THE DEVELOPMENT OF A VIRTUAL SCIENCE MUSEUM FOR THE PUBLIC UNDERSTANDING OF SCIENCE IN EASTERN CHINA AND IN THE UNITED STATES

A Dissertation

by

JULIE ANNE DELELLO

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2009

Major Subject: Curriculum and Instruction

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ABSTRACT

The Development of a Virtual Science Museum for the Public Understanding of Science in Eastern China and in the United States. (May 2009)

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Co-Chairs of Advisory Committee: Dr. Lynn M. Burlbaw
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In 1999, the Chinese Academy of Sciences realized that there was a need for a better public understanding of science. For the public to have better accessibility and comprehension of China's significance to the world, the Computer Network Information Center (CNIC), under the direction of the Chinese Academy of Sciences, combined resources from thousands of experts across the world to develop online science exhibits housed within the Virtual Science Museum of China.

Through an analysis of historical documents, this descriptive dissertation presents a research project that explores a dimension of the development of the Giant Panda Exhibit. This study takes the reader on a journey, first to China and then to a classroom within the United States, in order to answer the following questions: (1) What is the process of the development of a virtual science exhibit; and, (2) What role do public audiences play in the design and implementation of virtual science museums?

The creation of a virtual science museum exhibition is a process that is not completed with just the building and design, but must incorporate feedback from public audiences who utilize the exhibit. To meet the needs of the museum visitors, the

designers at CNIC took a user-centered approach and solicited feedback from six survey groups. To design a museum that would facilitate a cultural exchange of scientific information, the CNIC looked at the following categories: visitor insights, the usability of the technology, the educational effectiveness of the museum exhibit, and the cultural nuances that existed between students in China and in the United States.

The findings of this study illustrate that the objectives of museum designers may not necessarily reflect the needs of the visitors and confirm previous research studies which indicate that museum exhibits need a more constructivist approach that fully engages the visitor in an interactive, media-rich environment. Even though the world has moved forwards with digital technology, classroom instruction in both China and in the United States continues to reflect traditional teaching methods. Students were shown to have a lack of experience with the Internet in classrooms and difficulty in scientific comprehension when using the virtual science museum—showing a separation between classroom technology and learning. Students showed a greater interest level in learning science with technology through online gaming and rich multimedia suggesting that virtual science museums can be educationally valuable and support an alternative to traditional teaching methods if designed with the end user in mind.

DEDICATION

For my children: Hunter, Logan, and Summer.

ACKNOWLEDGEMENTS

A friend of mine once told me that as we get older, we tend to neatly wrap our dreams in a box and place them on a top shelf in the closet. Many people die without ever un-wrapping their dreams again. Although many dreams in life shatter and are forgotten, I believe with determination and persistence, one can reach their dreams. With the help and love of those listed below and many others not mentioned, my dream has come to fruition.

The dream of the completion of this dissertation would not have been possible without the support of many individuals. I want to acknowledge the Computer Network Information Center in Beijing, China, for letting me observe them at work in their laboratory. They invested countless hours sharing data, translating the materials, and revealing their culture to me, not just as a researcher, but as a friend. I would like to especially thank Cynthia for letting me peer into her world. Cynthia, may you soar and find your dreams.

I would like to thank the National Science Foundation for providing me the opportunity to make the trip to China. I would also like to express my deep appreciation to my committee members, Dr. Janie Schielack and Dr. Larry J. Kelly and to my committee co-chairs, Dr. Lynn M. Burlbaw and Dr. Jane Packard. Thank you for the direction you provided and for your countless hours (years) of patience.

I would like to express my gratitude to my parents for supporting me and pushing me to finish, while helping watch the kids during many long semesters. I want my

children to know that I love them and I know it wasn't always fair to that mommy couldn't play or ride bikes. Each of you will have to make choices, just as I have. Choose to pursue your dreams!

I am so blessed to have my husband, Steven, in my life. Not only have you encouraged me, but you have loved me during some of the most difficult days in my life. Thank you.

