user through graphical icons and visual indicators. The actions are performed through direct manipulation of the graphical elements, rather than typed commands via text..... mobile phone interface we use to dial numbers and send text messages” (p. 23).

### **Summary**

In this chapter, related research, books, and philosophical theory were reviewed. This chapter covered some important topics that help in investigating the research problem. It identified and discussed the history and background of educational spaces, the developments of design, the attention to users’ interaction, the modes of learning, and UX/UI design. The information provided helped in observing and analyzing the data collected to interpret the findings. The method of investigating the research questions is presented in the next chapter.

## Chapter 3: Methodology

This chapter outlines the steps that were taken to address the research questions presented in Chapter 1. The primary goal of this study is to explore the research questions that relate to enhancing individuals' learning experiences of the museums, science centers, and galleries and to determine how much information they received from that experience. The qualitative approach method is employed to explore these questions. The chapter is organized into four sections: (a) selection of participants, (b) instrumentation, (c) data collection, and (d) data analysis.

### Selection of Participants

The sample was composed of three case studies of museums: the Toledo Museum of Art, the Chicago Field Museum of Natural History, and the Ann Arbor Hands-on Museum.

**Toledo Museum of Art.** The Toledo Museum of Art was established in 1901 in the city of Toledo, Ohio. The museum houses more than 30,000 works of art, including American and European paintings from different eras. It has grown to have a sixth building. The main museum building has a Greek ionic façade. The interior contains four and a half acres of floor space on two levels. It has 45 galleries, classrooms, theater, lecture hall, resource center, family center, visual resources collection, museum café, and museum store. The interior galleries' designs are simple and classy, with consistent wall paint, lighting, and flooring. The objects are either displayed behind glass, as a painting on a wall, or sculptures (Toledo Museum of Art, n.d.).

**Glass Pavilion.** Glass Pavilion is another important building of the was opened in 2006. It represents more than 5,000 works of art from ancient to contemporary times. It includes five galleries for special glass exhibitions, two hot shops, a multipurpose GlasSalon, public and private courtyard space, and a coffee bar. This exhibition includes glassblowing demonstrations, which are live demonstrations of the glass-making process by museum instructors and local artists. That demo takes place daily, and visitors can watch and learn about making glass. In addition, the Glass Pavilion offers hour-long studio sessions that allow visitors to experience making glass objects (Toledo Museum of Art, n.d.).

**Ann Arbor Hands-on Museum.** The Ann Arbor Hands-on Museum opened in **1982 and** has been visited by more than 5.4 million people since then. The museum aims to inspire and educate kids **to discover, play,** and learn science, technology, engineering, art, and math. The museum is designed to enhance the imagination and interactive learning experiences. The 40,000-square-foot building includes more than 250 interactive exhibits designed by scientists, artists, designers, and engineers **who transfer their knowledge to create effective experimental science exhibits that can be enjoyed by children and families.** Over the years, the museum has received recognition from schools (**field trips**), libraries, community centers, camps, and festivals throughout Michigan (Hands-on Museum, n.d.).

**The Field Museum of Natural History.** The Field Museum of Natural History opened in Chicago on May 2, 1921. It is one of the largest museums in the United States. In 1945 the museum began to focus on scientific research and not just collecting items for its exhibitions. The museum houses collections of the natural history of the planet, its

life, and its cultures, and it includes scientific programs, workshops, and labs. Through its 30 million geological and biological objects, the museum aims to increase patrons' ability to understand, imagine, and explore the past, the present, and the future. The museum attracts a vast number of visitors and tourism annually (The Field Museum, n.d.).

The Field Museum of Natural History Museum is known for its full range of biodiversity, gems, meteorites, fossils, and other rich collections from around the globe. These collections include dinosaur bones such as those of Sue, the largest, most complete and best-preserved Tyrannosaurus rex. Moreover, in its learning programs, the museum intends to present the objects in such a way as to provide the most engaging and fulfilling experience-based discovery for learners of all ages (The Field Museum, n.d.).

### **Sampling Procedures**

Three main samples in this study are the Toledo Museum of Art and Glass Pavilion, the Ann Arbor Hands-on Museum, and the Field Museum of Natural History. The target population of this study was all visitors to the museums on the day of field study. Convenience sampling includes whoever happens to be available, including all ages, races, gender; therefore, there may be limitations in terms of gender, time, language, age, socioeconomics, or culture. As a participant observer, I became a part of the group and fully engaged in experiencing what the participants are experiencing.

**Data gathering procedure and instrumentation.** The phenomenological method of observations was undertaken to determine the characteristics of visitors' experience and communication in educational museums. To accomplish this objective, the observation method is used in unstructured and free-flowing environments, focusing on visitors' behavior in a natural setting.

The observations took a place in three museums located in different states and presented various aspects of each. Each museum was visited on a different day in February or March of 2017. Each observation lasted for 5 hours. The self-report study determined the design of the space in general, the display items, and presenting technique. Moreover, pencil, paper, and photos were used to record visitors' reactions toward the displayed items and to observe users' behaviors and attitudes. There was no interference of the natural setting nor any feedback asked from participants. Observation allows the description of behavior as it occurs naturally.

**Data collection.** The qualitative method of data collection incorporated site visits and records of users' behavior. The following steps were taken before, during, and after visiting the site:

1. Three museums were chosen depending on the type of display (science and art) and the presenting methods (experiential and nonexperiential). Research about each museum's history, location, design, and layout was addressed before visiting the site. In addition, a suitable day and time was picked during weekends or vacations to have more visitors (Table 1). Reports organized and printed with space for note-taking and a schedule to record users' reactions.
2. During the observation, the day, time and duration period was written in the note. Observations and space study were recorded once entering the museum. The first step was to identify whether there was any kind of guiding (audio, application, or tour). The second step was walking with the visitors' flow, recording their movements and reactions. The observation indicated the (a) setting, (b) people, (c) incidents, and (d) displayed objects. The report indicated the details of the interactions and relationships

between the design of the space, objects, and individuals. It investigated by taking photos, studying displayed objects, and recording the reaction of the users toward those items. In some cases, this involved standing on a spot, watching, and recording the number of times a behavior occurred during a specific time.

3. After visiting the museums, the photos, notes, and reports were organized and transferred to the computer. To find out the important and meaningful results, the information was reported and categorized. A written description was made of each case study: the design, the people, the display and environment.

#### *The Samples of the Study*

	Name	Location	Participants	Observation date	Observation time
Sample 1	Toledo Museum of Art & Glass Pavilion	Toledo, Ohio	All visitors	Sunday, Feb-12-2017	2:30-5 p.m.
Sample 2	Ann Arbor Hands on Museum	Ann Arbor, Michigan	All visitors	Sunday, March-5-2017	12:00-5 p.m.
Sample 3	The Field Museum of Natural History	Chicago, Illinois	All visitors	Sunday, Feb-20-2017	12:30 -5 p.m.



**Data analysis.** The qualitative analysis of data was composed of highlighting and comparing important data. The analysis part aims to (a) research emerging technology of user experience and user interface to verify whether it is relevant and applicable to learning space design and (b) formulate possible strategies to enhance learning experiences in museum interior design.

The data are explained in images and words. A full description of each museum, map, design, display method, object, type of educating, users' journey, and people's reactions are provided.

To analyze the data, first, a full description of the case study design, functions, and type of display was provided. Second, the modes of learning and compared the effectiveness of each mode on the users was explained. In addition, the most common behavior of user engagement, such as discussing, touching, or taking photos was listed. Last, to answer the research questions, the information from both the literature review and data from the observations were combined and compared. Then, new strategies and techniques were suggested to enhance the learning environment. The structure of organizing the data followed the UX/UI design procedure mentioned by Rosenzweig (2015) and was categorized into three sections: (a) the design system, (b) the users (persona), and (c) the visitors' journey. Each section covered the following.

The design system (telling the story):

- What type of display and learning methods are used?
- What is the provided information?
- What are the technologies used?
- Which area or display is the most popular and why?

- How can this information be applied to improving display, learning, and UX?

Understanding the users (persona):

- Who visits?
- What are they doing?
- How long do they stay?
- What is their goal?
- Body language: physically moving

Following visitors (journey):

- Movements and stops
- How do they interact with displayed objects?
- What limits their actions?

### **Summary**

This chapter restated the purpose of this research and presented the research questions. The selection of the sample of three museums of several types and from different location was discussed. The data collection procedures were also discussed in this chapter. Finally, the methods of data analysis and organizing the data for the three case studies were presented. Results of the data analysis are presented in the following chapter.

## Chapter 4: Presentation and Analysis of Data

This study intended to investigate the effective methods of enhancing displays in educational spaces. This chapter presents the results and analysis of the data for the three stated research questions and presents the data from three different case studies of museums. In addition, it explains the design type of display and the presentation methods used, and it explores the behaviors and attitudes of users. Finally, this chapter points out some strengths and weaknesses of the strategies used in those museums.

### Case Study 1: Toledo Museum of Art

The first museum explored was the Toledo Museum of Art, which contains many buildings. Both the Toledo Art Museum and Glass Pavilion are studied in this research.

The historic exterior Greek ionic façade of the Toledo Art Museum made the museum a landmark of the city of Toledo, with its low and horizontal white marble columns (Figure 7). Both the interior and exterior of the building were renovated over time and designed to be both classic and elegant.



Figure 7. Toledo Museum of Art main building (Greek ionic façade), <http://www.toledomuseum.org/>

**Design of exhibits (the system).** The museum consists of two floors. The lower level includes the entrance, reception and information center, workshops, kids' area, and small exhibits. The main exhibits are on the upper floor. Two large, terraced staircases located next to the entrance lead to the upper level. The exhibits are designed as halls, with the artwork displayed or hung on the walls. The layout is divided into sections, and each section presents the artwork of one era (see Figure 8). The overall design of walls, floors, and ceilings are similar in all halls. Some walls painted in a varied color, and the ceiling are higher in larger halls.

