5-2010

User's Behavior in Selected Online Learning Environments

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To the Graduate Council:

I am submitting herewith a dissertation written by Ai-Lun Wu entitled "User's Behavior in Selected Online Learning Environments." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Education.

Gary J. Skolits, Major Professor

We have read this dissertation and recommend its acceptance:

R. Steve McCallum, Schuyler Huck, Jeffery Davis, Diana Moyer

Accepted for the Council:
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Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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A Dissertation Presented for

the Doctor of Philosophy Degree

The University of Tennessee, Knoxville

Ai-Lun Wu

May, 2010

Acknowledgements

Special thanks to my parents, Chi-Lieh Wu and Chu-Hui Pan, who have been supporting me emotionally and finically in the process of my education. I want to express my gratitude to my former chair and advisor, Dr. Edwards Counts, who helped me to make transition from art to multimedia study, Perry. M Brakke, who encouraged me in the creation of Flash animation. I also want to thank new chair Dr. Gary Skolits, who stepped in to direct my dissertation, after Dr. Counts' untimely death. Thanks also go to committee members, Dr. Steve McCallum, Dr. Schuyler Huck, and Dr. Jeffery Davis for their patience and support. Most of all, I would like to thank my dissertation co-chair Dr. Diana Moyer, who kept me focused when I needed feedback and help. I also want to thanks my friend and editor, Laurie Knox, who has been tutoring me in writing since before I was accepted into the Ph.D program. In addition, I would like to thank my supervisor at the Office of Research, Lesli Rowan, and my colleagues, Harriette L Spiegel, LiLa Louise Holt, and Debra Lee. There are also many more family members and friends who have helped me in this long process. Thanks to all of you!

Abstract

The purpose of this study was to understand online users' behavior, preferences and perceptions in a museum's online environment in order to design systems that support users' needs. The setting of my study was the New York Museum of Modern Art's online learning program. The study participants were undergraduate and graduate art education students enrolled in a large university in the Southeast. Several issues concerning web design emerged from the study, including the following categories: the navigational structure, content design, search engines, and the museum's educational mission. This study used a case study methodology, which allowed me to gain direct access to participants' behavior, preferences, and perceptions as they navigated through the museum online website.

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Chapter 1. Introduction

Background of the Study

Education has been a central concern in most art museums for the last 30 years (Hein, 2000). Museum learning has been characterized as informal learning, which is different than formal learning. Informal learning is characterized as an authentic learning experience in which learners choose what and how they learn (Rossett & Hoffman, 2007). Over the years, museums have evolved from object-centered show places to visitor-centered institutions in which visitors are personally engaged in the construction of meaning (Ebitz, 2005). As Art educator Ebitz (2005) has pointed out, museums have shifted from spaces where paintings hang on the walls of bare rooms to institutions that emphasize the importance of learner-centered education. Perlez (2007) also suggested " [The museum's] aim is to be an educational institution rather than primarily a repository of important artifacts" (The New York Times, 2008).

As visitor-centered and learner-centered institutions, museums have been seeking new ways to engage and educate the public. Liz Addison, marketing director for the Museum of Modern Art, has stated that communication technology will make it possible for museums to engage a much broader audience (Wong, 2000). The Internet has been a great benefit to museums, because it informs and provides access in a way other means of communications cannot. Vince Thomas, an executive producer of Art Museum.net, has observed that the Internet offers the visitors a non-linear and highly interactive experience in an online museum environment because it enables the visitors to make

choices regarding museum artworks (Wong, 2000). Online virtual learning has become an important resource for museums that are committed to educating the general public.

As museums' online websites become more popular, it is important to understand how virtual visitors participate and behave in this virtual environment and what their expectations are for an online informal-learning environments. The literature review below discusses the importance of authentic learning in a learner-centered environment and how museum visitors construct meaning. The literature review also addresses the issue of visitors' behavior patterns in physical museums and users' perceptions as well as search patterns in online environments. The study will address how users behave in online environments, how visitors behave in physical museums and the online museum as a unique environment and how visitors' expectations for each space can be implemented to create online learning programs that improve museums' educational services. The New York Museum of Modern Art's online learning program will serve as the study setting.

Statement of the Problem

Many studies have been conducted on how users behave and interact in online environments. Researchers have investigated users' perception of libraries' web pages (Crowley, Leffel, Ramirez, Hart, & Armstrong, 2002), observed how students interact with online course management systems (Nickles, 2005), examined users' behavior while searching for images in digital images collections (Matusiak, 2006), and assessed users' preferences regarding physical web sites (Marshall & Ferney, 2006). One of the common goals in these studies has been to gain insights that can help designers create more effective user-centered online interfaces. A review of museum studies literature shows

that there is a large gap in our understanding of how users interact with museum websites. Dierking and Falk (1998) argued that research in this area is still in its infancy and they pointed out that researchers still lack knowledge about users' expectations, interests and behaviors as well as how research can guide designers in improving museum web designs in order to more fully meet users' needs.

Purpose of the Study

The primary purpose of this study is to understand online museum users' behavior, preferences and perceptions of exhibitions in a museum's online learning environment. A second purpose is to identify how use this knowledge to design systems that better support user needs. Very little research has been conducted on how users behave in virtual museum settings. Examining how users interact with the New York Museum of Modern Art's online virtual museum can help designers better understand the potential value of online learning programs to meet the needs of learner-centered education through more user-centered system designs.

Significance of the Study

The study of users' behavior in an online learning environment is significant for several reasons. This research will provide designers with insight into the expectations of users in an online informal learning environment in which learners choose what they learn. Since this type of research is still in its infancy, it is anticipated that this study will also increase research interest in this topic. This research will hopefully draw attention to the importance of online informal museum learning environments and help the designers more successfully present museums' artifacts in websites.

Assumptions

The following assumptions apply to this study:

- Participants are honest and cooperative and accurate while performing think-aloud protocols, completing self-reported logs, and answering semi-structured interview questions.
- The participants in this study, university students, have various levels of experience using online search strategies. University students are assumed to have more search experience than the general public.
- Self-reports reflected in logs accurately reflect participants' perceptions of their online behavior.

Limitations

The sample population of my study was very small. Participants were limited to Art Education students from a university in the southeast. Due to the high price, the Morae 2.0 software (Recorder/Observer Bundle) that I used for this study had no capacity to synthesize data in graphic and chart formats.

Delimitations

The setting of my study is limited to the New York Museum of Modern Art's online learning program. The selection of participants for data collection is limited to adults 18 or older who possess a high school degree. I will use Art Education major students to discover how they interact with museum online website.

Definition of Terms

The following section defines terminology that will be used throughout the dissertation. It is important for the readers to become more familiar with these terms because they will provide them a better understanding of this research topic.

Informal Lifelong Learning: "is characterized by its unstructured nature and is based on the philosophy that education should be openly and easily accessible to all at any time of life." It is marked by its "unstructured nature" (Candy & Crebert, 1997, p. 7).

User-Friendly: means that user can use the program, device or software without much training. "The software has many icons and tip ballons that guide the user making their computing experience easy" (Suite 101.com, 2007).

Organization of the Study

The study will be divided into five chapters. Chapter One will introduce the study, the statement of the problem, the purpose of the study, the significance of the study, as well as the study assumptions, limitations, and definition of terms. Chapter Two will provide a review of the literature relevant to the study. Chapter Three will detail the methods, procedures, and rationale for conducting the study, and include the description of populations and setting, and the procedures of data collections and data analysis. Chapter Four will discuss the results from the data collection, analysis, and interpretation. In the final Chapter Five, I will provide conclusions and recommendations for future study.

Chapter 2. Review of the Literature

The following review of literature surveys the landscape of research on users' perceptions and search behaviors in online environments. This landscape has several prominent features: one body of research addressing visitors' behavior patterns in physical museums, another addressing users' perceptions of online environments, and a third addressing the online museum as a unique environment. This review also synthesizes literature on physical museums and online environments to explore how both sets of research might inform designers' efforts to improve museum websites. Early research on visitors' behavior patterns in physical museum was conducted using quantitative methodologies, such as measuring the average time users spent at each display object and the number of objects they visited. Research on users' perceptions and search behavior in online environments has conventionally been conducted using a qualitative methodology. Researchers have employed a variety of qualitative tools to capture users' behavior, preferences and perceptions in online environments. Researchers have also relied on self-reported logs to allow users to report their experiences with web-based information and have gained access to users' preferences and perceptions through semi-structured interviews and group discussions.

Users' Perceptions and Search Behaviors in Online Environment

Understanding users' behavior

Researchers believe that it is important for designers to understand users' behavior in online environments. As Sawasdichai and Poggenpohl (2003) wrote,"User behavior needs to be deeply understood in order to design a system that will allow users

to perform their tasks easily, without struggle and frustration" (p. 60). They pointed out that the more we can anticipate users' search behaviors with this goal in mind, the better we can determine what kind of information and functions need to be included in designs (p. 59).

In their article entitled "Supporting Scholarly Inquiry: Incorporating Users in the Design of the Digital Library," Payette and Rieger (1998) stressed the importance of examining the behavior and preferences of users in order to design more effective digital library systems that support users' needs effectively. From an ecological design point of view, the structure of an online environment significantly shapes and constrains behavior (Kirlik, 1995). Nickles (2005) noted that this is also true for academic course websites, "where students' behavior is constrained by the function and content available" (p. 113). Borgman (2003) likewise pointed out that in order to improve usability, it is important to understand users' behavior, context, practice, and expectations. Krystyna K. Matusiak's article "Information Seeking Behavior in Digital Image collections: A Cognitive Approach" (2006), focuses on "the initial, but critical phase of user interaction with collections, such as users' preferences, search strategies and their effectiveness, and obstacles that users encountered in the image discovery process" (p. 481).

Understanding users' needs

From the research on users' behavior, we can learn that a gap of knowledge exists between designers and users. One major theme in the literature on web page design has been the need for a better understanding of Internet users' goals and behaviors. Designers need to understand how users' general goals, modes of search, searching strategies and

methods influence their search behavior (Sawasdichai & Poggenpohl). Sawasdichai's research (2002) suggested that website designers should take both clients' intentions and users' purposes and needs into consideration. As Crowley, Leffel, Ramirez, Hart, and Armstrong (2002) wrote, "Designers of web pages cannot assume that features that are understood in one culture (the designer's culture) will work in another (the users' culture)" (p. 210). Web designers need to recognize users' goals and design a web structure that can anticipate their tasks (Sawasdichai & Poggenpohl, 2003). Matusiak wrote, "Understanding how users construct mental representations of digital collections can help designers to create system that are more closely aligned with user expectations and their cognitive abilities" (p. 487). Ferney and Marshall (2006) have recently proposed that "user-centered development methods can assist in understanding the preferences of potential participants for website functions and content, and may lead to more effective programs" (p. 560). They believe that by "examining information-seeking behavior," web teams can create more intuitive interfaces.

Ideas developed by marketers for using customer input to improve and sell products online have been adapted in libraries to improve services (Widdows, 1991, pp. 352-359). Crowley, Leffel, Ramirez, etal study (2002), "User Perceptions of the Library's Web Pages," similarly attempted to gain insight into users' experiences, opinions, expectations, wishes, and concerns to enable Web teams to create more intuitive interfaces.

Alexander and Goodyear in the "Voice of the Customer: Feedback Strategies for Libraries and Vendors" (1997) stressed that quality should be defined by the customer, and not by the service organization. To further solidify the point, Norman summarized in

his book "*The Design of Everyday Things*" (2000) that a designer's model should be aligned with a user's mental model in order to create a successful user-centered design system.

