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A Study of Visitor's Learning Needs and Visit Satisfaction in Real and Second Life Museums

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Abstract: The purpose of this study is to explore visitors' learning needs from visiting museum exhibitions and satisfaction for their museum visits in the real and virtual NCKU museums. A real exhibition, called Ancient Locks, is represented in an online game, Second Life. Two groups of visitors, a total 50 students viewed, by invitation, the exhibition either on-site or online, and then they completed a survey regarding their needs and satisfaction for their museum visits. As a result, a significant difference in the participants' responses to levels of satisfaction (F = 25.089, p < .001) appeared. The study also explored visitors' differing learning needs. Conclusions and discussions are included at the end of this study.

Keywords: Second life, Visitor satisfaction, Visit needs, NCKU museum,

Introduction

In recent years, the most popular online game is Second Life (SL) in which multiple game players simultaneously enter SL to experience a truly realistic virtual world. SL has continued to incorporate more and more interactive activities for the players. Beginning in 2009, some researchers, collaborating with the National Cheng Kung University Museum (NCKU Museum), have attempted an exhibition in SL. By receiving a one-year research grant from the National Science Council, the researchers selected a real exhibition, Ancient Locks and displayed it in SL. This study explores museum visitors' satisfaction with, and need-fulfillment from, the NCKU SL Museum. The literature review provides a brief introduction to the SL environment, its design tools, and its interactive methods, followed by a discussion of the differences between real and virtual museums in SL. The last section of the literature review summarizes previous studies of museums in SL. [Note: The web address of its SL landmark is http://maps.secondlife.com/secondlife/HITHOP/219/224/22.]

1. Museum Research in Second Life

The following paragraphs introduce the SL environment as it refers to the Second Life official website. The sub-sections discuss creation of virtual objects, the features of the SL programming software, LSL (Linden Scripting Language), methods and outcomes of interaction and involvement activities in SL, and finally, the differences between real and virtual museums in SL.

a. SL and its Design

Initiated in 2002, Second Life (SL) allows multiple users to simultaneously connect to a 3D virtual world. More and more academia and enterprises are now entering SL; they are seeking alternative learning and business environments for facilitating different learning activities and marketing. With a free-registration account, SL users, also called avatars, may login and, become a different, virtual, human being, animal or other character. However,

users under the age of 18 are prohibited from entering SL-normal version, which is for adults. Users, between ages 13 and 17, may obtain their parents' or guardians' permission to enter Teen SL. In addition, Linden dollars are the users' (or avatars') daily currency and are exchangeable with USD in SL (250 Linden=1 USD). Some SL avatars spend their real-world currency to purchase more than one virtual SL island. For educational institutions, the island costs 700 USD per 65,536 square-meters. Island owners pay a monthly maintenance fee of 147.5 USD. For new SL avatars, rental of a region (195 USD per 65,536 square-meters) on an avatar's island allows developing familiarity with the SL interactive environment.

Only the owners of islands have authority to write code, called LSL (Linden Scripting Language, developed by Linden Lab), for constructing 3D objects in SL. Such language is similar to object-oriented programming languages (e.g., C++) and some 3D modeling tools. Since the LSL functions vary, the interactive effects in SL sometimes surprise avatars. For example, if avatars come close to a virtual door, it will be automatically open as they have often seen in the real world. LSL programmers are encouraged to employ some 3D modeling tools, to ease construction of virtual buildings, machines, scenes, transportation modes, and so on. As in the real world, copyrighted images, photos, videos or audio clips are protected by SL. Any SL object can be also tagged "no copy" (i.e., not allowed to be copied), "no mod" (not allowed to be modified) or "no trans" (not allowed to be transferred). Overall, an avatar's SL 3D world is very similar with the real world.

b. Interactive Activities in SL

Most objects are created through LSL. Hence, avatars can become involved with a variety of activities, such as chatting, holding seminars and concerts, learning mathematics and other subjects, and conducting scientific experiments, by interacting with the virtual objects or other avatars in SL [6, 11, 16]. More importantly, the avatars can use one of the interactive SL features, Instant message (IM), to talk with other avatars, as in the real world. SL offers two kinds of chatting features, local and global chats. Within 25 meters between two avatars, they can hear each other. Otherwise, they can shout to be heard if an avatar is within 100 meters. In other words, distance differentiates the volume of avatars' voices Private conversations and group meetings are, however, not restricted by distance [13].