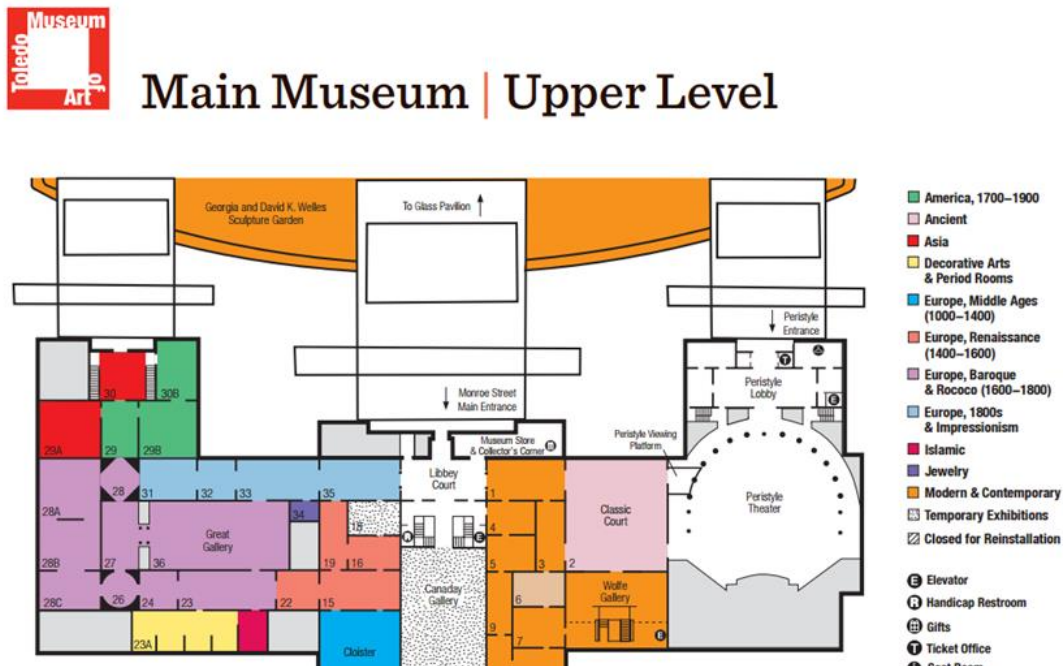


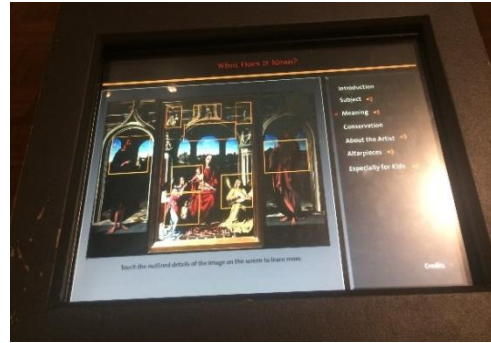
Figure 8. Toledo art museum upper floor layout, <http://www.toledomuseum.org/>

The artwork is either hung on the walls, such as paintings and photographs; as free standing objects, such as sculptures and models; or objects in glass containers. The information about the displayed objects is mostly on a reading base presented in small text hung on the right side of the objects (see Figure 9). Limited audio guides and

technology are used. A touchable screen is available for the Morrison Triptych painting (Figure 10). A phone Application can be downloaded but with limited object recognition and references. There are some experimental elements provided in some sections, such as a table with building blocks. There is no sounds, music, or any environmental engagement.



*Figure 9.* Information provided in small text on the right side of the painting. Toledo art museum, Toledo, Ohio (2017). <http://www.toledomuseum.org/>



*Figure 10.* Touchable screen, Morrison Triptych. Toledo Art Museum, Toledo, Ohio (2017). <http://www.toledomuseum.org/>

**Users' behaviors.** Through the observation, the visitors of the museum were divided as follows: (a) families, which included both parents or one of them with their kids. Usually parents read, discussed, and explained to their young children; (b) seniors, older visitors who seemed more engaged. They read, moved slowly, and spent a longer time discussing and talking about an object; (c) groups, usually teenagers or adults. Groups were more energetic and active. They walked quickly through halls, skipping a lot of display and almost never read or stopped by an object; and (d) singles, the visitors who came alone. They appeared to walk slowly through exhibits and read and stopped by most of the objects. Some used a headphone while looking.

In general, visitors wanted to be closer to the displays. Many of the users tried to point at something and discuss it with another person. A lot of kids tried to touch, which was not allowed. Some people made guesses and wondered about certain displays

but rarely read. Even though there was limited use of technological devices and applications, some visitors were using them. Areas in the lower level—shop, workshop, and education area—were more engaging, crowded, and dense than the upper floor, which houses the main exhibits.

**Visitors' journeys.** The design of the exhibition uses halls that open to each other, with displays presented on the sides. That design made a lot of visitors walk straight through the halls and look around (see the yellow lines in Figure 11). Some visitors made stops or spent a longer time (see the red hashed lines in Figure 11). Many more visitors stopped by sculptures and 3D elements than by 2D paintings.

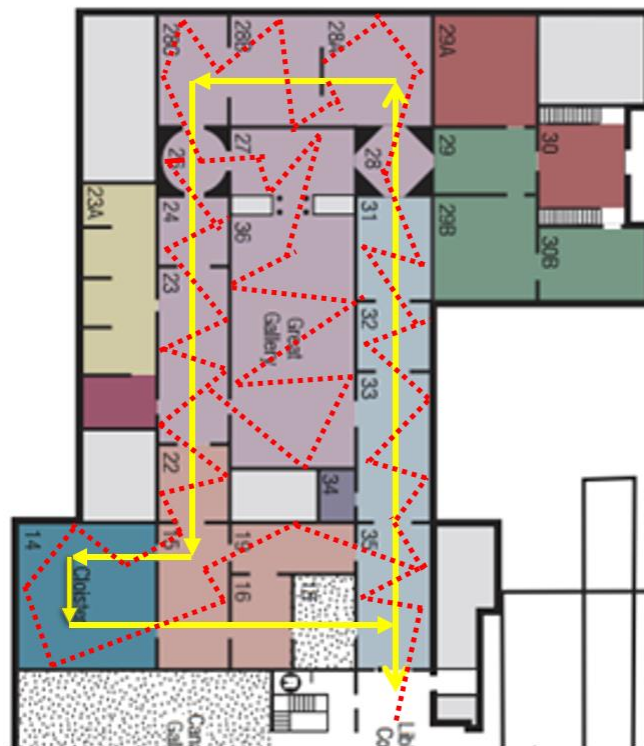


Figure 11. Visitors journey, Toledo art museum upper floor layout, <http://www.toledomuseum.org/>

## Case Study 2: Toledo Art Museum (Glass Pavilion)

**Design of exhibits (the system).** Glass Pavilion is one of the Toledo Art Museum buildings. It was designed to be an attractive and functional museum. The main display and artwork showed in this museum is glass. As a result, transparency and glass materials were used to reflect the concept of glass. Glass is used in many of the interior and exterior walls and is considered a piece of art in and of itself. Curved glass panels supported by a flat steel roof present simplicity and modernity of design (Figure 12). The plan is simple and asymmetrical, with rounded panel edges and high-tech modern materials (Figure 13).



*Figure 12.* Toledo art museum Glass Pavilion exterior view, Toledo, Ohio.  
<http://www.toledomuseum.org/>

One of the important impressions that attract visitors is the glass live demonstration. Glassblowing is the process of making glasswork. In the museum, the instructors and local artists present a daily live demonstration of glassmaking. In one of the galleries visitors can sit, watch, and experience the process and technique used in making glass. The live demonstration allows the users to experience by watching, feeling the heat, listening, and learning from the direct source, the glassmaker. There is also a



workshop studio that teaches glass blowing and allows the users to experience and make glasswork by themselves.

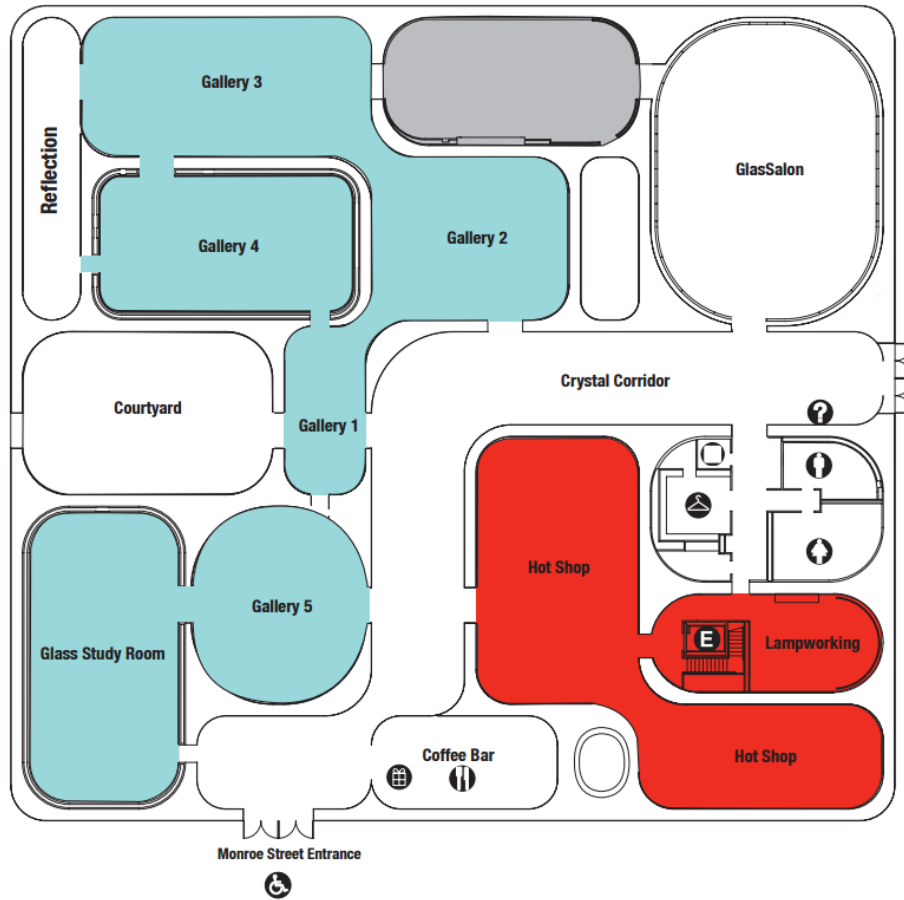
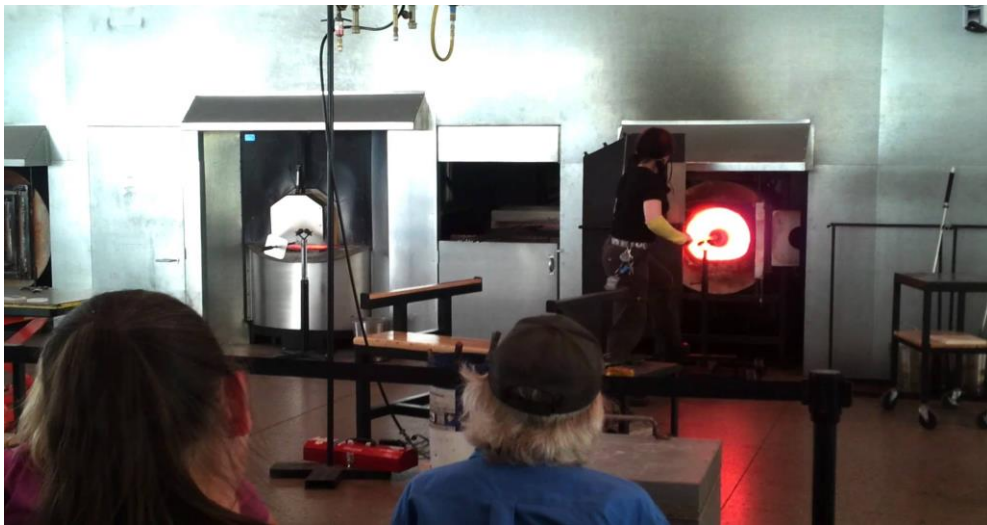


Figure 13. Glass Pavilion museum layout, Toledo, Ohio.  
<http://www.toledomuseum.org/>

**Users' behaviors and journeys.** Users of all ages enjoyed waking around and taking photos. The surrounding transparent glass panels attracted all visitors. Most of the visitors were attracted by the building itself more than the exhibition. The exhibit area was not huge, so as the display items were limited. That allowed visitors to see most of the items, and they did not seem to be bored. Live glass demonstration was an experience that attracted the most people. Both adults and kids were excited by watching, smelling, and feeling the heat. Many visitors became excited about experiencing and attending the demonstration class studio (Figure 14).