Users' background knowledge and information seeking strategies

Another theme in the literature addresses how users' background knowledge influences their behavior in online environments. In their study "User Analysis Framework," Sawasdichai and Poggenpohl (2003) found that users' action sequences online are based in part on their demographic and techno-graphic profiles: (1) levels of knowledge and skills in a particular domain; (2) levels of skill and experience in certain tasks; (3) levels of experience and familiarity with a particular website interface; (4) levels of computer, internet literacy, and ability to operate a personal computer (p. 65). Abels, White, and Hahn (1997), in "Identifying User-Based Criteria for WebPages," claimed that users' behavior is influenced by their experiences with the web, their overall information-gathering patterns, the types of information they use in work activities, and their previous established methods of locating information. Similarly, Matusiak (2006) found that "users' mental constructs and the choices they make in the searching process have a strong correlation with their past experiences in web searching; expectations for the collection, the level of their computer skills, and to certain extent, background knowledge of the subject matter do influence the searching process" (p. 486).

Researchers also emphasize the importance of understanding users' information-seeking strategies and individual differences in the mental models users follow as they seek the information. As noted by Matusiak (2006), various models of the information

seeking process have been developed: Kuhlthau (1988) maintained that library patrons seek information in a six-phase process: from uncertainty to (1) initiation; (2) topic selection; (3) exploration; (4) formulation; (5) collection of relevant sources of information; and (6) final presentation (pp. 257-304). Borgman (2003) saw information-seeking as a problem-solving activity, which involved a model of the knowledge and skills to search the information. Marchionini (1995) also viewed information- seeking as a dynamic process that not only requires new information, but also requires using previously stored knowledge. He distinguished two types of information seeking strategies: analytical and browsing (p. 9). Marchionini (1995) claimed that each individual develops and uses different domain of knowledge and different mental models for a wide range of mental and physical objects, including information objects (p. 12). Bates's (2002) four modes of information seeking are awareness, monitoring, browsing, and searching. Matusiak (2006) found evidence of just such behavior in the environment of a digital image collection: users with limited Internet experience who felt less confident about their Web searching skills tended to use what Matusiak called an "online exhibit model" of searching; however, students who searched the computer daily and felt confident about their web skills tended to search by selecting keywords.

Another theme that emerges from the survey of the literature is that many different types of websites exist, and that these sites are used very differently. As the Internet has developed, various genres of websites have emerged, each with distinct characteristics, such as information-driven websites, service-driven websites, educational websites, entertainment-driven websites, task or activity-driven websites and various hybrids that combine these attributes (Sawasdichai & Poggenpohl, 2003, p. 70).

User's perceptions of library web pages

One online context that has received considerable attention is library websites. As the number of electric resources has increased, so has the need to provide library-users with intuitive and user-friendly interfaces. Studies on user input in the design of library web pages are increasingly common.

A study conducted by Crowley, Leffel, Ramirez, Hart, and Armstrong (2002) found that users were looking for five kinds of services in the library web pages: (1) access to research portals where they can quickly find all the information they need for research; (2) efficient access to research resources; (3) a guide to navigational structure (Users suggested libraries should refrain from frequent changes in navigational structures, because they value familiarity with the navigational structure); (4) help (Users preferred immediate help from a person when the answers are not provided by the help function); (5) terminology (Users wanted a simple clear terminology for performing navigation and making decisions) (p. 208).

User's behavior on online course management system

Another online context that researchers have examined is course management systems. By assessing how users behave and interact with online course management systems (CMS), instructors can understand what type of activities students should engage in and how they should engage (Nickles, 2005). Ingram (1999-2000) pointed out that CMS data can reveal users' work patterns and thus can provide valuable information on how user-friendly the websites are and how easily students can access information. From such measurements, we can understand how CMS systems impact learning.

In a CMS study, Nickles (2005) measured students' average length of visit, total number of visits, total hits on course content file, and total hits on the course assignment page over an entire course. He found that measures of each individual's behavior in the server log are not strongly related to students' final grades. Nickles found that in the year of 2002, three out of the six measures over the course were significantly negatively correlated with their final grades. The researcher claimed that even though students' final grades were not strongly correlated with these measures of their interaction with CMS, the measures of interaction were still useful information for the instructor.

Visitors' Behavior Patterns in the Physical Museum

Visitors' circulation through a museum

Researchers of visitor behavior in museums have assumed that the design and layout of exhibitions influence visitors' experiences (Lehn, Heath, & Hindmarsh, 2001). As Serrell (1997) wrote "Visitor behaviors are not random; there are patterns"(p. 121). Visitors' behavior can be investigated in relation to (1) time and attention; (2) label reading; (3) social factors (EunJung Chang, 2006) and (4) how visitors circulate through museums (Bitgood, 2006). According to Bitgood, "Visitors' movement through a museum can determine what they will see, where they focus on their attention, and what they learn and experience" (p. 463). Visitors' circulation patterns through museums are influenced by their prior knowledge, interests and agenda as well as the design of the museum. In his article on "An Analysis of Visitor Circulation: Movement Patterns and General Value Principle," Bitgood (2006) pointed out that "both visitor and exhibit factors must be considered jointly" (p. 463).

Despite individual differences in circulation patterns, studies have shown that most visitors tend to turn right at intersections and also walk along on the right side of pathways. According to Serrell (1996), after entering a gallery, visitors tend to turn right and then follow the right-hand wall through the space. Visitors also often pay more attention to the exhibits near the entrance than those at the end. Only very few people move first into the center of the exhibitions. In one of the earliest studies of visitor behavior, Melton (1935) reported that 70 to 80 percent of visitors in a number of galleries turned right as they entered the space. Weiss and Boutourline (1963) also saw a right-turn bias, but found that the tendency of visitor to circulate in a counterclockwise direction also depended on the design of the exhibits.

When objects are displayed on both sides of a path, visitors tend to move along one side of the path through exhibition. Klein (1993) found that visitors also do not like to backtrack in an exhibition in order to see what they missed on their original walk through. Visitors want to save steps, following an "economy of movement principle" (Bitgood, 2006, p. 465). Weis and Boutourline (1963) were among the first to find that visitors seldom cross from side to side unless they find landmark exhibits on opposite sides of a space. Bitgood (2006) noted that the less time and effort visitors use to find their way in museum exhibitions, the more likely they are to value their learning experience and focus on the educational messages that are provided by the museum.

Chang (2006) wrote that visitors also make personal judgments about what they want to see and why, often without regard to the educators' and exhibit designers' intentions for how exhibitions should be viewed. In other words, visitors direct their

behavior and experience in museums in their own ways. As Combs (1999) wrote, "People want a museum "experience" where they can participate actively, engage their senses, socialize with family and friends, and acquire information" (p. 187).

Visitors' behavior in relation to time

Chang (2006) noted that scholars disagree somewhat about the importance of time in museum learning. Chang cited a study by Serrell (1997), which concluded that time spent viewing an exhibit, is an useful indicator of the educational effectiveness of a museum. Other studies have also established that length of time is an important factor for having a meaningful and effective learning experience in a museum (Falk, 1998b; Falk & Dierking, 1992, 2000). Chang (2006) concluded, however, by citing a number of researchers who argue that time is not the only indicator for measuring effective learning experiences in museums (Chiozzi & Andreotti, 2001; Doering & Pekarik, 1997).

Chang (2006) also noted Serrell's observation in an earlier study (1996) that visitor's average time spent in museums varies by the scale of the exhibitions. Large exhibitions have different averages for time spent than small ones. According to Chang (2006), Serrell's (1997) investigation into the duration and allocation of visitors' time in 108 museum exhibitions offers insight into the patterns of visitors' interaction with exhibitions. As common sense would predict, she found that visitors who spent more time at an exhibition usually stopped at more elements and became more engaged with what each exhibition had to offer than those who spent less time. However, visitors tended to budget their time by making more stops at more exhibits, rather than by spending more time at a few exhibits. Similarly, Treinen (1993) has found that "Visitors

tend to spend very little time in front of each object; they tend to view as many exhibitions and objects as possible" (p. 88). She collected data on how fast visitors moved through exhibitions, how many objects they visited, and their ability to recall facts, ideas or concepts from exhibitions.

Serrell (1996) pointed out that the demographic and psychographic profiles of audiences do not predict how visitors will allocate their time in an exhibition. The idea of museum professionals as experts and visitors as non-experts is important in this regard: In the visitors' eyes, the museum is the domain of cultural experts. In sociological terms, the museum's public spaces are seen by visitors as structuring and guiding the possibilities of behaviour and interaction. Serrell (1996) found that the effectiveness of an exhibition could be judged by measuring museum visitors' informal social behaviour and their reactions to the exhibits. According to Serrell, to assess the effectiveness of an exhibition, the first criterion is time and how visitors spend it. These observations begin with tracking and timing visitors: unobtrusively observing and recording their movement from the time they enter the gallery until they exit, and measuring the number of units that they stop to observe out of the total number in the exhibition. 'Units' can be widely defined as a group of graphic panels, a video, a diorama, or a case of objects, for example.

Visitors' behavior in relation to label reading

Another theme in research on visitors' behavior patterns in museum concerns label reading. "Label reading behavior can be a significant variable for evaluating museum learning because these exhibit texts are essential learning tools" (Chang, 2006, p. 176). Label reading can influence visitors' learning results. Chang (2006) indicated that

McManus (1989) observed 150 individuals' label-reading behavior at five museum exhibits and classified three types of label reading behavior: (1) not seen to be reading; (2) brief glances at text; and (3) attentive reading. Bitgood, Dukes, and Abbey (2006) have shown that length of the text passage can determine visitors' reading. Bitgood (2006) claimed that shorter labels are more likely than longer labels to be read regardless of interest level. Serrell's (1997) study in the Cleveland Museum of Art also demonstrated that more people read short labels than long labels.

Visitors' label-reading behavior also depends on group types. In his (2004) study at the Museum of Modern Art, where the works included only very basic identification labels, Pekerik (2004) found that none of the interviewed visitors were troubled by the lack of information. Visitors came to the museum for their own reasons, not necessarily for information. Many came simply to experience something new. Pekarik concluded that if museums intend to be individualized and self-accountable, they must provide a wider range of representations and interpretation of information in multiple short texts. According to Pekarik (2004), museums need to become more creative about the information that they offer in order to help visitors make good individualized choices to shape their visits.

Visitors' behavior in relation to social factors

McManus (1987) found that it is possible to categorize visitors' behavior patterns and interactions by understanding the social context. For example, in McManus' (1991) study, visitors' label reading behavior depended in part of the configuration of visitor groups. He categorized four distinct "groupings constituencies:" (1) groups with children

were more likely to participate at interactive exhibits with longer conversations, more discussion, longer visits, and brief glances at texts; (2) single visitors tended to be 50 percent more likely to read labels more thoroughly than any other groups, compared to females, males who visited alone were less likely to participate in interactive exhibits, but instead tended to focus on the text or label reading rather than on activities; (3) couples tended to stay at the exhibits longer and read labels more comprehensively before discussing them; (4) adult social groups tended to focus on interaction with other group members and paid less attention to the exhibits.