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CHAPTER I

INTRODUCTION

Children in the United States, as in other countries, know little about their contemporaries other than what they might have read at school or heard in the media. A report by the National Commission on Asia in the Schools (2001) portrays a huge gap between the strategic importance of Asia, which is the largest, most heavily populated, and fastest growing area of the world, and America's lack of knowledge about that importance (p. 3). As former Secretary of State Colin Powell said, "The young people of Asia and the U.S. need to know and understand one another because they will be building and sharing the same future" (Asia Society, 2005, p. 20). The National Commission on Asia in the Schools expressed the following vision for the coming decade:

"Every child, from elementary through high school, should encounter intellectually challenging material about the world integrated into diverse subject areas at appropriate grades. Student learning about international affairs, world history, geography, cultures, and languages should entail experiential opportunities, including interaction with students from other world regions through the Internet and exchange programs" (Asia Society, 2001, p.56).

This dissertation follows the style of the *International Journal of Qualitative Studies in Education.*

Jiang Zemin (2000), former President of the People's Republic of China, stated in an editorial of *Science* that

> Upgrading scientific literacy of all Chinese citizens is essential: A high-caliber scientific community supported by an increasingly astute workforce is China's engine for change, ensuring our continuing modernization and preparing the nation to embrace the world and the future... Scientific research and education are both national priorities and should be incorporated into all of China's development strategies (p. 2317).

The Law of the People's Republic of China on the Popularization of Science and Technology was adopted at the 28th Meeting of the Ninth National People's Congress of the People's Republic of China on June 29, 2002 (Legislative Affairs Commission of the Standing Committee of the National People's Congress of the People's Republic of China, 2006). The law required action items to be put in place, including: Increasing efforts to popularize science and technology to the community, creating activities for the general public to participate in, and the cooperation and exchange of ideas with foreign countries.

In 2005, the Chinese Ministry of Education, the Asia Society, and the Council of Chief State School Officers invited a delegation of K–12 education and business leaders to China. The delegation made the following recommendations, which are listed in the report *Education in China: Lessons for U.S. Educators*. According to the delegation, educators must:

1. Make learning about China and other world regions a top priority,

2. Target the U.S. math–science achievement gap,

3. Redesign high schools for the global age to include international knowledge and skills and connections to schools in other countries,

4. Engage China, welcoming peaceful growth, while picking up the pace of educational progress within the United States (Asia Society, 2005, p.7).

Nature of the Study

In order to create scientific literacy and provide intellectual enrichment world-wide, Xiao Yun (2003), Professor and Director of the Scientific Database, noted that the Computer Network Information Center of China's (CNIC) mission is to establish the most influential scientific educational database on the Internet in China. This entails three major steps: 1) setup interactive theme-based Web museums for IT science education, 2) develop media-based education, and 3) establish an integrative base of science education through the promotion and advancement of public understanding of science concepts. This is a story of a particular institution and the exhibit produced within it.

The Problem

In order to facilitate the skills necessary to operate in a competitive international world, the Computer Network Information Center (CNIC) of the Chinese Academy of Sciences (CAS) was established in April of 1995. The CNIC is a research institute involved with the Scientific Database and the China Science and Technology Network (CSTNet). The Scientific Database of China houses a comprehensive scientific information system and includes content from biology, chemistry, astronomy, optics, mechanics,

ecology, and material sciences. The China Science and Technology Network worked with the CNIC and the SDC to launch the first global Internet link, allowing educators across the globe to have better accessibility to and understanding of China's significance to the world through virtual scientific museum databases.

Although Chinese officials have moved forward with initiatives to create more opportunities for public understanding and education in science, few books or articles have been published on the creation of virtual museums. Despite an increased movement towards computerized instruction, only a few empirical research studies have been conducted focusing on the comparison of cultural differences of students using instructional technology to further scientific learning. Despite the rapid growth of using the Web, a search of literature has shown that "evaluations of this technology are surprisingly scarce" (Sheard & Markham, 2005, p. 353). Much of the research conducted to date has been with pre-constructed virtual environments: environments created by designers and instructors, rather than by the students themselves (Osberg, Winn, Rose, Hollander, Hoffman, Char, 1997; Sheard & Markham, 2005). Furthermore, only a handful of studies (Joo, 1999; Wen, 2002; National Commission on Asia in the Schools, 2001) have specifically examined differences in pedagogy between Chinese and American classrooms.