*Figure 14.* Glass Pavilion, Toledo, Ohio. <http://www.toledomuseum.org>

### Case Study 3: Hands-on Museum

**Design of exhibits (the system).** The Ann Arbor Hands-on Museum is an experimental, educational science museum that targets children as its main users. Therefore, the layout, colors, and items in the museum are designed to attract children (Figure 15). Many subjects are presented: science, technology, engineering, art, and math. The museum develops imaginative and interactive learning experiences that inspire kids to discover and explore. The museum is three floors. The main floor includes the entrance, reception, shop, and service area. The first and second floors contain the exhibit sections. The layout space is open, with multiple galleries. Each gallery or section presents different subjects such as water activities and Michigan nature (see Figure 16).



*Figure 15.* Ann Arbor Hands-on Museum exterior entrance, Ann Arbor, Michigan (2017).



Figure 16. Ann Arbor Hands-on Museum layout, Ann Arbor, Michigan (2017).

Many attractive techniques and educational methods were applied in the Ann Arbor Hands-on Museum. Multi-modes are used to provide information (read, see, touch, listen, and practice). The interactions are provided everywhere and are often unexpected. When people enter they use the steps, which make sounds like a piano. Each step creates a different tone, which makes children go up and down fast and slow to hear how the tones sound. Another method is the use of experimental items that allow users to learn from practice. The water gallery, for example, provides water containers with water in

them. Kids can see and touch the moving water; they can put in some balls and see how they move in the water (Figure 17).



*Figure 17. Water gallery, Ann Arbor Hands-on Museum, Ann Arbor, Michigan (2017).*

Many other displays are hidden and need exploration or action taken by the user, such as the skeleton bicycle (Figure 18). When a user rides a bicycle, the glass next to it is lit and shows a skeleton making the same movements as the user. This type of display needs participation from the user to activate it. For kids who are curious, the use of mysteries and hidden things motivates them to explore.

Furthermore, complexity also attracts exploration. One of the stations demonstrated coding by sending colored balls in a specific pattern to a person who receives the balls and reads the code. It was not simple to understand the coding and sending, but kids were engaged and kept practicing until they figured it out (Figure 19).



Figure 18. The use of skeleton bike, Ann Arbor Hands-on Museum, Ann Arbor, Michigan (2017).

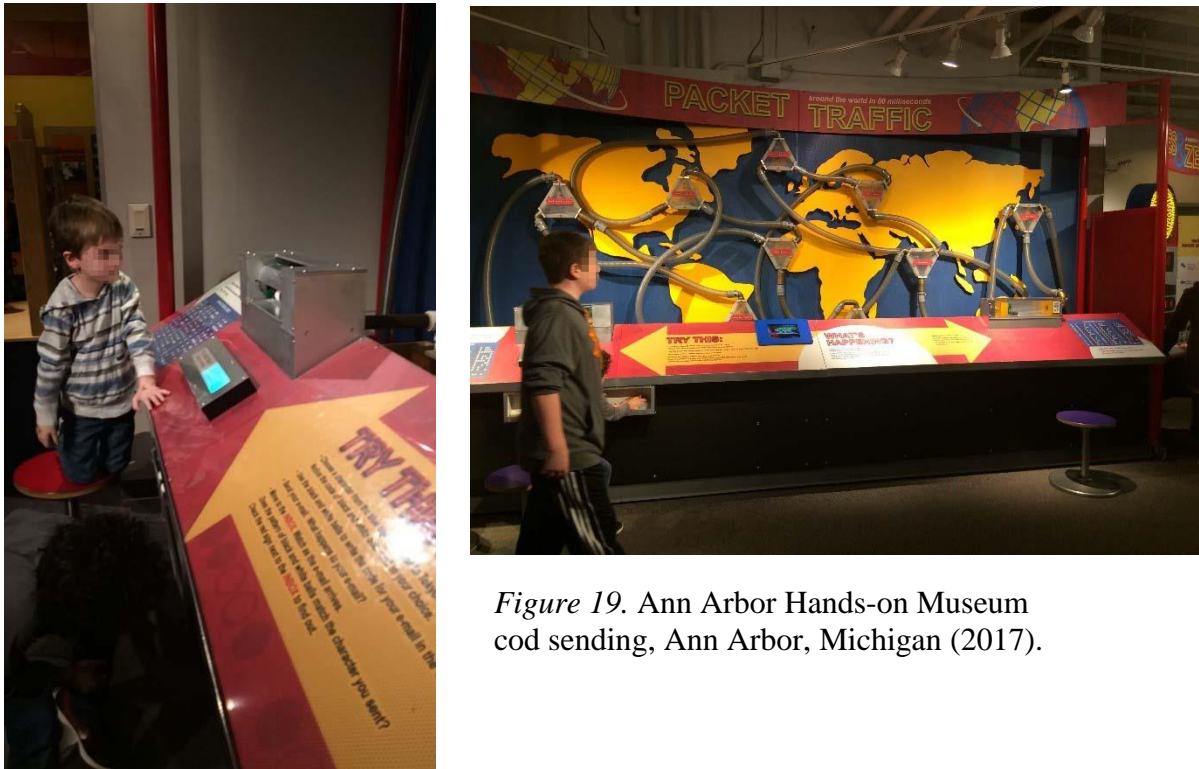


Figure 19. Ann Arbor Hands-on Museum cod sending, Ann Arbor, Michigan (2017).

**Users' behaviors.** The space was full of engaging stations. All kids and parents were busy exploring and discovering, moving from one station to another. Some parents explained to their kids about some items, but mostly kids were exploring and discovering without the help of parents. Users are motivated and look everywhere at the objects and screens that are present everywhere: in floors, ceilings, and walls. Users have the freedom to touch and try everything. Information walls were provided so parents can read while their kids are exploring (Figure 20).

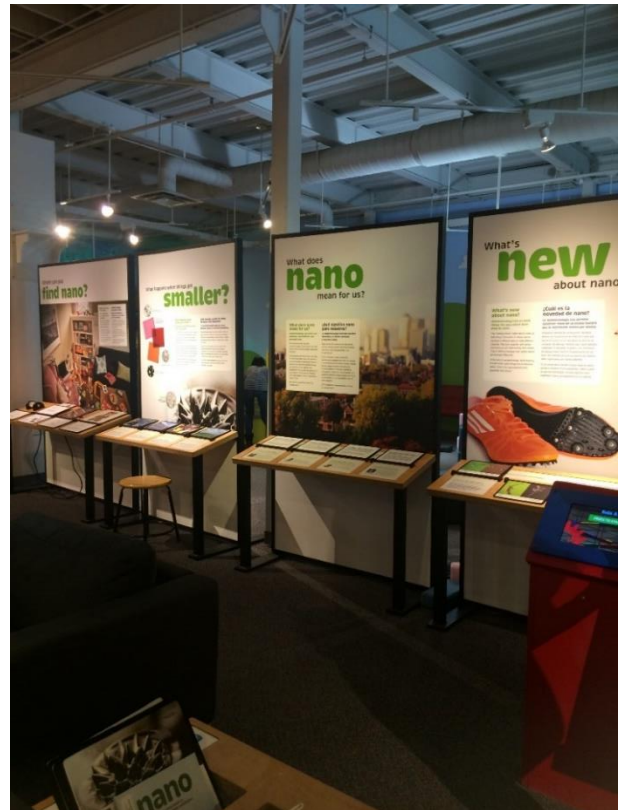


Figure 20. Science gallery. Ann Arbor Hands-on Museum, Ann Arbor (2017).

**Users journey.** The users entered from the main floor and started their journey by moving from one section to another. Most of the areas were crowded, as visitors stopped by each section exploring the different stations and displays. Even though the users walked in a path, they made stops in the stations that attracted them, and they sometimes returned. A lot of visitors stopped by the largest items, such as the ambulance (Figure 21), which was attractive to both kids and families.



*Figure 21.* The ambulance car. All About You gallery, Ann Arbor Hands-on Museum, Ann Arbor, Michigan (2017).



#### Case Study 4: The Field Museum of Natural History

**Design of exhibits (the system).** The Field Museum of Natural History is a scientific and historic museum. It displays objects about the natural history of the planet, its life, and its cultures. It is famous for its dinosaur exhibit that houses a vast collection of dinosaur fossils, including Sue, the largest, most complete, and best-preserved Tyrannosaurus Rex ever discovered. It is in the main hall of the museum, and visitors can see it as soon as they enter (Figure 22). The museum consists of three floor plans. Most exhibits are on the main and upper floors. Workshops, special exhibits, services, and more exhibits are in the lower level (Figure 23).



Figure 22. The Field Museum, Chicago, Stanley Field Hall (2017).