Conclusions on Visitors' Behavior Patterns in the Physical Museum

According to Chang (2006), "by taking a closer look at how visitors behave and interact, museum staff members can make better matches between visitors' expectations and the museum's objectives, be more realistic about the exhibits and program size, and make more informed choices about different kinds of media and experiences they might offer" (p. 178). Ultimately, such efforts can increase visitors' satisfaction and result in meaningful and effective museum learning experiences. Lehn, Heath and Hindmarsh (2001)'s study showed there is an increasing interest in understanding how to redesign collections and create exhibitions that will encourage new forms of participation and learning experience and contribute to public life.

According to Serrell (1993), "good exhibitions are visitor-centered"(p. 143). Serrell lists three criteria for an effective exhibit:

1. The exhibition developers' goals have been clearly stated in term of visitors' experience-what they will do, feel, say and know - and not just in terms of how the content will be presented.
2. Visitors are able to orient themselves quickly and consciously. The layout of the hall of gallery is apparent, and visitors can make choices and budget their time accordingly.
3. Labels are not long, and they speak to visitors in non-technical terms. Developers do not try to say too much or cover too many topics, either in a single label or in the exhibition overall.

She has found that few exhibitions meet all three criteria, but the ones that do seem all centered on visitors' needs.

The Online Museum as a Unique Environment

Current literature on user behavior in online environments, because it has centered primarily on environments dedicated to formal learning and non-leisure setting—sites such as libraries, online digital collections and formal educational course management systems --is not sufficient to explain how users behave in online museums. Online museums are different from other online environments in three main respects: First, an online museum is a collection of images and text, in which texts supplement the images, rather than the other way around. Second, online museums are committed to educating the general public openly and freely through their websites rather than providing structured formal learning environments. Third, visitors' goals when visiting museum websites are different from their goals in other online environments.

The online museum website as a collection of images and text

A museum website is not just a collection of monographs, and journals, or a collage of digital-images; it should integrate text and images, just as physical museums integrate label reading and visual connection. A museum website should also be able to provide interactivities, just as the physical museum promotes discussion and social interaction. One significant difference between museum websites and other online environments is the primacy of the image in the museum website. While some studies focus on how users interact with online digital images collections, we have very little knowledge about how users interact with images online, or how they handle the text-image interface. Unlike online digital image collections with little text information, or library websites, where texts and non-visual aspects dominant, museum websites emphasize the interface between texts and images.

In the last century, museums have evolved from object-centered show-places to visitor-centered educational institutions (Ebitz, 2005). Many art museums have changed from an inward focus on their collections to an outward orientation toward service to meet the expectations of the public (Anderson, 2004). In Stephen Weil's (2002) terms, American museums have transformed from "being about something to being for somebody" (p. 28). As Art educator Ebitz (2005) maintains, museums have shifted from spaces where paintings hang on the walls of otherwise bare rooms, to places that are now home to proactive staffs that educationally engage the visitor.

Museums' commitment to providing public opportunities for lifelong learning

Museums are committed to educating the public freely, openly, and informally; museums have become centers for life-long learning. Lifelong learning is "characterized by its unstructured nature and based on the philosophy that education should be openly and easily accessible to all at any time of life" (Candy & Crebert, 1997, p. 7). This type of learning has received increasing attention as society has transformed from an industrial-based economy to knowledge-based economy (Falk & Dierking, 2000). With this transformation, the value to society of informal learning sectors and leisure sectors has also increased (Packer & Ballantyne, 2002).

Formal learning has been identified as teacher-controlled, which happens in a school or college setting (Malcolm, Colley, & Hodkinson, 2003). Informal learning happens beyond the limits of the classroom, and beyond the control of people who deliver the learning materials (Rossett & Hoffman, 2007). "Informal learning gives learners more control of what, where, and how they learn and usually involves intrinsic motivation" (Rossett & Hoffman, 2007, p. 167). Museum learning has been characterized as informal learning. The challenge for museums is how to nurture self-governing learning: museum must respect the visitors' control of what exhibits to see and how to engage with them, and must encourage visitors to explore the themes, issues, and exhibits on their own (Scott, 1997). Breaking the boundary between formal and informal learning and increasing the educational access for the public should be museum's goal because as Hein (2000) stated education has become a central concern in most art museums.

Since attending a museum is a voluntary activity, there is little structure involved for museum visitors (Leinhardt, Crowley & Knutson, 2002). The open, leisure setting of

a museum can provide learner-centered experiences which involve exploration and choice; museums allow visitors to exercise control and to make personal connections with museum objects (Meadows 1997; Paris 1997).

Visitor's goals are different from other online environment

The majority of visitors to museum web sites probably don't come with particular goals in mind. From the review of literature on visitors' goals in physical museum indicated that they are there (physical museum) for a variety of reasons: personal learning, mental relaxation, and recreational purposes through online exploration (Combs, 1999). Online museum visitors' goals and intentions are very different from the goals of users in formal educational environments or environments where people are searching for specific information or performing specific, well-defined tasks (Sawasdichai & Poggenpohl, 2003, p. 60) For example, on a commercial website, a user's primary goal is buying merchandise/service. On an information-providing website, where users are seeking specific information relevant to their immediate needs, their primary goal is to find that information. On educational websites, users' primary goals are learning and practicing specific skills assigned by their instructors. On identity websites, where users go to make transactions or contact companies, their goals are to seek the information that will allow them to perform these specific tasks (Sawasdichai & Poggenpohl, 2003). Museums' website engages users in different modes of searching and different ways of interacting with material than these other websites. Thus, museum website designers need to be cautious when applying research finding on other environments to their own work. Currently, it is not know as to whether museum visitors actively search for specific

information, following regular search strategies directed by mental models, or whether they simply navigate moment by moment.

Albert Badre and Anne Jacobs (1999) sum up the current state of knowledge on visitors' goals in museum websites as follows: the research on visitors' preferences for museum web sites is too limited to help the web site design teams know how to attract visitors to museum web sites and fulfill museums' missions online. Obviously, much more attention to user behavior patterns in online-museum environments is needed in order to give designers the information they need to create sites that will serve users' interests and needs and will fulfill museums' educational missions.

Summaries of Literature on Physical Museums and on Users' Behavior in Online Environments

From research on users' behavior on library web pages, educational websites, and other websites, we can learn that there are ways to measure how users behave and what perceptions they have of online environments. This literature review has demonstrated that by studying access patterns to course management systems we can understand how students learn in online environment (Nickles, 2005). Likewise, by investigating users'-perceptions of the structure of electronic databases and listening to users' feedback can laed to improvements in library website design (Crowley, Leffel, Ramirez, Hart, & Armstrong, 2002). In addition, tracking how users search digital image collections "can help designers to create systems that are more closely aligned with user expectations" (Matusiak, 2006, p. 487). Systematic investigation of users'-preferences for website information and functions can lead to better design (Ferney & Marshall, 2006).

From these studies, we can postulate some general recommendations for improving online environments. These recommendations address the issues of (1) design and layout; (2) accessibility; (3) interactivity; (4) the environmental context; (5) how often content should be updated; and (6) descriptions for library terminology. A website home page's design should make content accessible. Users do not like to have to search for information; they want to go straight down the page and get what they want. Another design issue, related to accessibility, is the speed and download time of a website: elaborate design may take longer to download (Ferney & Marshall, 2006, p. 562). Regarding interactivity, participants like to engage with interactive features and have access to social support networks with helpful suggestions. Regarding the environmental context, participants want to use online resources to learn about activities available in their real community. Regarding content, websites should be updated continually to maintain users' interest (Ferney & Marshall, 2006, p. 563).

Regarding terminology, prior to the internet becoming popular, the user population was primarily dominated by academics and computer professionals who understood technical terms. For less-expert users, there is a need for detailed definitions of library terminology. Clearer, simpler terminology can facilitate navigation and decision- making. As a user of a library web page remarked, "there is need for descriptors to be more explanatory" (Crowley, Leffel, Ramirez, Hart, & Armstrong, 2002, p. 208).

From research on visitors' behavior patterns in physical museums, we can learn that there are ways to measure visitors' behavior patterns in a museum and to understand their expectations. Visitors' circulation patterns determine what they see in an exhibition

(Bitgood, 2006). Time is often used as a powerful measure of visitor behaviors. (Falk, 1982; Serrell, 1995). Visitors' label reading behavior is a significant factor for evaluating the museum experience (Chang, 2006).

We can adapt these criteria for evaluating visitor's behavior in physical museums to our task of evaluating museums' online learning programs. The criteria for evaluating visitors' behavior in relation to time and attention, label reading, social factors, and how they circulate through the physical museum can also be applied to online virtual museums. We can analyze visitors' label reading behavior by adapting McManus's study of individual's three types of label reading behavior, discussed in visitor's label reading behavior. We can learn about how visitors circulate through museum websites by investigating how they navigate through the physical museum. How much time do they spend on each page? What hyperlinks do they follow? Do they move through virtual museums laterally or deeply? We have learned from Klein's study in 1993 that visitors do not like to backtrack in an exhibition to see all the displays. In museum websites, do they cycle back to formerly visited pages or move constantly to new pages? Since McManus (1991) found that visitors' behavior patterns and interactions are also based on social contexts, we can learn about visitors' behavior in relation to social factors by investigating what kind of activities they do in online museum websites.

It is important to design pages that are intuitive, because if users note that the steps for finding information on a web page are complex and confusing, and if they cannot find the information that they need, they are unlikely to return to the website (Crowley, Leffel, Ramirez, Hart, & Armstrong, 2002). As Bitgood (2006) noted in his

study, the less time and effort visitors spend in finding their way in the physical museum, the more likely they are to value their learning experience.

The idea of "a user-centered approach" has become an important goal for website design, at the same time that museums have become visitor-centered institutions, so it is important for researchers to use what we have learned about user-centered guidelines for general website design to understand visitors' behavior and needs in museum's online learning environments.

Information about how users behave in online environments, how visitors behave in physical museums and what they expect in each space can be implemented to create online learning programs that improve museums' educational service. By combining these two bodies of literature, designers can understand how visitors behave and interact in virtual museums and make better matches between visitors' needs and the museum's objectives.

Chapter 3. Methodology

Introduction

I used a case study methodology in this study in order to capture the participants' search behavior, preferences and perceptions in online learning environment. The collections of data via different methods (e.g., Morae software, direct observation, self-reported logs and semi-structured interviews) allowed me to verify and enrich my findings.

In the following sections, I will discuss the research questions, methods, and procedures of the study. I will describe the participants and setting, and provide the assumptions and rationale for the research design that generated answers to questions one and two that may provide the most insight for designers, followed by the discussion about the role of researcher, data sources, data collection procedures, data analysis procedures, and methods for verification.

Research Questions

The research questions are designed to investigate online users' behavior, preferences and perceptions regarding museums' online learning programs. Researchers have very little understanding about how users behave in virtual museums. This study seeks answer to the following research questions:

1. How do users explore a museum in an online environment?
2. What are users' preferences and perceptions regarding their virtual museum experiences?

Description of Participants and Setting

Participants

The study participants were undergraduate and graduate art education students enrolled in a large university in the southeast. I found my participants through the coordinator of the university's art education program. The coordinator forwarded my email to her students, including intern, pre intern, junior, and senior art education students, asking them to contact me if they were interested in participating in this study. Thus, I avoided collecting backyard data that might lead to a personal bias. I recruited 11 participants who met the study's criteria. The criteria were that participants should have some interest in art and design. The minimum computer requirement for participants was that they must be able to use a computer, work in a web browser, and be able to use the Google search engine. The recruitment of participants continued until data saturation was reached, that was until no more new information could be gained by adding more participants.