In addition, SL avatars can interact with others from different countries, since their real backgrounds are diverse. They have opportunities to understand other avatars' social norms in reality by exploring exotic buildings and rituals. The most significant benefit is increasing the SL avatars' international viewpoints for the real global-oriented world. However, most avatars are English speakers. Asians, especially Chinese, are hesitant to enter SL. Recently, a simplified-Chinese version of the SL web site, Chinese 3D Virtual Community Website, has been established; consequently an increasing number of Chinese have become involved in SL activities [8]. If an avatar owns an island, that individual can even provide services for selling and trading real products, or start a new business in the SL free market.

2. Virtual Museum in Second Life

a. Comparison of Real and Virtual SL Museums

An expanded number of virtual buildings for different purposes have appeared in SL. Enterprises, such as BP, BBC, Cisco, Coca Cola, Dell, Disney, Google, HP, IBM, Motors, SONY, SUN Microsystems and Toyota, entering SL to construct virtual offices conduct

international marketing of brands, and/or provide alternative service channels to sell their products [2, 15, 18, 19].

Educational institutions use the site to recruit international students and enhance institutions' (Harvard Law School, New York University, Midwest College/Alliance Library, University of Kansas Medical Center, Stanford University and Virginia Tech/ICT Library) degree of global visibility [1, 3, 7, 9, 10, 14, 15, 18, 21]. In Taiwan, the Chilee Institute of Technology's Play Center Island and National Central University's Wonderland have both constructed virtual campuses in SL. Many learning activities and research projects are already conducted there.

SL has the reputation of being a valuable venue for promoting cultural events, since avatars can simulate the real experience of touring foreign villages or interacting with virtual objects in SL museums [20]. Some SL museums directly copied their real in-world museums, such as the Bolinas Art Museum, the Holocaust Museum in the US, the Natural History Museum in the UK (Figure 1 NHM) and the Louvre Museum in France (Figure 2 LM). Some SL museums are only appeared in the virtual world, such as the Bayside Beach Galleria Museum of Contemporary Art (Figure 3 BBGM-CA), the Crescent Moon Museum, the Fort Malaya History Museum, the International Spaceflight Museum (Figure 4 ISM), the Paris 1900 (Figure 5), the Second Life Computer History Museum, the Star Trek Museum of Science, the Splo Interactive Science Museum and the Xibalba Maya Museum. The Nomilly Exhibition Hall in Playcenter of Taiwan is the only museum displaying Taiwanese folklore activities and antiques (Figure 6). Overall, the constructors or designers of the SL museums have carefully considered how avatars can interact with virtual objects when they visit SL exhibitions. However, even if the appearance of the SL museum can be very much like the real one, realistic building materials do not appear realistic if the avatar closely approaches the museum. Also, due to budget or time constraints when constructing an SL museum, virtual exhibition content is sometimes not as rich as in a real museum,. (Resources: http://www.nhm.ac.uk/; http://www.youtube.com/watch?v=_zWioQSoUW0; http://library.thinkquest.org/08aug/01151/spread.html; http://secondlife.com/destination/paris-1900)

Figure 1NHM

Figure 2 LM

Figure 3 BBGM-CA

Figure 4 ISM

Figure 5 Paris 1900

Figure 6 Museum of Taiwan 1950s

b. Research on SL Museum Exhibitions and Visitors

To identify a type of SL museum, for future researchers, after conducting several interviews with SL museum designers and developers, [20] summarized a list of characteristics: scale, setting, persistence and evolution, media richness, visitor engagement, social interaction,

intended purpose, collection types, and target audiences. By observing the virtual International Spaceflight Museum and the Splo Science Museum, [22] discovered the intended purposes of designing and building museums in SL. Finally, these researchers considered educational purposes as important to effectively motivate educators or designers to continuously devote time to creating virtual and interactive objects in SL. Some suggestions' intents were to ensure the success of future museum buildings' educational purposes in SL (p.266): (1) a demonstration of how virtual worlds can be used for learning; (2) a collection of related information from around the real world; (3) a financial accounting, and (4) a team of collaborative programmers, artists, and experts. Some examples of virtual and interactive objects designed in SL are well presented in two museums as introduced in the following paragraph.

The International Spaceflight Museum (ISM) appears in SL as a virtual museum [4, 20]. Many visitors from the real world who have an interest in spaceships are motivated to voluntarily and collaboratively spend time collecting information and constructing virtual objects to create as many interactive activities as possible in the ISM. These aspects include: an auditorium, small conference areas, and group discussion spaces. ISM currently presents its rich media and social interactions: a solar system simulator, a planetarium, and a rocket ride into space. Visitors are even able to teleport to a planet to explore different spaceships. Splo is another virtual museum, developed by Exploratorium to achieve social, contextual and educational purposes [5, 17]. Visitors to Splo closely watch a solar eclipse, fly through the solar system, scan their own bodies or change gravity.