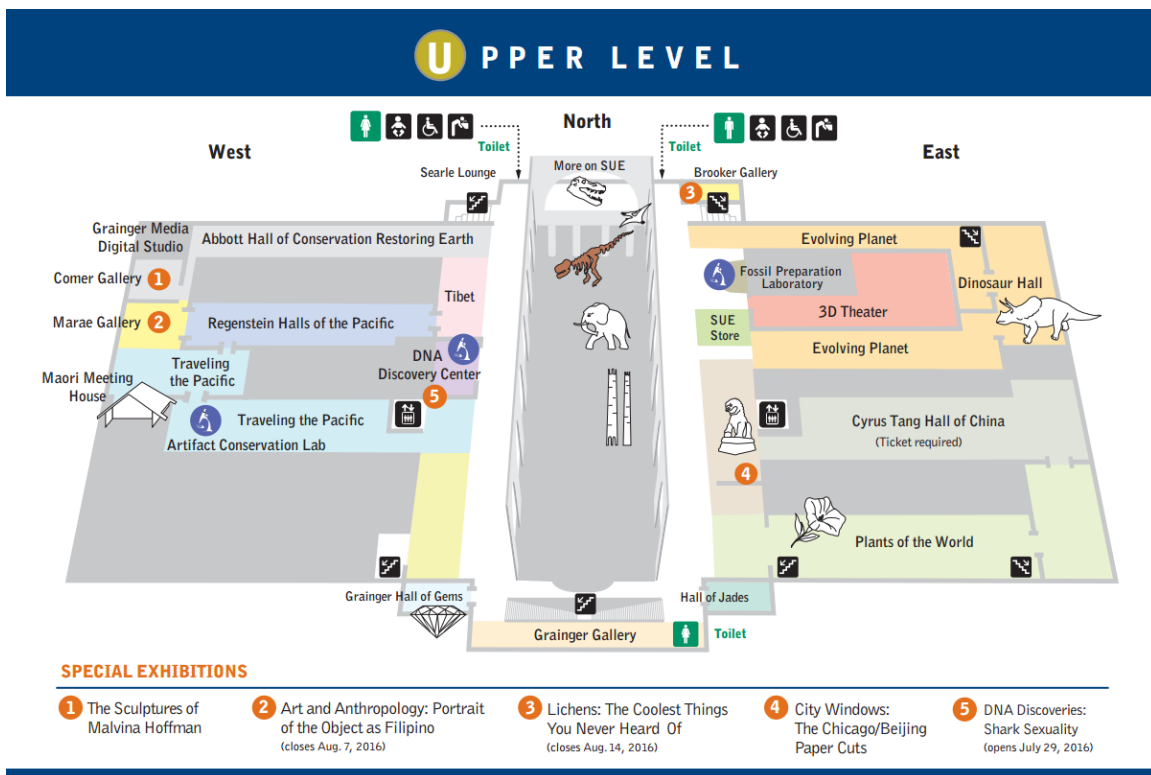
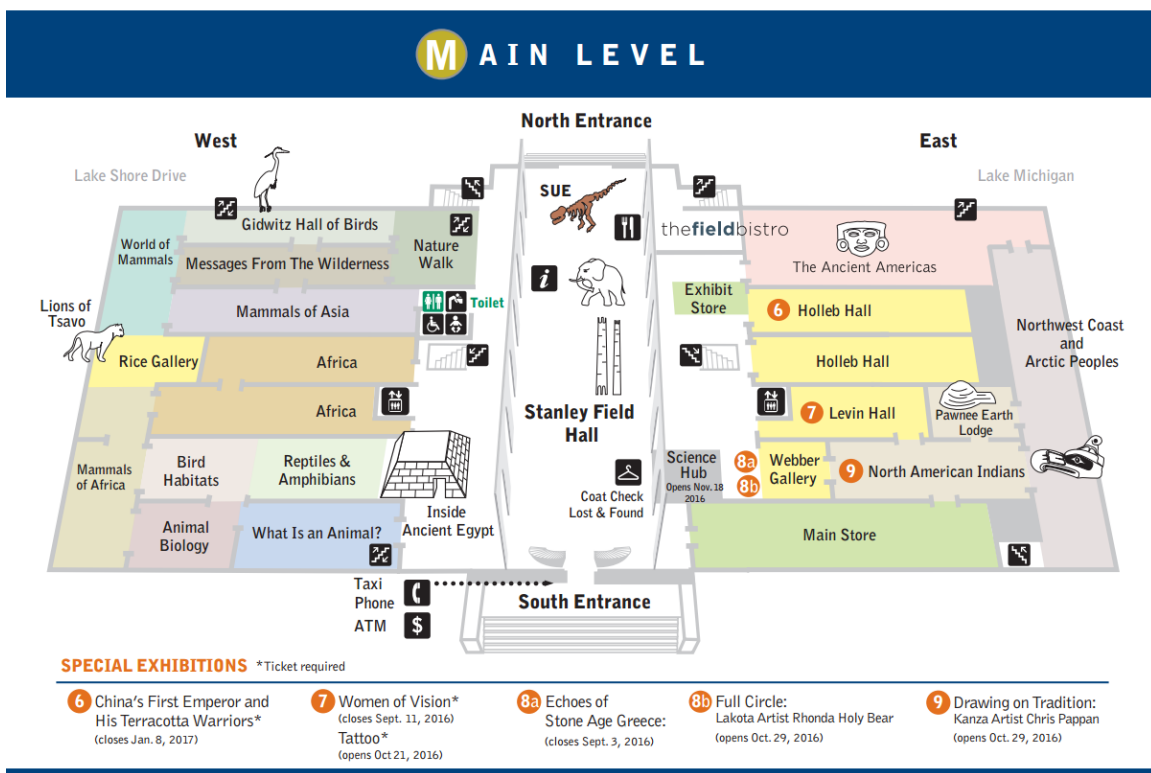


Figure 23. The Field Museum of Natural History main and upper level layout, Chicago <https://www.fieldmuseum.org/>

The Field Museum of Natural History has multiple exhibits and halls. It presents each exhibit with a variety of interactive and experiential displays. Even though many objects are displayed in glass cases, the realistic and actual scale attracts visitors (Figure 24). A demonstration of nature was in all surrounding environments: on the ground, ceiling, hidden, and free-standing objects (Figure 25). Information about the display was presented in many ways:

- Reading-base: This is a classic way to present information and is used in most museums. Reading panels, are usable by patrons who prefer reading as their learning style. The text and small notes are provided everywhere, even on the sitting areas, so that visitors can read while they rest (Figure 26). The information is also written in a variety of materials, such as a plastic book, so users flip pages for further reading (see Figure 27).
- Graphic display: In most of the displays, a panel provides an illustrated image of the same object displayed inside the glass containers. This type of display helps users point to and touch the images they need to discuss instead of touching the actual display. One of the visitors used this illustration to count the number of fingers that the dinosaur has (Figure 28). Figures are also important to present specific information without the need to read written text, such as an image of the map showing where Bongo animals live (Figure 29).
- Screens and iPads: Technological devices, such as videos, touchable screens, and iPads, are often used in museums (Figure 30). Videos and projectors are available in each section with seating areas. The touchable iPads were used by some of the visitors, but they were was not usable for reading, as the use of audio is limited and

the sounds were not loud enough to be heard. For example, in the Gidwitz Hall of Birds exhibit, a girl put her ears close to the speaker to hear the bird's sound (Figure 31).

- Experiential objects: There are many stations where objects are provided for users to touch, press, and manipulate. For example, one station teaches the type of food the animal eats depending on the type of tooth it has. A touchable tooth is provided so that users can touch the tooth and make guesses (Figure 32).
- Generally, users were attracted to objects with large scale. They read, engaged, and experienced the provided elements. More explanation about display is explained (see Figures 33 and 34).



*Figure 24.* Nature walk exhibits, Field Museum, Chicago (2017).



*Figure 25.* Nature walk exhibits on ground exhibit, Field Museum, Chicago (2017).

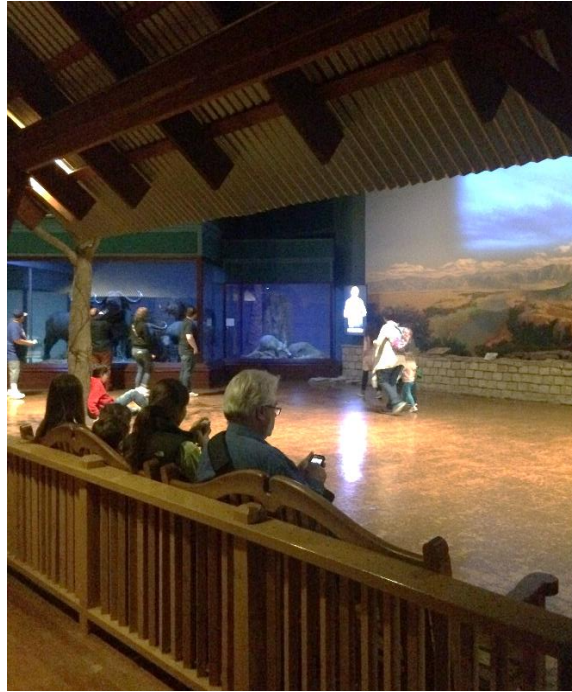
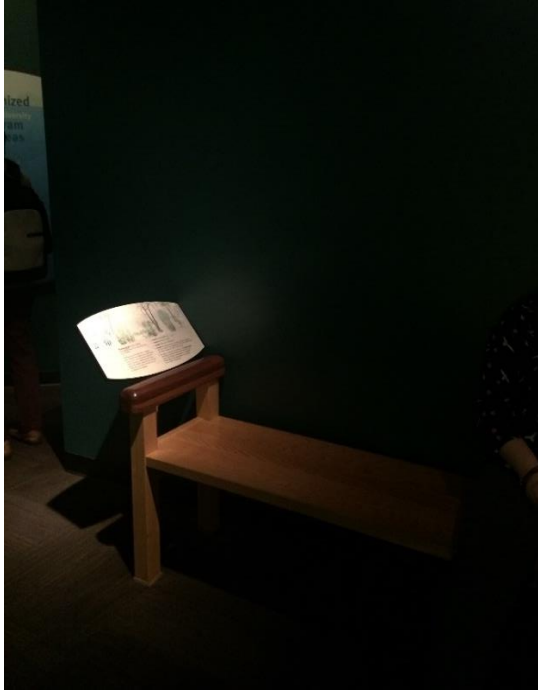


Figure 26. Information on a board on the bench side. Griffin Hall of Evolving Planet exhibits, Field Museum, Chicago (2017).

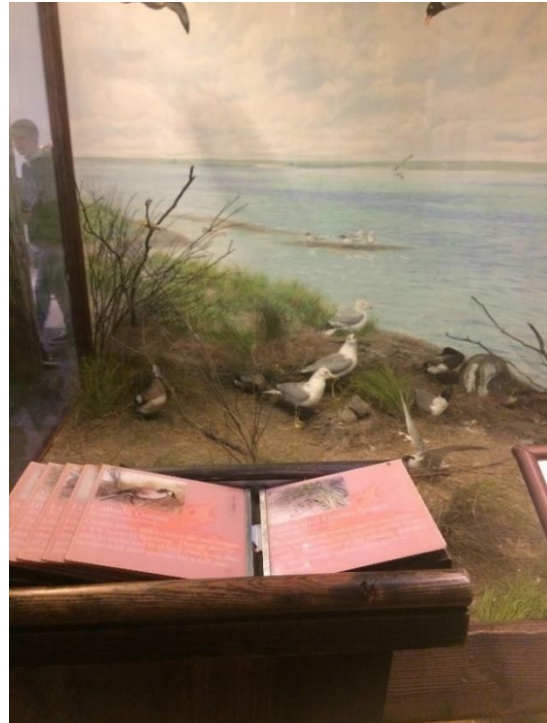


Figure 27. Information display, Nature walk exhibits, Field Museum Chicago (2017).