Setting

The setting of this study was a museum online learning program. The study was conducted using the New York Museum of Modern Art's virtual online museum. The New York Museum of Modern Art was founded in 1929 and is located in Manhattan, New York City, where it houses modern and contemporary art in various forms of visual expression, including painting, sculpture, print, film, video, photography, design, and

architecture. According to the Museum of Modern Art's website, the collection of the Museum of Modern Art provides one of the richest and most comprehensive views into modern art in the world. The museum offers gallery talks, lectures, and programs for family, adult, teachers, and high school students. The museum also maintains an active schedule of exhibitions, which allows the public to have access to a wide range of subject matter and mediums (The Museum of Modern Art, 2007). The Museum of Modern Art's website contains multimedia projects in various formats, including audio, video, and online image collections. It also is home to an online archive of some past exhibitions, which allows visitors to view these projects remotely on the Internet. The design and interactivity of these online projects has brought MoMA to the attention of a wider public. The Museum of Modern Art (MoMA), as an educational institution, is committed to providing a complete program of activities and the opportunity for the public to understand and enjoy contemporary art. The choice of the Museum of Modern Art's website is consistent with the study purpose as The Museum of Modern Art (MoMA) attracts visitors locally, nationally and internationally and it has an online museum program. MoMA also has asserted a strong commitment to the public's understanding and enjoyment of modern art. I have selected the Museum of Modern Art's website for this study is because MoMA attracts a large number of visitors both in the U.S and internationally to its high quality online museum program. Furthermore, MoMA has a strong commitment to increasing the public's understanding and enjoyment of modern art.

Methodological Assumptions and Rationale

Denzin & Lincoln (2000) pointed out, "Qualitative research is a situated activity that locates the observer in the world" (p. 3). It involves an interpretive, naturalistic approach to the subject matter, which means that the qualitative researcher studies things in their natural settings, and tries to make sense and interpret the meanings of phenomena as they are experienced (Creswell, 1998).

This study used a case study methodology. As Merriam (1998) pointed out, "A qualitative case study is an intensive, holistic description and analysis of single instance, phenomenon, or social unit" (p. 21). She stated that researchers are likely to choose qualitative case studies because they are interested in insight, discovery, and interpretation rather than hypothesis testing. Bromley (1986) suggested that case studies allow researchers to get as close to the subject of interest as they possibly can, to use direct observation in natural settings and to gain access to subjective factors (thoughts, feelings, and desires). The case study methodology was well suited for my study, because it allowed me to gain direct access to participants' behavior, preferences, and perceptions as they navigated through museum online website.

While it is possible to gather information through a quantitative approach, this type of information is less sufficient for web page designers, who need more detailed, nuanced information to improve website designs. A qualitative methodology was well-suited for this study because it helped uncover the reasoning behind participants' behavior so I can explore the perceptions, and preferences that guide participants' behavior. In other words, a qualitative inquiry will facilitate more contextual descriptions

and interpretations than a quantitative study. A qualitative research design allowed participants to articulate their attitudes, their satisfaction and dissatisfaction with online search options and the kinds of difficulty they encounter while visiting virtual museums. Collecting qualitative data, I will be able to provide web design teams advice on how to create better virtual museums that are aligned with visitor's expectations and needs.

Data Sources and Data Collection Procedures

Multiple of data sources were used for this study. The *Morae* software (a software tool that tracks Internet users' path through a site) provided information about users' online search behaviors, while the qualitative methods provided insight about the meaning behind their behaviors.

Question one was assessed by using *Morae* software to track and record how users navigate through the museum's online website, such as how do they utilize museum online search features, how much time they spent on each page and, how they cycled back to formerly visited pages or move to new ones. *Direct observation using "think-aloud protocols*" (the cognitive process of translating non-verbal thoughts into verbal forms) was employed during the participants' first encounter with the virtual museum, when they were required to perform some pre-defined tasks, such as looking at a particular artist or online exhibition. *Semi-structured interviews* (Appendix A) and *self-reported logs* will be used to answer research question two, as shown in Table 1. The following procedures were used to collect data:

Procedures for using morae software

Morae is a software tool that tracks Internet users' path through the site; it allows researchers directly to observe and record users' interactions with a website or application, so the researcher can describe the users' behavior. Researchers can use *Morae* software to test usability and identify design changes that may improve website design (TechSmith Corporation, 1995-2008). *Morae* can capture users' online behavior and record their voices as they verbalize their thoughts and feelings while interacting with a website. *Morae* also can generate graphs and charts on how many web pages users visit and how long it takes users to complete certain tasks.

Table 1. Specifies the data sources that will be used to answer these research questions.

Questions	Data Source
(1) How do they explore museum in the online environment?	a) Software data (Morae) b) Direct observation using "think-aloud protocols" c) Self-reported logs d) Semi-structured interviews
(2) What are users' preferences and perceptions in the virtual museum?	a) Software data (Morae) b) Direct observation using "think-aloud protocols" c) Self-reported logs d) Semi-structured interviews

Direct observation using "think-aloud protocols"

According to Ericsson and Simon (1993), *a think aloud protocol* is the cognitive process of translating non-verbal thoughts into verbal forms. Think-aloud protocols have been used as a research method especially in product design and development, where participants are asked to perform specific tasks and vocalize their views, feelings and opinions as they work through tasks (The Usability Company, 2007). I observed the participants during their first encounter with the virtual museum, when they were required to perform some pre-defined tasks, such as looking at a particular artist or online exhibition; I asked them to articulate their thoughts and opinions during the process of performing the tasks. The *Morae software* recorded their voice and captured their searching process on the screen. I opened the browser window and located the Google (http://www.Google.com) search engine for participants to perform pre-defined tasks as shown in Table 2.

Self-reported logs

Participants also explored the online virtual museum on their own and recorded their comments in a log once. The self-reported logs allowed participants to express their thoughts and feelings as they explored the online museum in a setting without feeling that an observer is watching them. The participants were asked to record their preferences for various search strategies, describe their experiences in the virtual museums, describe how they navigated through the web, and express their level of satisfaction with the content, design, and interactivity of the website, as shown in Table 3

Table 2. Lists of Pre-Defined Tasks for "think-aloud protocols"

Name	Description
Task 1	What is your first impression of the site? What draws your attention the most? (Please talk aloud your thoughts.)
Task 2	View one online exhibit. (Please talk aloud your thoughts.)
Task 3	Find out more about your favorite artist. (Please talk aloud your thoughts.)

Table 3. Guidelines for "self-reported log"

Name	Description	Instructions
Question 1	Please return to the *Explore*, then go to *The Collection*. Please search for the term "*Minimalism*" and artist "*Donald Judd*." Using at least three of search features on the page, as illustrated in the diagram.	Please write down your thoughts, preferences, and describe the method that you use and comments on any difficulty that you encounter.
Question 2	Explore the *Explore* link on your own, commenting on the content and features of the website. (10-15 minutes)	Please write down your level of satisfaction with the content, design, visual appeal, and interactivity of the website.
Question 3	What is your overall impression of the website?	Please write down your thoughts.

Semi-structured interviews

I asked the participants follow-up questions about their experience while visiting the online virtual museum, such as (1) What do you consider the most interesting aspect of the museum's online website?; (2) What kind of difficulty did you have while visiting the website?; (3) If you could change one thing about the museum's online website, what would it be?; (4) What are the major differences between visiting an online museum and a physical museum?; (5) How user-friendly would you say the website is for people who use it as a resource?; and (6) To what extent do you consider the museum's online website educational or entertaining?

The questions were open-ended in order to encourage the participants to develop their answers fully. Semi-structured interviews also allowed the interviewer to take a somewhat direct role and understand the phenomena in a more holistic way (Denzin & Lincoln, 2000). The interview questions were modified based on the article "User perceptions of the library's web pages: A focus group study at Texas A&M University," electronic resources protocol.

Validity, Reliability and Methods for Verification

I used a qualitative triangulation methodology to gather information from the study participants. Triangulation, i.e. the comparison of information from different methods of data collection (e.g., using morae software, direct observation, self-reported logs, and semi-structured interviews) can promote validity. Therefore, "readers and audiences are then invited to explore competing visions of the context" (Denzin & Lincoln, 2003, p. 8).

When information is drawn from multiple sources, the researchers are encouraged to examine discrepancies and patterns in their data. By doing this, they can develop more critical reports, which are both accurate and credible (Creswell, 2004). In the method of triangulation, surprises and discrepancies can also lead to unexpected findings. When researchers try to reconcile the differences among the results, it might open the opportunity for enriching the results (Jick, 1979).

Creswell's and Miller's (2000) article "Determining Validity in Qualitative Inquiry," identifies nine types of procedures for establishing validity: (1) triangulation; (2) disconfirming evidence; (3) researcher reflexivity; (4) member checking; (5) prolonged

engagement in the field; (6) collaboration; (7) the audit trail; (8) thick, rich description; and (9) peer debriefing. According to Creswell and Miller, "triangulation is a validity procedure where researchers search for convergence among multiple and different sources of information to form themes or categories in a study" (Creswell & Miller, p. 126). In this study, I used (1) triangulation and (3) researcher reflexivity for establishing data validity, when appropriate and possible (Appendix D).

Data Analysis Procedures

Data analysis consisted of (1) text analysis, and (2) identification of patterns and themes, leading to interpretation of the larger meaning of the findings. The procedures of data analysis include coding and organizing data, transcribing data, analyzing data by hand or computer, using qualitative computer programs, and exploring the general sense of the data (Creswell, 2004). I employed the following steps for the data analysis procedure.

Step One: Creswell suggested (2003) that researchers need to organize and prepare the data. This work includes transcribing interviews, typing up field notes, and arranging the data depending on the data sources. For my (own) semi-structured interviews, I used an audio-tape recorder (with permission of users) to record respondent comments as fully and explicitly as possible, and I transcribed interview data from the audio-tapes into text. During the direct observation using "think-aloud protocols," I generated field notes from my observations of the participants' first encounters with the virtual museum. I collected the participants' self-reported logs. I then collected and organized the data by type, including the data generated by the *Morae* software, the

interviews, my own observations (field notes), and the participants' notebooks (self-reported logs). Organizing the materials by participant or by task might also be considered.

Step Two: In general, researchers should read through all the data and gain a general sense of its scope and its meaning. Researchers need to be aware of the participants' general ideas, the tone of the ideas, the credibility and depth of the information (Creswell, 2003). Exploring the data was the first step of my own data analysis. A preliminary exploratory analysis helped me to obtain the general sense of the data and decide whether I needed to collect more data. As Agar (1980) suggested, I read the entire data set several times and immerse myself in the details and tried to get a sense of the whole picture as a first step in data analysis. I was also benefit from writing notes in the margins of the data in the initial process of data analysis. I identified some general themes and patterns through the data collection, so I became more aware of the participants' general experiences in this study. Following Creswell's advice that researchers should write their notes at the same stage, I also kept a research journal for writing ideas, thoughts, and initial interpretations of my observations.

Step Three: Researchers need to analyze the material in *chunks* and code the information (Rossman & Rallis, 1998, p. 171). I read and reread the data collection from the interview, observation, self-report log, and my research journal in order to look for answers to my research questions. I broke data into analyzable parts by identifying general themes. I followed the Seidel and Kelle (1995) procedures for coding the data. According to Seidel and Kelle (1995), coding is a form of conceptualization that requires

the researcher to commit three kinds of operations: (a) being aware of related phenomena, (b) incorporating examples of those phenomena, and (c) analyzing those phenomena to try to find common grounds, divergences, patterns, and structures. I used the coding procedures to refine my observations of the data, and to understand the relationship among the phenomena I observed.