Despite efforts, predicting visitors' needs, to enhance the level of satisfaction when visiting the museum, is sometimes difficult. [12] suggested developing an adaptive museum by considering visitors' abilities, interests, preferences or history of interaction. Based on visitors' previous learning, museum guides should provide appropriate amounts of detail Different language options (e.g., English and Greek) for museum guides should also be available to produce a unique personalized museum visit for each visitor.

3. Research Methodologies

To achieve this study purpose, a survey, developed and then distributed to the SL avatars, targeted those who had visited the Ancient Locks exhibition in the NCKU SL museum. A group of real visitors' responses to the survey were also collected to compare learning needs with the avatars and their different levels of satisfaction.

a. Participants and Fields

Two groups of participants were invited, via recommendation, to view the real NCKU or the virtual SL museums. Participants were either senior undergraduate students or graduate students with design, multimedia or information management backgrounds. The Ancient Locks exhibition at the real NCKU museum is currently open to the public. The visitors to the real museum could obtain souvenirs immediately after their visits and at the completion of the survey. The virtual NKCU museum exhibition has appeared in SL for less than a year. The visitors of the SL exhibition received 200 Linden dollars upon completing the survey.

b. Survey Questions

This study explores visitors' levels of learning needs from visiting the real and virtual NCKU museum and satisfaction for their museum visits through a two-section survey. Besides questions of visitors' demographic backgrounds, the first section, regarding learning needs, contains three, 0 to 9 point-scaled questions and two open-ended questions.

The second section collects data of visitors' levels of satisfaction with their visits through a five-point Likert-type scale (0 very unsatisfied to 9 very satisfied). Both sections were available for evaluating the current use of the interactive components, such as visitors' message posting and movie self-broadcasting, provided at the NCKU museum or in the NCKU SL museum. The survey had questions in both Chinese and English, and was both paper and online versions (http://miniurl.com/51287). For SL avatars, the questions were (Real visitors completed a version of survey with similar questions later comparison.):

- SL visitors' learning needs
  - The audio effects in the exhibition
  - The video effects in the exhibition
  - The animated effects in the exhibition
  - Other suggestions pertinent to interactive components
  - Other overall suggestions for the exhibition in SL
- SL visitors' levels of satisfaction
  - The representation of the overall exhibition design
  - The explanation of the exhibited content
  - The responses of the exhibition guide
  - The hardware facilities represented in the exhibition
  - The software features in the exhibition

c. Data Analysis Methods

Reliability and validity analyses, followed by descriptive analysis, were first conducted for all survey questions. One-way Analysis of Variance (ANOVA) revealed significant differences between SL and real visitors' responses to the survey questions regarding levels of satisfaction with their museum visits. A comparison of their different learning needs determined any significance in responses. Coding of SL and real visitors' written responses to the two open-ended questions explored differences in learning needs.

4. Research Results

a. Descriptive analysis results

In total, the numbers of participants entering the real NCKU museum (Group 1) and the SL museum (Group 2) were 26 and 24, respectively. Since participation in this study was by recommendation, all of responses to the survey were valid. Hence, the reliability and validity tests re-confirmed that the survey questions regarding visitor's learning needs could be differentiated from the survey questions regarding visitors' levels of satisfaction. The participants' responses were further analyzed in Table 1) The overall reliability in this study is significantly high (Cronbach alpha = .689). Table 2 summarizes the participants' background and their responses to the two sections of the survey questions.

Table 1 Reliability and Validity Test Results

Constructs	Reliability	Validity
Levels of satisfaction	.853 (valid n = 47)	r = .086
Learning needs	.749 (valid n = 50)	

Table 2 Summary of Participants' Background and Responses

Items	Group 1	Group 2	All
Gender			
Female	15 (57.70%)	12 (50.00%)	27 (54.00%)
Male	11 (42.30%)	12 (50.00%)	23 (46.00%)
Age mean (standard deviation)	22.17 (2.01)	22.70 (2.07)	22.43 (2.04)
Learning needs	5.41 (2.32)	5.03 (2.47)	
Audio effects	5.00 (2.81)	4.92 (2.76)	n = 50
Video effects	4.65 (3.05)	5.04 (3.53)	Mean = 5.23
Animated effects	6.58 (2.48)	5.13 (2.74)	SD = 2.38
	7.18 (1.01)	5.52 (1.27)	
Levels of satisfaction	7.23 (1.07)	5.71 (1.57)	
Overall design	7.15 (1.12)	5.33 (1.66)	n = 47
Exhibited content	7.62 (1.24)	5.24 (2.28)	Mean = 6.44
Exhibited guide	6.46 (1.36)	5.70 (1.99)	SD = 1.39
Hardware facilities	7.46 (1.53)	5.43 (1.83)	
Software features			