Figure 28. Graphic display. Griffin Hall of Evolving Planet exhibits, Field Museum, Chicago (2017).



Figure 29. Map highlight the location of Bongo. Field Museum, graphic and information display, Chicago (2017).





Figure 30. Screens and videos. Griffin Hall of Evolving Planet exhibits, Field Museum, Chicago (2017).

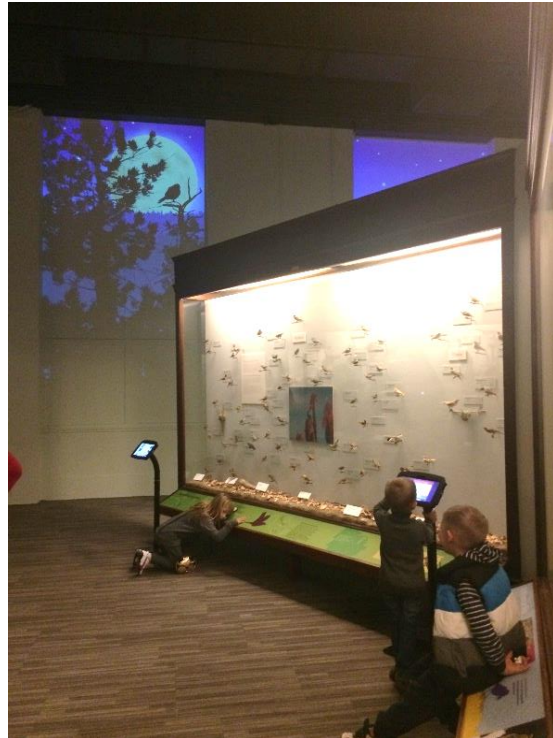
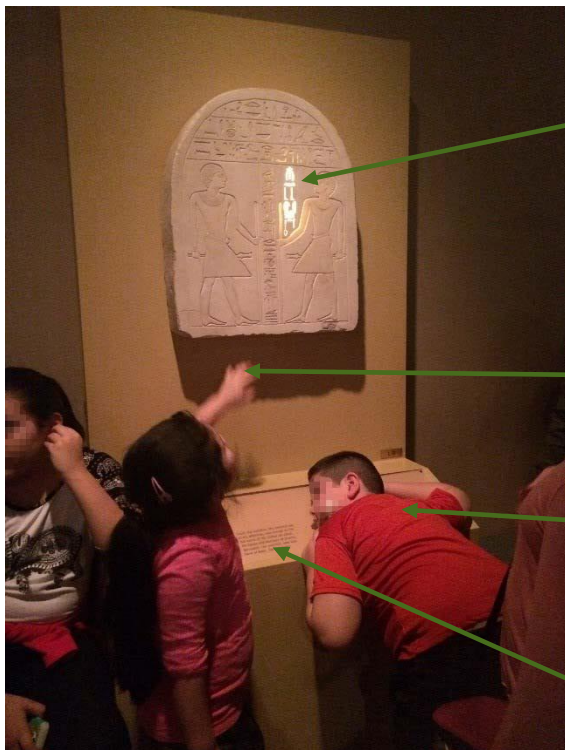


Figure 31. iPads and sound Gidwitz Hall of Birds exhibits, Field Museum Chicago (2017).



Figure 32. Animal tooth. World of Mammals exhibits, Field Museum, Chicago (2017).



Each item lit as the audio explain it

Touch

Listening to the audio (sounds are not clear)

Further explanation

Figure 33. Tomb like exhibits, Field Museum, Chicago (2017).



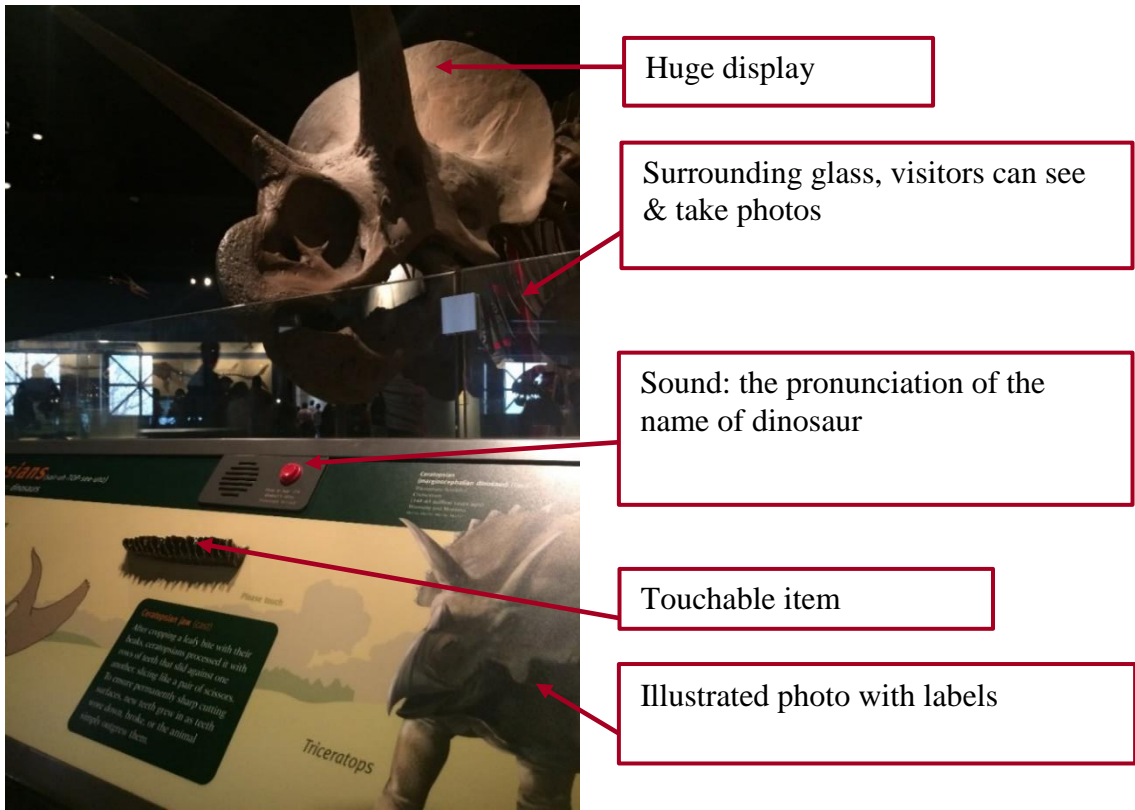


Figure 34. Dinosaur Hall exhibits, Field Museum, Chicago (2017).

**Users' journeys.** The Field Museum of Natural History includes many exhibits and areas where visitors move around, discover, and enjoy. There are many methods used to guide, orient, and attract visitors throughout the museum. In each section, a map is provided at the entrance so the users can determine their orientation through the area (Figure 35). Not only maps and images are used to guide visitors; objects also are used. For example, in front of the dinosaur hall, a flying dinosaur hangs from the ceiling and can be seen from the lower floor (Figure 36). It creates a visual connection and help users to find their path. The dinosaur hall exhibits are considered the most attractive to many visitors. As a result, it is in the upper floor, and the elevators and stairs are located in the center of the museum. This way, visitors have to pass through other exhibits to reach the hall. This eliminates the crowding and encourages people to visit other exhibits (Figure 36).



*Figure 35. Maps in front of the exhibits, Field Museum, Chicago (2017).*

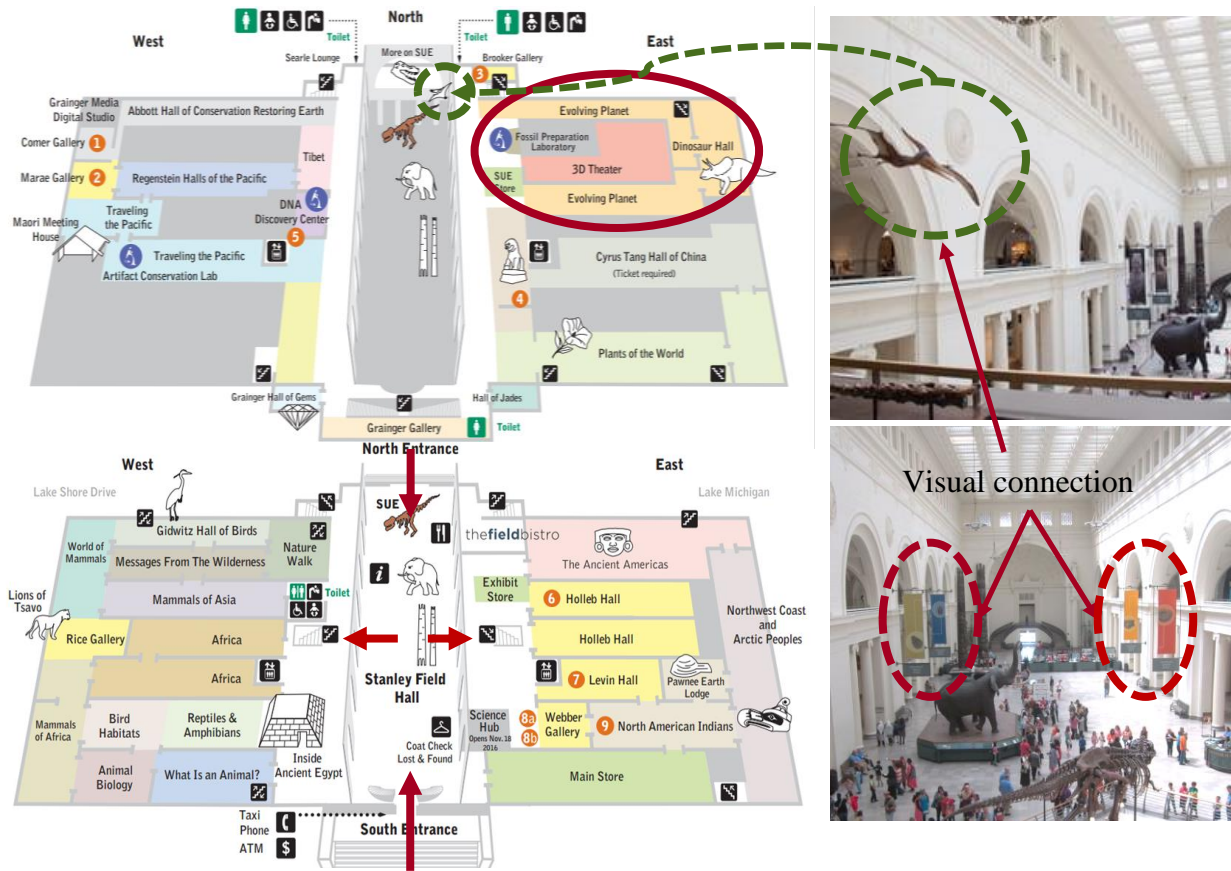


Figure 36. Way finding and users guide systems, Field Museum, Chicago (2017).