Researcher's Role

Qualitative research involves interpretation, which requires a researcher to have intensive and continual experience with participants (Creswell, 2003). "Since a wide range of strategic, ethical, and personal issues are involved, researchers need to be aware of their roles, biases, values, ethical issues, and personal interests during the process and research topic" (Creswell, 2003, p. 184). As a researcher, I kept these issues in mind and followed the steps below.

I gave the research problem and a purpose statement of my study to the participants, so they had better understanding of the study setting. I avoided "backyard" research (Glesne & Peshkin, 1992) in which data are taken from the researcher's own organization, friends, or immediate work setting. This type of data collection may be convenient, but it can generate bias or incomplete data collection (Creswell, 2003). My participants were not come from my own academic department or working environment.

As a researcher, I took ethical concerns into account from the very beginning of my study through to the end of my research process, such as thematizing, designing, interview situation, transcription, analysis, verification, and reporting (Kvale, 1996). I demonstrated that I was protecting participants' rights by detailing the steps (Creswell,

2003). Regarding personal confidentiality, I assigned a number to each participant to protect each participant's identity. I did not report any data which can be associated with the participants personally. I discussed in the research report how the researcher gained access to the participants and the research setting (Marshall & Rossman, 1999). When I obtained permission and gained access to the participants, I contacted the large public university and the museum in order to obtain permission to conduct the study. I keep a record of how I gained access to participants and how I communicated with them.

Conclusion

I have addressed the methods and procedures in the section above. A qualitative methodology was well-suited for this study because it helped uncover the reasoning behind participants' search behavior and explored their perceptions, attitudes and preferences. Through the process of analyzing data, the study continues developed and grown. As a researcher, I intended to let my observation to guide the path of my research. My methodology allowed me to maintain flexibility in data collection.

Chapter 4. Findings

Introduction

This chapter presents the findings of this study in response to the following research questions:

1. How do users explore a museum in an online environment?
2. What are users' preferences and perceptions regarding their virtual museum experiences?

In this chapter, the following main topics are addressed: 1) a description of participants; 2) a description of MoMA's Website; and 3) a summary of the results. The summary of results describes how participants interacted with MoMA's website and what their reactions were to various aspects of the website as well as their overall experience of MoMA's online environment. The observations made here can generate guidelines and strategies that web designers can use to create more accessible and satisfying experiences in online environments like MoMA.

Description of participants

The study participants were recruited from a large university in the southeast. Originally, I planned to find my participants through the coordinator of the University's art education program. The coordinator forwarded my email to her students, including interns, pre interns, juniors, and senior art education students, asking them to contact me if they were interested in participating in this study. However, only one participant

responded to my email. I recruited nine out of the eleven participants by going to the art education classes and one by snow ball sampling (I asked one participant to identify others to become participants). A total of eleven participants met the study's criteria, which were having an interest in art and design and having basic computer literacy. The participants were all able to use a computer, work in a browser, and use the Google search engine. I have assigned a number to each participant in this study.

There were two males and nine females. Only one participant (P2) had actually visited the Museum of Modern Art in New York City. This participant (P2) had also previously used its website as a resource for a lesson plan for an art project. Nine of the participants were art education students, and two of them were art majors. Nine of the participants' age was between range 18-30 years, and two were between 40-50 years old. The two older participants claimed that they were not highly computer literate and seldom searched the Internet.

MoMA's website

As an educational institution, the Museum of Modern Art (MoMA) is committed to providing the public an opportunity to understand and enjoy contemporary art. Visitors can visit the museum in person or visit it remotely by visiting its online website. The Museum of Modern Art's website is comprehensive; it contains multimedia projects in various formats, including audio, video, film, and interactive online image collections. It also is home to an online archive of some past exhibitions where visitors can view artworks remotely. The design and interactivity of these online projects has brought MoMA to the attention of a wider public.

In order to understand the results of this study, it is helpful to be familiar with the fundamental design and structure of MoMA's website. Users' first encounter with MoMA's website is the home page. The home page of MoMA's website is primarily dominated by large pictures. The images and texts change constantly; the vivid and colorful display also includes an interactive rollover image function. All the images are arrayed against a white space. These images and texts on the home page change every 2 – 3 seconds with a text size that is between 12 – 14 in verdana font. Users' attention is immediately drawn to a large picture on the upper left side of the home page. The large images on the homepage also function as hyperlinks, so if users click on them, they are led to the next level of the website, where they can view current/special exhibitions, the MoMA's collection, films, join online, and shop at the online MoMA store. Unlike other websites, MoMA's navigation area is not on the left hand or right hand side of the page, but instead is located at the bottom of the website. The navigation area contains five major buttons: *Visit*, *Explore*, *Learn*, *Support*, and *Shop*. Each button contains a drop up list, which contains more links to different resources. Figure 1. below is the sitemap for MoMA's website:

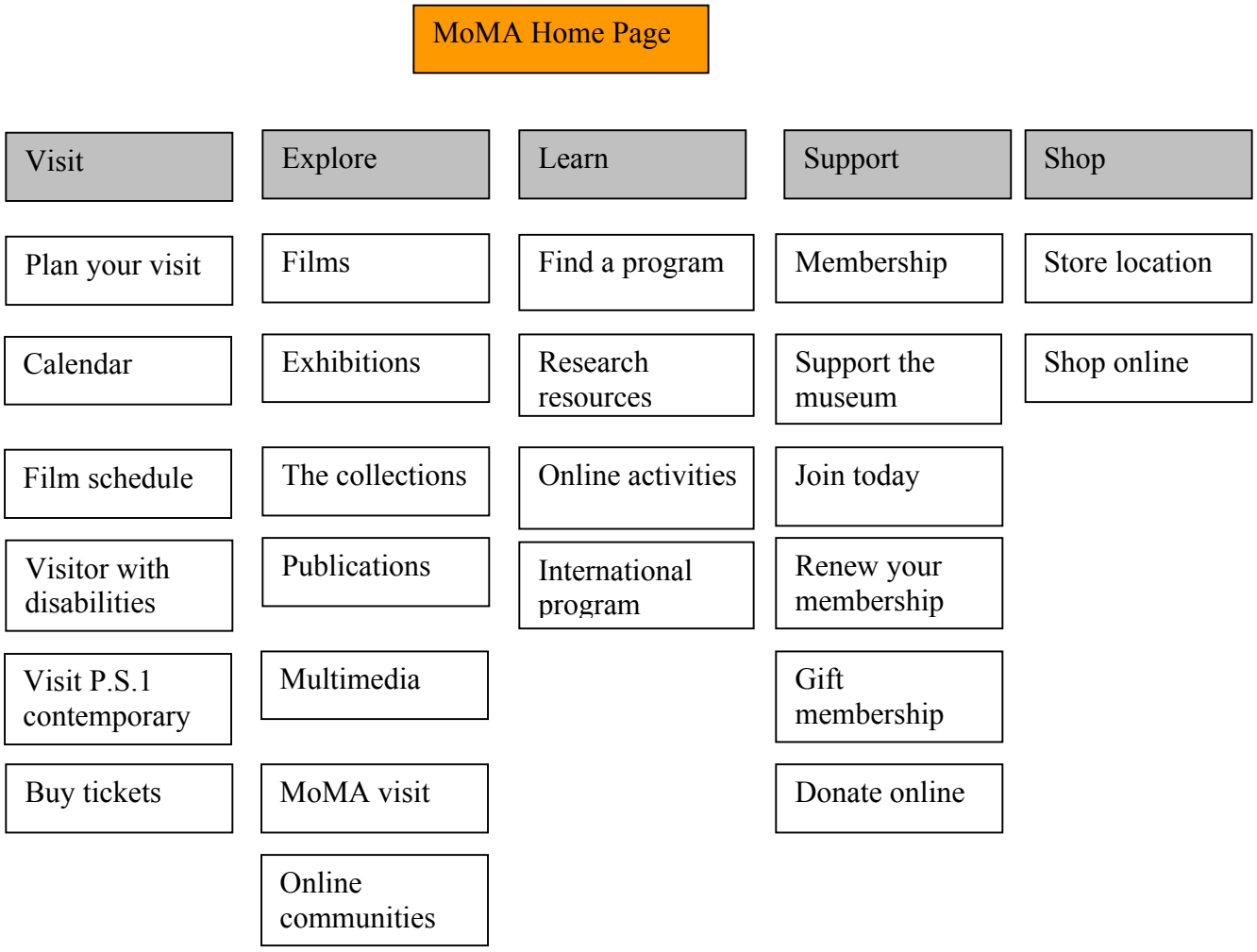

Figure 1. This shows the architecture of MoMA's website

Summary of the results

Several issues concerning web design arose in the study findings of the two research questions "how users explore museum online website, and what are their preferences and perceptions regarding their virtual museum experiences." These issues fell into the following categories: the navigational structure, content design, search engine, and the mission of education.

Online museum exploration

I found that the 11 participants seemed not to search for specific information, but instead simply navigated moment by moment, from one online exhibit to another. We have learned from Klein (1993) that visitors do not like to backtrack in an exhibition to see all the displays in a physical museum. The findings of my study follow the same pattern as Klein's: visitors in an online museum also do not like to backtrack in an exhibition in order to see what they missed in their original navigation through the site. Participants did not return to previous web pages; they simply kept moving to a new web page by clicking on new images or hyperlinks.

MoMA's online collection provides visitors three options for different ways of viewing exhibitions: slideshow, thumbnails, and a list. I observed which view participants selected and if they tried out alternate ways of viewing the exhibitions. I noted in my field notes and the Morae video documentation that only two participants tried different ways of viewing the online exhibits. Most of the participants seemed to be unaware of these options. Only two participants, P9, and P7 were aware of the default setting for viewing exhibitions and selecting another view. The only participant who tried the options (P9) particularly liked the slideshow. This participant (P9) indicated her preferences by saying "it almost felt like you are in the museum, and you can stop and just look at the one [picture] that you like, you can walk from one exhibit to the next," and "if you want to see the picture, you can just browse quickly, you do not have to click it individually."

Another category that emerged in the findings concerned online users' reading behavior. Unlike online digital image collections with little text information, or library websites, where texts and non-visual aspects dominate, museum websites emphasize the interface between texts and images. In the physical museum, according to McManus (1989), visitors' label reading behavior can be classified into three types: (1) not seen to be reading; (2) brief glances at text; and (3) attentive reading. In the physical museum, the label next to the art object normally provides the title, date of artwork, name of artist, and type of media. But in the MoMA website, the text is richer, and there is more to read than would be normally available on a physical museum's label. I observed that participants seemed to be looking at the art images more than reading the texts. The field notes I generated showed that participants tended to make only brief glances at the text. Only three participants (P2, P7, P3,) were actively seeking information that related to educational purposes.

Navigational structure

Most of the participants reported no problems navigating through the website. However, two participants (P6, P3) mentioned that they were confused when they first encountered the website and identified having trouble finding the navigation buttons; they expected navigation buttons to be located on the left hand side of website instead of on the bottom of the homepage. One participant (P8) was not even able to complete the tasks I gave participants to complete on their own, because of her basic navigation problems. Stalled in her work, she had to ask me "Can you show me how to find the link of *The Collection*?" Another participant (P5) was confused about where she was while

trying to navigate through the main site; she stated that she felt that she had become distracted, that she had got lost and that she wanted to see some headlines indicating where she was.