As Table 2 suggests, the numbers of female and male participants are about the same. The Group 1 participants' responses to learning needs for their on-site NCKU museum visits were not as high as expected (M = 6.58; SD = 2.48). They thought that the animated effects of the exhibited content should be enhanced, even though other effects (audio and video) were already presented in the real museum. The participants in Group 2 had even lower levels of learning needs for any effects (M = 5.03; SD = 2.47), since they visited the Ancient Lock exhibition by entering the media-rich SL environment but not much familiarizing with such environment. For the Group 1 participants' levels of satisfaction, their responses were higher (M = 7.18; SD = 1.01) than the Group 2 participants, visiting the SL site (M = 5.52; SD = 1.27). Other than the listed learning needs, the participants' responses to the two open-ended questions are worthy of further analysis. The analysis results are shown in Table 4 of the next section.

b. Comparison Analysis Results and Learning needs

Based on the descriptive analysis results, the two groups of participants had different levels of satisfaction from their museum visits. Consequently, One-way ANOVA examined the differences and established a significant difference in the participants' responses to the levels of satisfaction with museum visits ($F = 25.089$; $p < .001$; Table 3). However, no significant difference appeared in the responses of the two groups' participants to their learning needs during their visits. However, they did declare their learning needs by responding to the two open-ended questions. Table 4 shows the codes of their responses to one of the open-ended question, with suggestions pertinent to interactive components. Apparently, many Group 1 participants asked for a 3D animated or simulated movie. They even expected to find copies of ancient locks, so that they could try using copied ancient keys to unlock them. Group 2 participants already registered avatar accounts in SL 3D space, so many of them expressed their willingness to visit the exhibition but asked for more sophisticated or mature designs, such as better audio and video effects. However, they were disappointed with their computers' refresh rate. Sometimes a lag in loading images occurred when moving quickly from one virtual place to another. These participants suggested a need for the exhibition guide to offer the same services as they expect when

visiting a real museum. A large touch-sensitive screen was an expectation for the display of images of the ancient locks in the NCKU SL museum's exhibition.

Table 3 Response Comparison for Levels of Satisfactions and Learning Needs

Constructs	*F*-value	*p*
Levels of satisfaction	25.089	.000
Visit needs	.319	.575

Table 4 Other Suggestions to Interactive Components

Group 1	Group 2
3D animated or simulated effects (7 responses)	Delicate design (5 responses)
Interactive virtual reality (5)	The guide's services (3)
Copied ancient locks (2)	Computer memory space (3)
Others - explanation of movie content, numbers of computers, smoothness of animation (5)	Others – real image, large and touchable screen, more small animations (5)

c. Exploring Visitors' Experiences

The two groups of participants should have perceived different experiences in viewing the Ancient Lock exhibition, since the groups represented visitors to different locales: on-site or in SL. Group 1 participants expected to find more historical background for the ancient locks. However, Group 2 participants expected a large-scale exhibition, containing rich knowledge content and exhibited objects. Some Group 2 participants noticed the design outlook of the NCKU museum building and the indoor decoration of the exhibition. They suggested all virtual objects to be as real as possible. They also believed that the exhibited objects, virtual ancient locks, should be large enough so that they could easily play with them with their avatars' virtual hands. Overall, many participants (Group 1: 8 responses, Group 2: 11 responses) actively provided useful suggestions for the exhibition. These are important references for three aspects: modifying the Ancient Locks exhibition in SL for this study, designing the NCKU SL museum's other virtual exhibitions, or preparing future exhibitions at the real NCKU museum. A series of scheduled, semi-interviews, to be conducted soon, may provide rich descriptions of participants' thoughts, feeling, and opinions.

5. Conclusions and Discussions

This study explored two groups of visitors' learning needs from visiting museum exhibitions and satisfaction for their museum visits in the NCKU museum in real-life or in Second Life. All participant visitors received invitations enter the Ancient Locks exhibition hall and then completed a survey at the end of their visits. As a result, a significant difference appeared in the responses to levels of satisfaction with their museum visit, but not for their learning needs. However, different groups had different learning needs and provided suggestions according to their responses to two open-ended questions. These results show that visiting museum exhibitions could become a serious leisure activity for more and more people [20]. Finally, this study concluded that the functions provided in the real museum could become supplements to the virtual museum and vice versa. In other words, the real and the virtual museums can exist coincidently, so that the visitors' diverse expectations could be achieved, such as studying and manipulating copied ancient locks and their interaction with 3D virtual ones.

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