Hints and mysterious displays are used to attract and guide visitors. For example, once visitors enter the tomb-like exhibit, they see mostly an empty space with a square of glass on the floor. Most visitors are excited to discover what is inside. Through the glass they can see a mummy located on the lower floor. This causes visitors to want to see more and continue the exhibits. A staircase is located next to the room so visitors are guided to the lower floor (Figure 37).

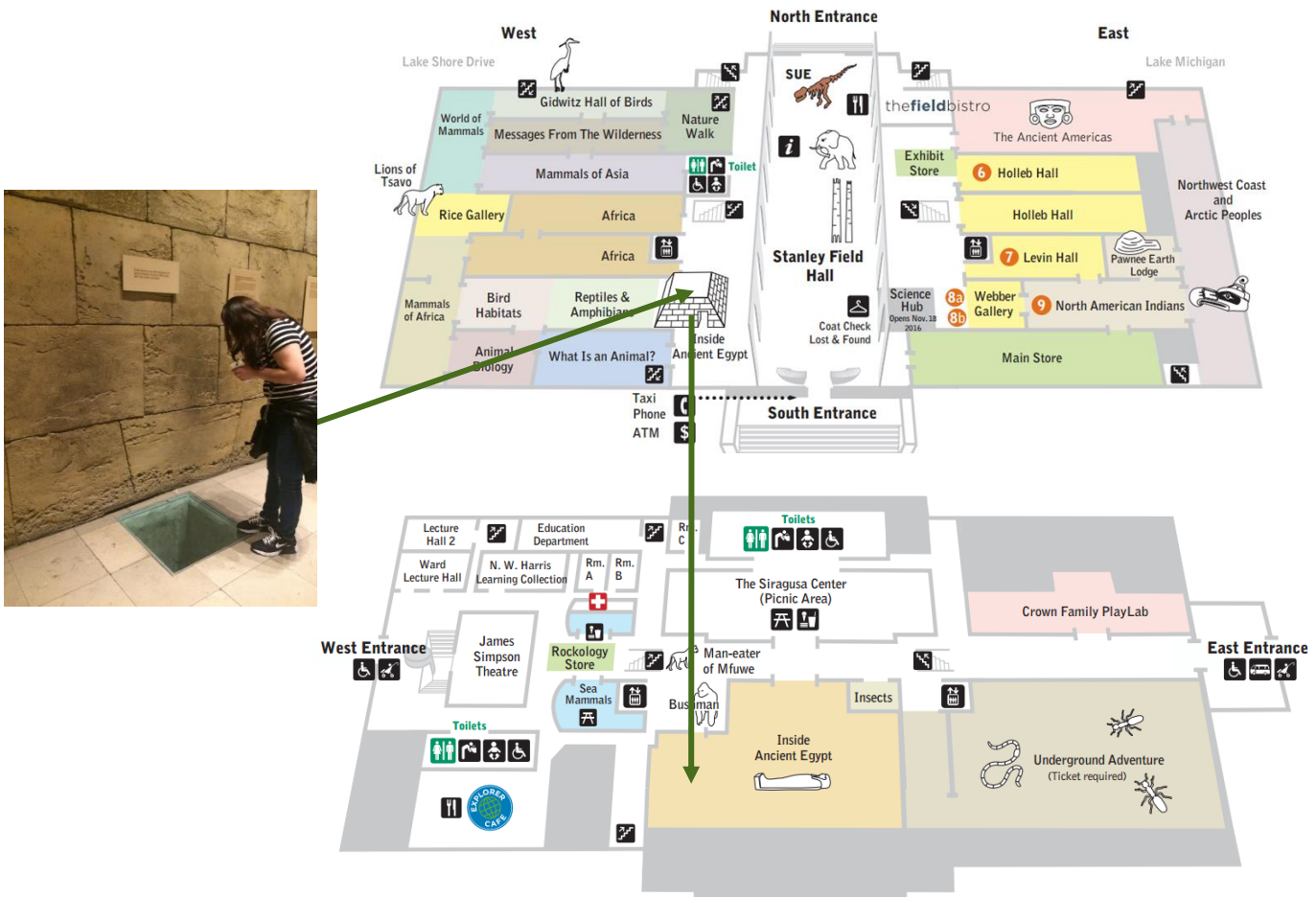


Figure 37. Way finding and users' guide systems continued, Field Museum, Chicago (2017).

## Summary

This chapter presented the three case studies of different museums. The data collected were organized and presented. Each case study was analyzed and explained by (a) describing the purpose of the museum and the design system and method used for display, (b) observing visitors' behaviors and interactions with the display, and (c) studying users' journeys and movement through the space. Graphics and maps were also presented. Discussion and implementation of the findings is presented in the following chapter.

## Chapter 5: Summary, Discussion, and Conclusions

In the previous chapter, the presentation and analysis of data were described. This chapter covers the following elements: (a) a discussion and summary of the findings, (b) implications for practice, and (c) conclusions. This section provides further description of museums' display strategies and their impacts on visitors. Additionally, it presents strategies that could be applied to expand upon the concepts and implications for further research. Finally, some suggestions are given for enhancing other learning environments such as schools and libraries.

### Discussion and Summary of the Findings

The purpose of this study was to improve learning methods and enhance learning through interactive design. The study also aims to find out whether user experience design strategies is applicable for interior spaces. A qualitative approach was implemented through three case studies of museums and observations of visitors' behaviors. This section discusses the implications of the findings for the three research questions stated in the first chapter. Additionally, a summary of each section is explained in this chapter.

**System design.** System or service design is the study of the whole space as a system including the design of the interior, displays, and guiding maps. The design system is not only related to a specific space, but it is also a design that considers every detail that users interact with. An effective design system is one that satisfies all users and meets their expectations without difficulties (Rosenzweig, 2015). An example of a useful design system is applied by Apple Inc. According to Norman (2010), when Apple created the iPod, they developed all the services that users might need to use that device. They simplified the entire system, including finding music, buying it, and playing it.

Apple’s success secret is that they understood the main problem, “Apple treated iPod as a service, not as an isolated product” (Norman, 2010, p. 151–152).

Another example of service design has been applied in Walt Disney World’s waiting line. The waiting line at each attraction is long but designed in a way that distracts visitors to avoid impatience during waiting. They intentionally designed twisting and turning lines so that those who are waiting will not see how long the line is (Rosenzweig, 2015). In addition, they engaged built-in entertainment, exhibits, or videos



*Figure 38.* Walt Disney World entertainment area waiting line.

to entertain customers (Figure 38).

In museums and other learning environments, applying such a system would be beneficial. It is essential to provide a variety of learning methods with effortless ways to gain knowledge. The Toledo Museum of Art, for example, provides an application that users can consult for further information, in addition to the website. In the Field Museum,

benches and seating are either attached to an information board or located in an area where videos are played, so even if visitors are resting they can still gain information.

**Effective methods of information display design.** There are many techniques that have been used in previous studies and in of other museums to display and present information. Those displays could be graphs, statues, boards, or experiential products. Following the UX design principle, those presented elements should be (a) easy to use, by making the function easy to be found or clicked on; (b) easy to understand so that users do not need to ask for explanations from others; (c) clear in directions and information provided; and (d) effective so that the users can perform their tasks efficiently and correctly (Rosenzweig, 2015).

Making information displays easy to use does not mean making them simple. In video games, for example, the designer intentionally makes it difficult to reach the winning point. Those tricks make games more exciting and challenging. Sometimes complexity is enjoyable, and some is desirable, “Visual complexity is one of the attractions” (Norman, 2010, p. 18). In Cas 2, the Ann Arbor Hands-on Museum, these methods were applied (Figure 20). Since kids like exploring, involving some complexity in the space and experiential products could encourage them to discover more. On the other hands, if the exhibition space is too clear and simple it might be boring, “Complex things do not have to be confusing. Similarly, confusing things do not need to be complex” (Norman, 2002, p. 63).

Another method of displaying information is to integrate some mysterious or hidden thing that requires action to discover. This action would lead to a change or the appearance of a new item (Norman, 2010, p. 134). An example shown previously is the

riding bicycle at the Ann Arbor Hands-on Museum (Figure 19). Another example is the glass square used in Cas 3, Field Museum, where users look through the glass to see what is hidden below (Figure 37).

**Users behaviors (persona).** The things that attract people may differ from one person to another. Still, some type of learning mode is common to all users. Interaction modes employing a combination of senses are used in all museums in different attractive ways: (a) vision, by the use of graphics; (b) hearing, by involving sounds, audios, and music; (c) touch, by providing a practical object that allows command and control fingers or body engagements; (d) kinesthetic, by providing information through the sense of movement; (e) smell, although it is rarely used in museums and technology; and (f) taste, the least used in displays but applicable in food products (Rosenzweig, 2015).

From the observation of visitors' behaviors, we divided visitors into two types: engaged and not engaged. A common behavior was reported for each type. Visitors who do not seem engaged or attracted by the display walk faster through exhibits and rarely make stops. Visitors who were engaged displayed the following behaviors, depending on the level of engagement: they walked slowly, made stops, discussed, read, listened, point to or touched the objects, and took photos (Figure 39).

**Users' journeys.** The way that users move in a space is identified as the users' journey, including their movements and stops. The path and the arrangement of the displays in museums can play a significant role in attracting and guiding visitors (see Figure 40 for several types of display paths). It is important to provide users with easy and clear paths, "Make it easy and obvious to the user how they are to move through the



environment, incorporate clear and simple signage, and clear cues” (Rosenzweig, 2015, Ch. 11).

The amount of display presented in an area can make a difference in how visitors stop and move. Case Studies 2 and 3, the Ann Arbor Hands-on Museum and Field Museum, have a dense way of arranging elements. Multi-display stations are provided in the same area.

Even though there is a suggested walking direction, that direction forces users to pass through certain displays or make turns. That way, visitors are exposed to a larger number of presented objects. Even visitors who were not attracted by the display may stop and notice another element when passing through. (Figure 41 shows how the users travel in multiple display paths).