Two participants noted the unusual placement of the navigation tools at the bottom rather at the tope of the page:

- (P6)"I would maybe move the bottom tool bar to the top, it was not a problem at all at the bottom, but I was not used to that. Usually, it is at the top, Explore, Learn, I didn't know where to find it at first."
- (P3)"The navigation is at the bottom instead of on the top of the page. It seems to be unusual, but I guess it works."

Neither of these comments, though, suggests that this distinctive design feature made it hard for them to navigate the site.

General responses to the search engines

In this study, all eleven participants were asked to try three out of the five search engines and to use the *self-reported logs* to write down their reactions and preferences, about the search engines, describe the method that they use and comment on any difficulty that they encountered. When asked during the *semi-structured interview*, what kind of difficulty they had while visiting the website, (7 out of 11) participants mentioned the search engines.

In the physical museum, visitors normally don't have access to a database to search for their favorite artist or other information. An online museum website allows

them to use a search engine to find out more information about artists or exhibits of interest. The Museum of Modern Art's search engines included an *Index of artist in the Online Collection*, *Index of art terms*, *Browse the Online Collection*, *Filter a selection of works*, and *Search the Online Collection*.

In general, most of the participants seemed to be unsatisfied with the search engine. One of the participants (P1) even suggested that MoMA should get rid of the entire search engine by saying "it turned me off. It made me not want to look at the art stuff. Just keep the last one, the *index of art terms*."

The "filter-a-selection-of-works" search engine

Several of the participants (P1, P4, P11) echoed this perception that MoMA could have eliminated some of the search engines because of the redundancy and difficulty of using them. *Filter a selection of works* was the one most often mentioned as being difficult to use. Participant (P1) expressed his dissatisfaction by saying that "It is too much text for me. It looks like a lot of extra words. Too many categories." He stated that for people who are in visual art, the last thing that they wanted to see is a lot of text, he found the search engine "un artistic." Participant (P4) found that functions of browsing and searching led him to the same results, but this participant noted that the filter function had some value, because it allows visitors to narrow their searches down.

A total of seven participants (P1, P6, P7, P8, P9, P10, P11) encountered difficulty with the *Filter a selection of works* search engine. Participant (P8) said that it was definitely a good resource, but she was confused about how exactly she was supposed to use it and needed some instructions. Another participant (P7) also noted that *Filter a*

selection of works took her a while to figure out, but once she did, she was able to find a lot of images and helpful information. She also liked how she could select terms at the right side for more information.

Additional participants' comments regarding the *Filter a selection of works* search engine*,* taken from the *semi-structured interviews*, the *self-reported log*s, and *think-aloud protocols (Morae video section)*, also addressed difficulty using this tool.

- (P6) "*Filter a selection of works*, you have to know the era of the artist to find anything by him. I tried the 1950s and nothing showed up. I could have looked a while, in other words, before I hit the right decade."
- (P9)" Like the filter, [the *Filter a selection of works*] I tried that one, maybe I didn't do it right or something. Because if I put in the artist name, but it brought up all the different other ones, but I specially put his name in, it should have only brought up only his works. Instead it brought up a bunch of other stuff. I was like maybe I did it wrong, so I didn't care about that one that much."
- (P8)" Filter, [*Filter a selection of works*] I keep clicking on it. Maybe some instructions will be easier, but it just took me a second to do what I needed to do. It is not as specific as you type it in."

All of these users reported frustrating, unproductive search process, and question their ability to use the tool correctly.

Only one participant (P10) identified the *Filter a selection of works* search engine as a very useful tool in her *self-reported logs* section: she said "I love how you can filter your search results to get exactly what you want, easy to get around and I love the way it's displayed." However, even this participant reported some difficulty figuring out how

to use the search engine. In the *semi-structured interviews* she said that she didn't know that she had to click on the filter before she clicked on the artist; she didn't know how it could be more self-explanatory and she didn't know how to use the filter section.

The "browse-the-online-collection" search engine

One participant (P5) pointed out during the *think-aloud protocols* section that *Browse the Online Collection* might be useful for people who are studying a period or movement and would like to learn about various artists. One participant (P7) even remarked, "I am taking Modern Art history this semester and will probably use this site on an upcoming paper for more information [looking up artists though search filter]." Participant (3) considered the lists easiest to use because they provided so much information.

The "Index of art terms" search engine

The *Index of art terms* seemed to be the popular search engines for the participants. Although most participants felt some of the search engines were cumbersome at first and many felt they needed more help or instructions for using them. 4 participants (8, 6, 1, 3) expressed satisfaction in the *self-reported logs* section with the *Index of art terms*, which they found easy to use and comprehensive. Participant (8) said the *Index of art terms* is "great," especially if people want to look at a special movement about art because it gives you pretty in depth definition about art movements. She considered it a great resource for definitions and really liked it a lot. Participant (3) said this search engine is well organized, clear with no questions of where to look. Participant 6 explained in some detail why she preferred this search engine:

- (P6)"*Index of art terms*, good, comprehensive list, a long description if I didn't have prior knowledge of the style, scrolled down to related works and recognized Judd's piece from just these few minutes of looking at his work."

Participant (1) confirms the ease of use is what makes this search engine the most popular one:

- (P1) "Get rid of the entire search engine. Just keep the last one; I think it is the *Index of art terms*. All the terms, the ability to type in, and it takes you where you need to go. I don't know why they have the other one. Some are okay; some are horrible. *Index of art terms* is the easiest one.

Participants' suggestions about search engines

Several participants suggested that it would have been better if the MoMA's website had provided some help or explanation about how to use the search engines. There was an obvious need for instructions, explanation, and help for users to navigate through some of these search engines. One participant (P9) indicated in the *semi-structured interviews* "the fact that I am not a computer whiz did not take away from the experience of getting into their website. Their multiple searches, ways you can search for something. It took away from the difficulty for not being very computer literate for me." Since she thought she lacked computer skills, sometimes trying to find something was a little bit disconcerting for her, but she appreciate the fact that MoMA provides different kinds of search functions for people to use. The fact that she is not a sophisticated computer user did not detract from the quality of her experiences on MoMA's website. This participant found that the multiple ways of searching compensated for her lack of computer literacy.

During the *think-aloud protocols*, one participant suggested that it would have been more helpful if the search engine could check spelling: "Like if I misspell something, like the Google thing, it will say 'did you mean this,' like the artist name can be difficult to spell, so it will help out." Another participant (P11) wondered why MoMA thought it necessary to divide the search engines into different sections because she saw all of them as doing exactly the same things. Other similar comments:

- (P8)"Apparently you can pick up certain thing [*Filter a selection of works*], and it will be more specific, which is definitely good, but maybe a small amount of instructions maybe better."
- (P7)"[The site needs a] Popup [to] explain how to use the search engine. It is pretty easy, but it just takes a little bit more time to figure it out. Maybe more explanations about how to use the site. How to use the search engine."
- (P8) "They don't have the kind of Google search engine. I think it [that kind of search engines] will help a lot with user-friendly."

These comments suggest that the procedures for using MoMA's search engines are not intuitive, even for participants familiar with popular search tools like Google.

Design of content

Data from the *semi-structured interviews, think aloud protocols,* and *self-reported logs* sections indicate that the majority of the participants were generally satisfied with the design of content and were overall impressed by the design. They seemed to think that the design of the website was "visually appealing" and "interactive." A couple of participants (P4, P5) came up with an opposite opinion about the design of the home page

and the online exhibits. In the discussion of design section below, the first section focuses on the home page, which is the first page that online users encounter while navigating through the museum's website, and the other section focuses on the general design and content of the website as a whole.

The portal (Home page): 1st encounter

The first page that users encounter is MoMA's home page. Participants had similar kinds of reactions toward the home page. Most participants (P1, P2, P3, P8, P9, P10, P11) were satisfied with the home page. According to data from Morae video's *think-aloud protocols* section*,* the general descriptions about the home page were: "very colorful," "very informative," "balanced, not too complicated," "good use of color," "interesting," "designed oriented, visually appealing," "very colorful, very easy to read, very informative," and "well organized."

Participants' comments also included:

- (P11)" Especially the home page, it gave you such a variety of pictures. It gave you information right on the first page, and I think it is very important. Everything is right there on that page; you do not have to click on something else or try to search for it."
- (P8)" My first impression of the site is really about art, because of all the different images on the front page. Especially the fact that they change. It is kind of interesting, it is kind of encouraging you to come back to the home page and you would not even have to search for it, you can just click on it as it changes."

Only Participants 4 and 5 had a different opinion about the home page. Participant 4 pointed out that the images on the home page were changing too fast. A suggestion from the *think-aloud protocols* for restructuring the home page was "It was only flashed for a few seconds; it would be nice if visitors could click on images and go to forward or backward buttons to see the image that they would like to see." Participant 5 said "I think the first page is kind of confusing because most of them are pictures. I think with most other websites, you see texts and then you see pictures, kind of supplementing the texts. Here are mostly pictures. It is kind of hard to navigate."

The website as a whole

Participants seemed to share similar opinions about the website as a whole, particularly how many images MoMA should have provided for the current exhibits. Six participants (P3, P5, P7, P8, P9, P10) expressed dissatisfaction with the number of images from current exhibits or from past online exhibits. They complained about how difficult it is to get the general feeling about the current shows if the website only provides one image per show. One participant (P5) said, "I did not get very much out of the main website, I guess it just introduces to you to different artists, maybe you will go out on your own and research." This participant (P5) also expressed her dissatisfaction with the current online exhibits because they provided very few images (about 3 images) per exhibit. Some of the shows only provided one image, or information only without any additional images. Participant 8 explained the unsatisfactory display of images: (P8)"The exhibitions need to have more than one picture. It is generally hard to get the feel of how the exhibit maybe with only one picture. May be three. I can understand why they want to

eliminate it, because if they put up all the pictures, nobody wants to come to the actual museum."

Others (P7, P9) speculated on possible legal issues involved in the usage of images in online exhibitions: (P7) "And it maybe is a legal thing with the online exhibits, it just shows one thing in the collection. It would be neat to see more of the pictures. And then have a paragraph or two about it. At least online, of course, it makes you go to the museum. It would have been nice to have more pictures to see for one exhibit." (P9) "Other than trying to fill in the blanks [empty space], maybe they don't have the permission to use the pictures or something. Images are not available; maybe that is a copyright or something. It may not be their fault."

One participant (P4) found there was also inconsistency in the information about current shows: some shows tended to provide more information such as the artist's name and date, while others didn't provide any information. Participant (P4) had a completely different opinion on this image issue and said, "I understand it is enough to put a few images, you don't want people to rely on exhibitions online." This participant further commented: (P4) "Most people don't live in New York; you cannot just go there all the time. It is hard to see the show. At the same time, I understand the impact of art comes from actually seeing it. I think it is relatively fair not to show every single piece for the current show. It is kind of fair to the artist, by not showing everything. Maybe after the show, they can have everything online."

Participant (P5) also complained that she disliked the big advertisements that were unrelated to the page's main content. As a matter of fact, MoMA did put up some commercial advertisements next to the show on the main website. Here are some

representative comments from the interview in which participants expressed disappointment with their limited access to images:

- (P3) "I went to click on the exhibitions that they have. I was thinking, I wanted to see the other five. Maybe they have it setup. You have to go and see it. But online at least give you thumbnails, so if you want to see it better you can go to the museum. I was kind of disappointed on the one photography exhibit."
- (P10) "Maybe some of the exhibitions went on back [many years ago], they didn't have all the images for all of them. I do not know if they can go back and put some more images in them. And then some of the exhibitions, they only show one artwork from it. It would have been nice if you could see more of the images from the shows."