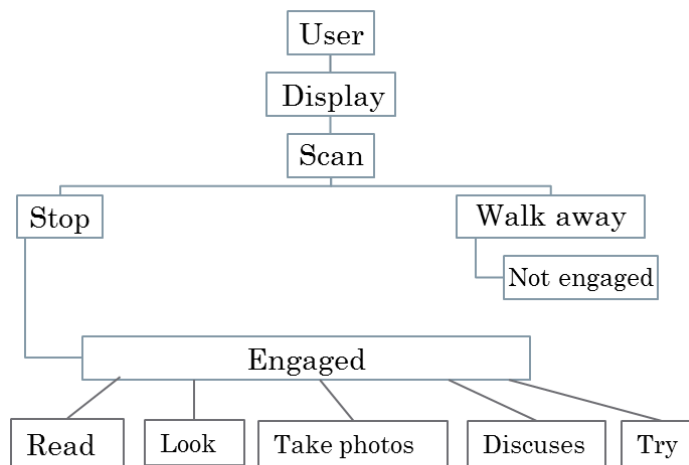


Figure 39. Users' level of engagement process.

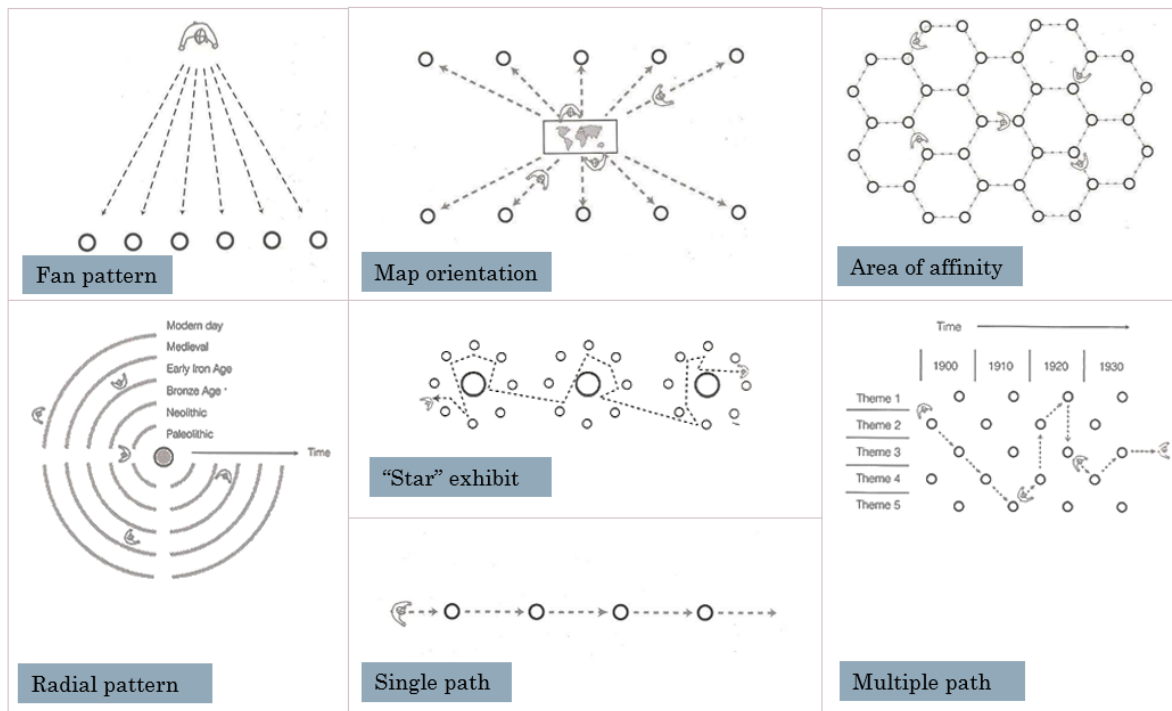
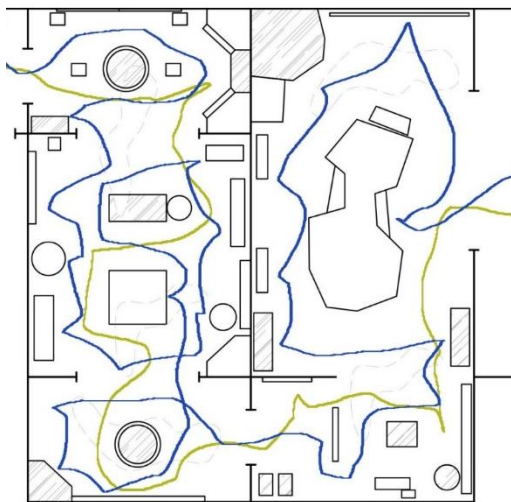
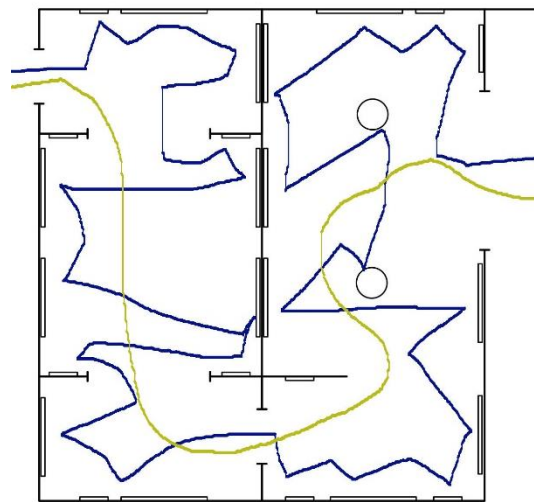


Figure 40. Devising a path, how exhibits are viewed, (Hughes, 2010, p. 74-77)



Example of user journey in multiple path type (blue line: path of engaged users, yellow line: unengaged users)



Example of user journey in single path type (blue line: path of engaged users, yellow line: unengaged users)

Figure 41. Users' journey in single and multiple paths.

On the other hand, in the museums that follow a single path or fan pattern display methods, visitors who were not engaged can pass through without making stops. In Case Study 1, the Toledo Museum of Art, the displays are standing or hung on walls in large halls. The users who were not attracted passed straight through the hall and only glanced around.

### **Implications for Practice**

To enhance the presentation methods in museum and learning environments, this section reviews some applicable strategies.

**Enhancement of technology and other services.** The uses of technology, such as mobile applications, touchable screens, and websites, should be considered one of the most effective design systems. In art galleries, for example, a screen could be added next to a painting (Figure 42). Users can make choices to gain further information about an object. The Toledo Museum of Art provides such systems in their website (Figure 43). This system would be more effective, however, if it were used in the museum. Moreover, this method will keep the classical design of an art gallery by not adding many objects. Another effective suggestion is the use of object recognition through mobile application. When users have the application in their devices and they pass by an object, a note pops up in their devices, providing information about that object.

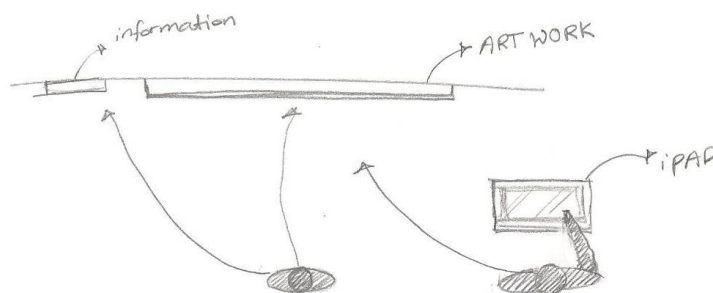


Figure 42. A touchable screen could be added next to the art work.

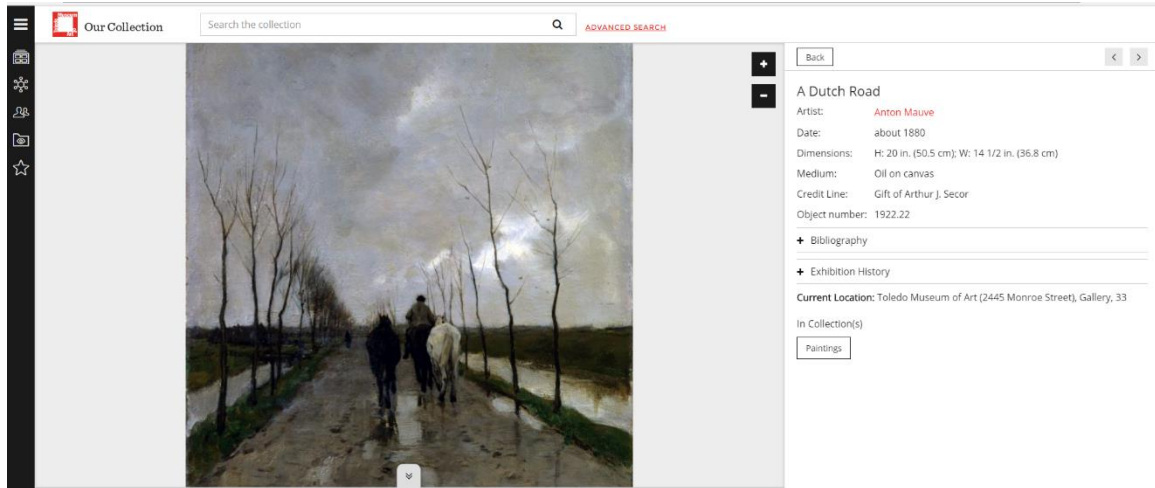


Figure 43. Toledo Art Museum website.

**Information display design (simple/crowded).** Increasing the number of presented items could create environments that are more attractive to visitors. The elements could be in the ceiling, floor, walls, or free-standing (Figure 44). The use of multiple types of information and display encourage visitors to stop or notice at least one object. Each user is attracted to a different information display mode (see, hear, or practice). As a result, involving several types of displays will enhance visitors' satisfaction.

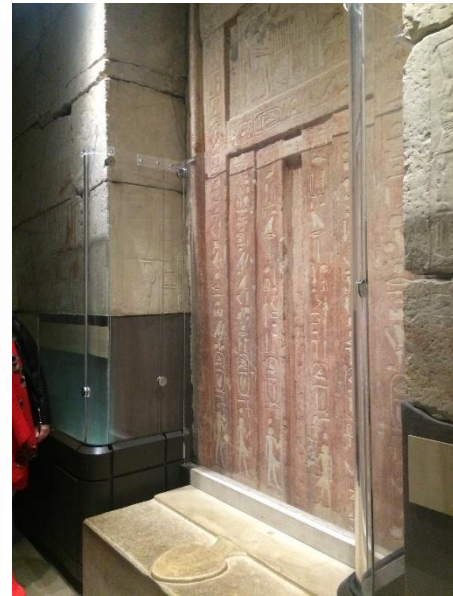


Figure 44. Apply multi-information display methods.