The mission of education

Overall, participants were impressed with and satisfied by the design and the content of MoMA's website. When asked whether they considered their experience of visiting MoMA's website as educational or entertaining, 6 participants (P3, P4, P5, P6, P7, P11,) considered their experience with MoMA's website educational, and 5 participants (P1, P2, P8, P9, P10,) said it was educational and entertaining in about equal measure. They all remarked that they would definitely like to revisit the website.

Overall, participants' experiences with MoMA's website reflects its online mission statement as an educational institution committed to educating the public. In specific comments on the aspect of education, participants said that educational value of the website is very high. They noted approvingly that it gives a lot of information on each

piece, and also has lesson plans for teachers to use in their classrooms. Three participants (P2, P9, P10,) said that teachers could show the website to students and take their students to visit some of the videos.

Participant (P4) considered MoMA's website information easily accessible and said it could be very educational if people takes time and read carefully. Participant (P4) also said that MoMA also tried to use multiple channels, such as flicker, twitter, youtube, to reach more audiences, which is good because some people learn more from watching videos. (P4) "Obviously, MoMA has great writers to put information in concise paragraphs so that it is not pages and pages of stuff, but it is all critical information. The movement of art and artist. Both educational and entertaining--about pretty much the same."

Two participants (P1, P6) both commented that the amount of content on MoMA's website is far greater than on the [local art museum's] website. Participant (P1) thought the information on MoMA's website was both educational and entertaining, she declared the information "endless." Participant (P6) said that MoMA website's information is very educational: (P6)"And the images can be very entertaining. It will depend on the museum, if you look at the [local art musuem's] website, there is far less information. [MoMA's] it [website] is more educational, I am sure you can entertain yourself for hours."

One interesting comment from participant (P3) is that she considered the educational value of the website is a lot more than in the physical museum. She said "At the museum you will be entertained, but you probably would not learn as much, but on the website, you probably will learn more than you will be entertained."

Other remarks from participants about MoMA's education mission included:

- (P11) "I think it is educational. It gives dates. A lot of paintings that I looked at were dated, which gave you good time line in history, so I thought even on the time line event. You can make a great time line event on that."
- (P8) "I think it is both [educational and entertaining], being an art student, I always think art is entertaining. … I was not able to go to the children program or anything like that [to judge, how educational it was]. But obviously, there is a lot of information about specific artists and specific movements, so I think it is definitely educational. Entertaining, they have videos and different things that you can interact with it."

For young adults and children

On MoMA's website, besides having the information for general visitors, there is also content that is particularly designed for young adults and kids on the *Learn* link. Some participants (P2, P5, P7, P10) were particularly impressed by the content of the *Learn* link and in their *self-reported logs* section said "It was easy to navigate and very interactive."

Participant (P7) in her *self-reported logs* section commented on the *Learn* link "lots of options but not overwhelming, looks really nice." She said that it made her want to keep looking at this particular section. She found one section (Destination: Modern art) under online activities in *Learn* link "very cute, fun and interactive." Two Participants (P2, P7) categorized this link as for (K-12). Participants 2 and 10 commented on the *Learn* link in their *self-reported logs* section by saying this link contained research

resources, lots of useful information about the museum, and also had good programs for teachers and resources for their classrooms.

Participant 5 commented on the young adult's and kid's website:

- Participant (5) further expressed "it was very interactive, the layout of pages was clear and simple, geared towards a specific age group, appropriate for children beginning to learn about art, most of text is read aloud, the recorded text for younger students was helpful for deaf students."

In the *semi-structured interviews*, participant (P5) also pointed out that the adult website was harder to navigate than the kids' website and that the kid's site was really interactive. She said "I think the kids one was very educational and was very entertaining. Because it showed all the steps and was very interactive, the design was very good, too. The letters were really big." She did not navigate everything, but she thought the kids' website had more content than the adult site. For example, if visitors enter into "the printing thing," all the artists will come up, for that specific media, which this participant found more helpful.

The overall level of satisfaction with the website

In the *semi-structured interviews* and *self-reported logs* section, when participants were asked about their overall impression of the site, participants were generally impressed and satisfied with the website, and many of them expressed that they would like to revisit the website or use it as a resource. The general comments from the participants about the website were "great variety," "nice layout," "the design is visually

appealing," "inviting," "very user-friendly," "very useful," "well-organized," "color relaxing," and "easy to navigate."

General remarks from the participants regarding their satisfaction of the online website:

One of the participants expressed her level of satisfaction by saying: "The MoMA's website is comprehensive, provides many alternative ways for searching, and is a pleasant experience." (P10)" I really enjoyed the website. The coloring and graphics were very inviting and easy to move around the website. The images displayed on the site reflected well on the actual artworks. The different options at search methods you could use were helpful, too." (P9)"I really like the website, some things were maybe a bit confusing, but overall it did not take away from the experience, I liked all the color and multiple pictures and would like to visit the site again."

Chapter 5. Discussion and Conclusion

Introduction

This study provides evidence about how users behave in a museum's online website, such as what search method they use to search for artists and art terms, to what extent they cycle back to formerly visited pages or move to new pages, and most importantly, what their perceptions and preferences are regarding their virtual museum experiences.

This study has also revealed that users' behavior in an online museum website was relatively different from what previous research been shown to be typical behavior patterns in physical museums. Their behavior was also different from typical behavior patterns in other kinds of online environments.

This chapter addresses the following topics: 1) relationship of the current study to previous studies; 2) recommendations for web designers; and 3) suggestions for additional research. These recommendations and suggestions will provide web designers some useful web design guidelines and researchers some directions for future research.

Conclusions and the relationship of the current study to previous studies

From the findings, I found that participants have the most difficulty with search engines, especially *Filter a selection of works*. Participants want opportunities to interact virtually with artworks to see the texture and surface of them. Providing more images for current shows is essential. Each collection needs to be labeled clearly. Participants'

background knowledge of the subject and computer skill may influence their search confidence in an online setting.

Two types of previous studies were relevant to this study: First, research on how users behave in online environments, and second, research on how visitors behave in physical museums. In the literature review, I synthesized literature on how users behave in online environments and how visitors behave in physical museums, to explore how both sets of research can be implemented to inform web designers' efforts to improve museum websites. One contribution of my study is to provide a comparison between users' behavior on an online museum website with the research on visitors' behavior in physical museums. This comparison can provide valuable feedback to museum web designers.

Previous studies on online users' behavior and perceptions have primarily focused on library websites, online course management systems, and digital image collections. However, very little study has been done on online museum websites. In contrast, physical museums have been extensively studied. Museum visitors' behavior patterns have been investigated in relation to (1) time and attention; (2) label reading; (3) social factors (EunJung Chang, 2006) and (4) how visitors circulate through museum (Bitgood, 2006).

In relation to time and attention, my study supports Treinen's (1993) findings that visitors to museums tend to budget their time by making shorter stops at more exhibits, rather than by spending more time at fewer exhibits. Participants in this study all tried to see as many exhibits as possible. My results for online museums are in keeping with

Treinen's (1993) finding for physical museum that "visitors tend to view as many exhibitions and objects as possible" (p.88). Many studies have shown that length of time spent in front of artwork is an important factor for having a meaningful and effective learning experience in a museum (Falk, 1998b; Falk & Dierking, 1992, 2000). My study, like Treinen's, shows that visitors need to be coaxed to spend more time with a work of art rather than moving quickly to another. The length of time visitors spend at individual exhibits affects their ability to recall facts, ideas or concepts (Treinen, 1993).

In term of how visitors circulate through the physical museum, Klein (1993) found that visitors do not like to backtrack in an exhibition in order to see what they have missed. In this study, I have also found that participants did not like to backtrack to the previous web page to see what they have missed while they are navigating through the museum online website. They seemed to prefer to keep moving to a new page.

This unwillingness to backtrack is an interesting fact for web designers to consider: should they encourage or discourage such back tracking? As in a physical museum, the design of the display can influence visitors' movement.

Chang (2006) indicated that in physical museums, "label reading behavior can be a significant variable for evaluating museum learning because these texts are essential learning tools" (p.176). Bitgood (2006) claimed that shorter labels are more likely than longer labels to be read. McManus in his (1989) study classified three types of label reading behavior: (1) not seen to be reading; (2) brief glances at text; and (3) attentive reading. In this study, the data from the Morae videos indicated that seven of the online users tend to fall into one of McManus's three types of label reading behavior, which is

not seen to be reading. They seemed to only look at the images of the art works and not to read at all. Four out of eleven of the participants were reading some of the online information, such as information for teachers, about workshops, about k-12 applications, or artists' bios. These four participants seemed to fall into one of McManus (1989)'s three types of label reading behavior, which is attentive reading. During the interview section, I asked one participant about the text. She said that in her view, the amount of text available in the online museum website was about the same as in the physical museum.

McManus (1987) found that in physical museums, visitors' behavior patterns and interactions also are influenced by the social context: groups with children, single visitors, couples, and adult social groups all have different kind of social interactions with exhibits. In this study, I found that MoMA's online website offered users access to online communities by providing links to facebook, flickr, iTunes, YouTube, and twitter. In physical museum, visitors can interact with others face to face. In online museum, visitors interact with others from across the globe by clicking facebook, or flickr, which can also create a sense of art community and of belonging.

Only one participant (P4) explored the online communities during the *self-reported logs* section (I was there but without my promoting). The rest of the participants did not explore this link, which suggests that one challenge for an online museum, like any online environment, is to create and encourage the use of authentic opportunity for social interaction.

One gap in knowledge revealed by the review of literature was, as Albert Badre and Anne Jacobs (1999) noted, the lack of data on visitors' goals in museum websites. Most previous research about online environment has been primarily focused on other type of online environments, such as library websites, digital image collections, and course management systems. The existing research about visitors' perceptions and preferences for museum website is very limited, providing very little information about users' behavior. Thus, web designers receive little guidance from research about websites and fulfill museums' educational mission. My research is an attempt to fill this gap to provide some insight on how users behave and what their preferences and perceptions are in an online museum website.

Another contribution of my study is to provide a comparison between users' behavior in online museum websites and in other online environments, such as digital image collections, online course management system, and library website. This comparison also can provide valuable feedback to museum web designers.

According to Matusiak (2006), "users' mental constructs and the choices they make as they search for information have a strong correlation with their past experiences in web searching; expectations for the collection, the level of their computer skills, and to certain extent, background knowledge of the subject matter do influence the searching process"(p. 486). In this study, I found one participant (P4) who claimed that because of his advanced degree in art, he did not have any difficulty finding his way around the website. This confirms that background knowledge of the subject does influence the searching process for museum website visitors as well. One participant (P9) described

herself not a computer whiz, but said that MoMA's website is very user friendly, so she found it easy to use despite her limited experience with computers. This comment also indicating that the level of visitors' computer skills may influence their search confidence in a museum setting.

In terms of the online visitors' level of confidence using search engines, my study found that most of the visitors responded best to *Browse the Online Collection*; they found it is more intuitive than using the option of *Filter a selection of works,* which required them to select keywords. Matusiak (2006) observed similar behavior in his study of visitors' search strategies in the environment of a digital image collection. Users with limited Internet experience who felt less confident about their Web searching skills tended to use what Matusiak called an "online exhibit model" of searching; however, students who searched the computer daily and felt confident about their web skills tended to search by selecting keywords.

In term of visitors' goals, data from the Morae videos indicated that the majority of visitors to museum web sites probably don't come with particular goals in mind. They seemed to be navigate movement by movement; they were not actively searching for any specific information. Only three participants were actively seeking information that related to educational purposes. They are there, as they would be in a physical museum, for a variety of reasons: personal learning, mental relaxation, and recreational purposes through online exploration (Combs, 1999). It is very important for web designers to remember that online museum visitors' goals and intentions can be very different from the goals of users in formal educational environments or environments where people are

searching for specific information or performing specific, well-defined tasks (Sawasdichai & Poggenpohl, 2003, p. 60)

Recommendations for web designers

From the study results and in order to guide the design system that support users' need, we can suggest some general recommendations for improving online museum websites.

As Hein (2000) stated in his book, *The museum in transition, a philosophical perspective,* education has been a central concern of most art museums for the last 30 years. In MoMA's online mission statement, the Museum of Modern Art, as an educational institution, is dedicated to being the leading museum of modern art in the world and is also committed to reaching local, national, and international audiences, allowing them enjoy and understand modern and contemporary art (The Museum of Modern Art, 2009).

As the internet has become more and more popular, it has been a great benefit to museums, because it informs and provides access in a way other means of communications cannot. To design intuitive museum web pages, museum web designers must understand their users' needs. Participants' feedback is one way to begin the process. The information that we have learned from the participants will enable web designers to create more intuitive web pages, and narrow the gap between what users actually know about the museum online website and what web designers assume they know. As Sawasdichai and Poggenpohl (2003) wrote, "User behavior needs to be deeply understood in order to design a system that will allow users to perform their tasks easily,

without struggle and frustration" (p. 60). They point out that the more we can anticipate users' behaviors with this goal in mind, the better we can determine what kind of information and functions need to be included in designs (p. 59). As Crowley, Leffel, Ramirez, Hart, and Armstrong (2002) wrote, "Designers of web pages cannot assume that features that are understood in one culture (the designer's culture) will work in another (the user's culture)" (p. 210).

First, the search engines need to be easy to use, with instructions readily available. Overall, participants were overwhelmed by some of the search engines. For example, when using *Filter a selection of works*, they did not know where to start and what to click to get the information that they needed. Participants wanted immediate help when they could not figure out how to use the search engine. Instructions, perhaps in the form of pop up box would be helpful. Participants expressed this need in their *self-reported logs* while performing the task of using search engines.

It is not surprising that participants found *Filter a selection of works* search engine difficult to use. Users would need to have a very good knowledge of art in order to do what it requires. This search engine allows people to select works, departments, decades, and artists (listed in alphabetical order), but unless online visitors come with a very strong background of art. They will frequently end up seeing this message: "*Sorry, your search criteria didn't return any results*," on the website. According to Crowley *et al*. (2002), it is important to design pages that are intuitive, because if users cannot find the information that they need, they are unlikely to return to the website. For non-experts, a designer requires a matching of works, departments, decades, and artists is not intuitive.

One useful suggestion is that web designers should help visitors narrow down their searches. For example, once they select the department and decade, it should show what artists are available in these categories, instead of showing all the artists who might not match the searching categories.

Second, the opportunity to interact virtually with the artwork should be expanded by providing 3-D walk around. Unlike in the physical museum, online users can only interact with digital images instead of real art works. The study participants commented on how difficult it was to have a sense of the real scale, texture, and surface of art works in two dimensions. One said, "I think definitely the scale of art work, because you can read the dimensions, but sometimes you cannot visualized it," during the interview section. My recommendation is to allow the visitors to magnify the art works and see the details, so online visitors can have better sense of the texture and surface of art works. The images should also contain high resolution.

Third, participants complained about the fact that MoMA only provided about three images for current exhibits. Since online viewers do not have the opportunity to travel to New York to see the show, they said that they would like to see more images of current shows to get a sense of an exhibits' scope. This complaint is understandable but difficult to address because a website cannot match the breadth and depth of the physical museum. After carefully reading and analyzing the data collection, I revisited MoMA's website and found that actually some of the current shows provide more documentation, such as video and more images than others. The web designer should keep this problem in mind and consider the balance and consistency of the information and images for each show; some of the shows did not even provide any images. The inconsistency of

information on each show can create frustration for online visitors and mislead them about the relative importance of different shows. They might overlook important shows just because those shows do not have the same emphasize with text and pictures and placement on the website.

Fourth, each collection needs to be clearly labeled, to facilitate navigation. The participants in the study were sometimes confused about where they were on the museum website. One of the biggest concerns that I have is that the relationship between current webpage and the hierarchical structure of the website. It is difficult to understand how to return to the previous navigation selection, which may cause confusion for online visitors.

Suggestions for additional research

This study provided some insights into the experiences of users of a museum's online environment and recommendations for designer to create web pages that are more closely aligned with users' expectations and preferences. As indicated earlier, there were numbers of limitations in this study, such as the selection of a single art museum and the number of participants. In this study, participants came from a large university in the southeast; it would be useful to select different groups of participants, such as community users, or adolescents.

As stated in the review of literature, early research on visitors' behavior patterns in physical museums was conducted using quantitative methodologies, such as measuring the average time users spend at each display and the number of objects they visited. So to fully understand the phenomena in this type of research, it would be useful for comparative purposes to collect quantitative data, such as how many pictures visitors

click while viewing online exhibitions and how much time they spend on each web page. Researchers also might compare users' reading behaviors and their information seeking behaviors in museum websites with earlier finding.

Second, the online context that researchers have examined most closely are library websites, online course management systems and digital image collections. However, as Albert Badre and Anne Jacobs (1999) sum up, the current state of knowledge on visitors' preferences for museum websites is too limited to help the web site design teams. Since this study has primarily focused on art museums, for further study, researchers can expand the field of inquiry by focusing on other type of museums, such as on science museums or historical museums.

A third research area for future research concerns accessibility. It is important for web designers to understand how to better present museum collections for people with various kinds of disabilities.

As museums acknowledge their commitment to public service, becoming educational institutions rather than simply repositories for artifacts, they are increasingly taking advantages of web-technologies to reach broader audiences. It is exciting to see MoMA and other museums have turned to the internet to enrich their educational program and become more visitor-centered and learner-centered institution. As the promise of online art museums opens the virtual door of the museum to global audiences. In this current ongoing study of users' experiences in museum online environment is essential.

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Appendices

Appendix A

Interview Protocol and Guidelines for students from the large public university in the Southeast.

Revised by Ai-Lun Wu
June 16, 2008

Pre-Interview

1. *Intro*: I will greet and introduce myself to the participant. " I am a Ph.D student at the University of Tennessee working on a study." I will explain through whom and how I found the contact.
2. I will briefly mention the goal of the study is to understand online users' behavior, preferences and perceptions in museums' online learning programs in order to design systems that support their needs. Very little research has been conducted on how users behave in virtual museums, so it is important to get your feedback.
3. Consent Form: I will let the participants know that I have been approved by the University of Tennessee to do this study and also complete the IRB form. I will follow the guidelines and protect their personal confidentiality. I will assign a number to each participant to protect participant's identity. I will tell them the interview will take at least 20-30 minutes. Audio-taping will be used during the interview. I will also tell the participants that I might need to contact them for clarification in the future.

Participants: University students and community members.

Interview Length: 20-30 minutes

Students:

Interviewer:

Hi! My name is Ai-Lun Wu, I am here to learn about what are users' behaviors and perceptions in online museum website.

Questions:

1. What do you consider the most interesting aspect of the museum's online website?
2. What kind of difficulty did you have while visiting the website?
3. If you could change one thing about the museum's online website, what would be it?
4. What are the major differences between visiting an online museum and a physical museum?
5. How user-friendly would you say the website is for people who use it as a resource?
6. To what extent do you consider the visit of museum's online website as educational or entertaining?

The questions will be open-ended in order to encourage the participants to elaborate their answers.

According to Patton, the standardized open-ended interview is highly focused, which allows the interviewers to use their time more efficiently. While analyzing the data, it is also easier to find and compare the responses (Patton, 2002, p. 346). Patton categorized the questions by type: (1) experience/behavior, (2) opinion and value, (3) feeling, (4) knowledge, (5) sensory, and (6) background/demographic (Patton, 2002, p. 350).

1. Experience/behaviors—what a respondent has done
2. Opinions/values—what respondent thinks about his/her experience or issue
3. Feeling—what a respondent's beliefs and considered judgments are
4. Knowledge—what a respondent's factual knowledge about a topic or program is
5. Sensory—what a respondent has seen, heard, touched, tasted or smelled
6. Background/demographics—a respondent's age, education, and occupation, etc.

Appendix B

Email to be sent to Art Education students by the coordinator of the program

My name is Ai-Lun Wu; I am a Ph.D student in Instructional Technology at the University of Tennessee working on my dissertation. I am interested in learning how people use and interact with museum websites. This study will help designers improve websites to better meet users' needs. Very little research has been conducted on how users behave in museum websites, so it is important to get your feedback.

I am currently looking for participants for my study. I am looking for participants from Art Education Program, who value art and understand the importance of art. I will learn from how you explore a museum website.

Participants will meet with me one time about an hour. I will ask you visit a museum website and answer some questions. I will also ask you to go to the site on your own and write down comments. If you are interested, please contact me at awu@utk.edu.

Thank you,

Ai-Lun

Appendix C

Email to be sent to participants after receiving their responses

Dear participant,

Thank you for your interest and response.

I have attached the Informed Consent in this email, please read and fill it out and return to me by email.

Please let me know when will be the best time for you to come to participate in my study, and then we will arrange it.

Thank you,

Sincerely,

Ai-Lun

Appendix D

Table 4. Finding content areas and sources of data for triangulation

Findings	Data Sources
Summary of the results (1)Online museum exploration	a) Field notes, b) Morae video (Think-aloud protocols), c) Semi-structured interviews
(2) Navigational structure	a) Field notes, b) Morae video (Think aloud protocols)
General responses to the search engines (a) The "filter-a-selection-of works" search engine	a) Self-reported logs, b) Semi-structured interview, c) Morae video (Think aloud protocols)
(b) The "browse-the online-collection" search engine	a) Self-reported logs, b) Morae video (Think aloud protocols)
(c) The "index of art terms" search engine	a) Self-reported logs, b) Semi-structured interview
(d) Participants suggestions about search engines	a) Semi-structured interview, b) Morae video (Think aloud protocols)
Design of content (1) The portal (Home page): 1st encounter	a) Morae video (Think-aloud protocols), b) Semi-structured interviews
(2) The website as a whole	a) Semi-structured interviews

The mission of education	
(1) For young adults and children	a) Self-reported logs, b) Semi-structured interviews, c) Morae video (Think aloud protocols)
(2) The overall level of satisfaction with the website	a) Self-reported logs, b) Semi-structured interviews, c) Morae video (Think aloud protocols)

Vita

Ai-Lun Wu was born in Lukang, Changwah, Taiwan. In 2002, she received an M.F.A degree in Painting and Drawing from the University of Tennessee, School of Art. In 2004, she started her Ph.D degree in Instructional Technology and Educational Studies, where she developed an interest in the creation of multimedia projects, especially with Flash software. Her animations have won numerous awards. In addition to her accomplishments in media, she is pursuing her research interest in users' behavior and perceptions in different types of online learning environments.