When the display item is a painting, visitors may only scan and may not be engaged or read from the small text beside the object. The presented objects cannot be changed, but the way of presenting them can. For example, since visitors like to touch and point at the objects, a small graph of the same object could be presented close by in a reachable place. Also, a touchable material could be provided such as the type of paper, materials, or brushes that were used in the art work (Figure 45). Using a combination of senses in presenting elements will enhance users' learning. Another helpful idea is to cover the artwork with glass. That allows visitors to touch and get closer to the objects without causing damage. This idea was applied at the Field Museum (Figure 46).



*Figure 45.* Provide touchable reachable items next to the art work.



*Figure 46.* Glass protect the display Tomb like exhibits, The Field Museum (2017).

**Information wall/screen.** The information wall is where the information is presented as text and graphs, and it could include some touchable or practical objects (Figure 47). The information wall design could be attractive, depending on the item presented. However, since all information appears on the wall, users do not have the freedom to make choices for further information in addition to the limited interactive movements. On the other hand, the use of a screen will allow users to interact and make choices regarding the information they want to learn about (Figure 47), since not everything that allows users to make an action to explore (body-object interaction) is shown. A website UX template could be used as a way of presenting information on the screen (Figure 48). The template presents the information in layers. A simple first layer with boxes to click will lead to further explanation.

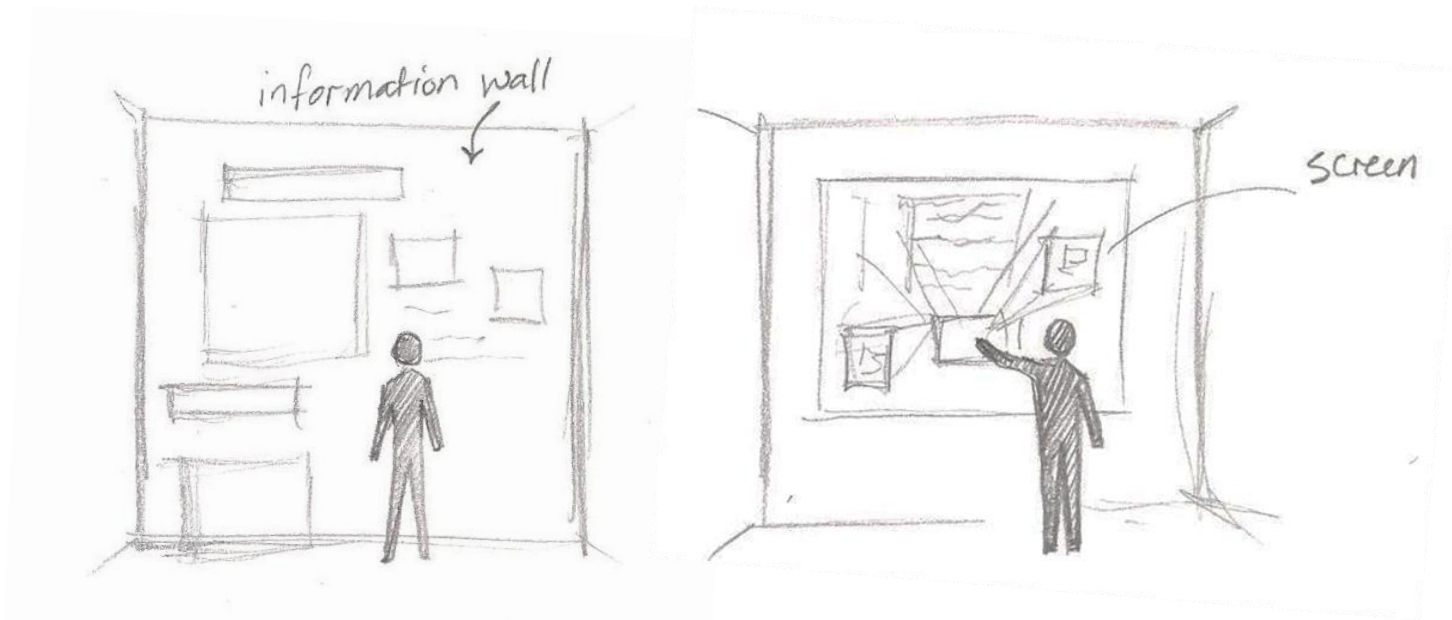


Figure 47. Information wall and touchable screen text, graph and touchable object.

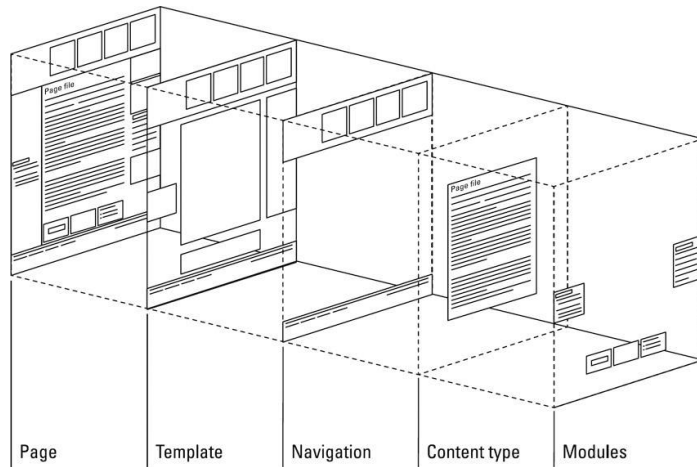


Figure 48. Modular template design system (Donald & Kevin, 2014, Ch. 9).

**Interactive (station).** A small, interactive station could be provided in some areas in the exhibits, museums, or libraries. Those stations are semi-isolated. They could include touchable screens, sounds, and videos. The benefits of those stations are that they allow users to have a clear sound and vision (Figure 49). Interactive stations are also used in the UK Pavilion, Expo 2005 (Figure 50).

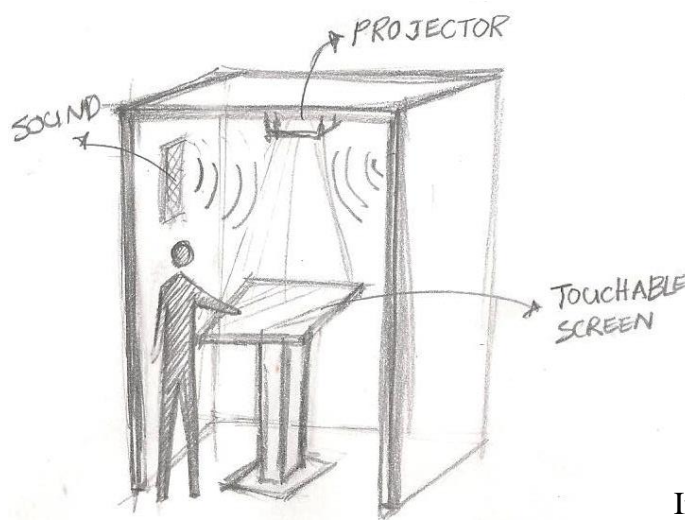
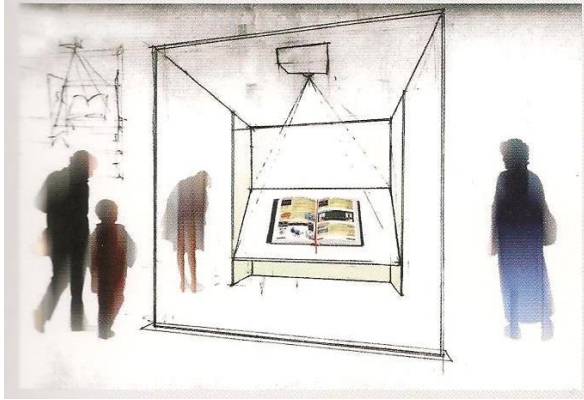


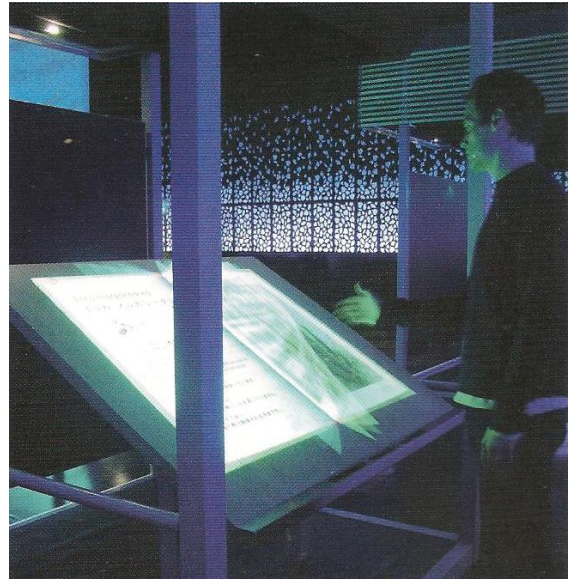
Figure 49. Interactive station.



Interactive Station, the Field museum, Chicago (2017).



*Figure 50.* UK Pavilion, Expo 2005, Aichi, Japan (Philip, 2010, p. 159).



**Engaging environments/ lack of learning modes.** Many museums and galleries lack these learning and educational methods but are still considered attractive and engaging environments. The role of space design, such as ceilings, flooring, and columns, can enhance the attractiveness of the space. For example, modern galleries (Figure 51) and classical galleries such as the National Art Gallery in London have integrated arches, ornamentations, and domes (Figure 52).





Figure 51. Robert Irwin “Piccadilly” Pace Gallery, London.



Figure 52. National Art Gallery, London.

## **Conclusions/Summary**

This study explained and investigated research into enhancing learning environments. Museums are traditionally considered diverse collections of artifacts and objects for visitors. As a result, the aim of the study is to enhance the presentation display methods and techniques of those collections. Additionally, the study investigated the different information display systems that were applied and could be enhanced. Users' behaviors and needs in such environments were observed. Furthermore, a consideration of user experience UX design strategies was implemented and clarified.

This investigation revealed that different learning modes should be considered in order to enhance the design of educational spaces. A further assessment of the case studies found that art museums generally are lacking interactive designs. Modern museums can enhance their social and educational functions by incorporating the concept of UX/UI for users. Even though UX/UI originated in IT and high tech electronic products such as iPhones, computers, and software, the UX/UI design strategies are applicable to museums and galleries. Moreover, they can be extended to other types of learning environments, such as libraries, media centers, and classrooms. In addition, interface mechanisms can be designed to improve visitors' learning experiences.

This study was limited to museums as educational spaces. The suggested strategies could be applied to other learning environments. In addition, there may be limitations in terms of recognition the observers' genders, time available, languages, ages, or cultures that might affect the findings. Further research could investigate the design of other educational spaces such as libraries and schools.

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