Purpose

This descriptive study serves three purposes:

1. To describe the process of developing a Web-based science platform, which allows students from China and the United States the ability to interact and navigate within a virtual interface of Web-design in their native languages.

2. To portray how the learner is able to provide reflective feedback through a survey analysis, which is part of the learning experience in a constructivist environment, contributing to a new and better-designed museum.

3. To add knowledge to the field of online museum studies.

Research Questions

The central focus of this descriptive case study is to provide a story, which begins with the conceptual stage of building a virtual science museum to the design, implementation, promotion, and usage of the Virtual Science Museum of China through the analysis of historical documents.

The following questions guided this study: (1) how was the Virtual Science Museum of China (VSMC) developed and (2) what role did public audiences play in the design and implementation of the VSMC?

Definition of Terms

The following terms are used in this narrative:

Culture- "The predominating attitudes and behavior that characterizes the functioning of a group or organization" (*The American Heritage Dictionary of the English Language-Online*, 2000).

Constructivism- Teaching based on the belief that students learn best when they gain knowledge through exploration and active learning. Hands-on materials are used instead of textbooks and students are encouraged to think and explain their reasoning instead of memorizing and reciting facts. Education is centered on themes and concepts and the connections between them, rather than isolated information (McBrien & Brandt, 1997).

Distance Education- "The process of extending learning, or delivering instructional resource-sharing opportunities, to locations away from a classroom, building or site, to another classroom, building or site by using video, audio, computer, multimedia communications, or some combination of these with other traditional delivery methods" (Instructional Technology Council, n.d, para.1).

Information Technology (IT)- Includes matters concerned with the furtherance of computer science and technology, design, development, installation and implementation of information systems and applications (San Diego State University, 2002).

Snowball Sampling- "Participants or informants with whom contact has already been made use their social networks to refer the researcher to other people who could potentially participate in or contribute to the study. Snowball sampling is often used to find and recruit "hidden populations" that is, groups not easily accessible to researchers through other sampling strategies" (Mack, Woodsong, MacQueen, Guest, and Namey, 2005, p. 5).

Usability- “The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (International Standard of Organization, 1998, section E).

Virtual Science Museum (VSM)- A virtual museum is a collection of digital electronic artifacts and information resources. The collection may include paintings, drawings, photographs, diagrams, graphs, recordings, video segments, newspaper articles, transcripts of interviews, numerical databases, and a host of other items which may be stored on the virtual museum's file server (McKenzie, 1997).

Virtual Learning Environment (VLE)- “Provides a means by which students can interact with course material outside of lecturer contact time (thus enabling them to become ‘e-students’). VLEs present the potential to stimulate depth of learning by encouraging students to engage more fully with the topics and issues covered in the module, increase the level of interaction within the student community, allow more students to participate than would be possible in a conventional seminar, and give less-confident students a chance to contribute in an unthreatening environment” (Pavey & Garland, 2004, p. 305).

Limitations

Using a historical data collection of extant data limits this research. Problems arise when analyzing records that have been retrieved from past databases. The following variables limited this study:

- Accuracy: The information in this dissertation was based upon data collected by researchers in China. The researchers in China analyzed their data manually and often the information and data was incomplete and difficult to obtain. For this reason, the accuracy of the data was not able to be verified.
- Reliability: Much of the research relied on contributions made by the CNIC in textual emails, which made the data difficult to interpret. Kellner (n.d.) emphasizes that "All texts are subject to multiple readings depending on the perspectives and subject positions of the reader" (p 8).

The original data in this study relied on local Chinese language translators to interpret information into English for the researcher. In using a Web-site that has been created and designed in the Chinese culture and then translated into the English language, it is possible that the textual communication within the cultural environment was different for American audiences when compared to Chinese audiences. According to Thanasoulas (2001), "Culture and communication are inseparable because culture not only dictates who talks to whom, about what, and how the communication proceeds, it also helps to determine how people encode messages, the meanings they have for messages, and the conditions and circumstances under which various messages may or may not be sent, noticed, or interpreted... culture is the foundation of communication" (para. 23).

Extant data was collected before the study was conceptualized and research questions were formulated, which may also place some limits on this study. Furthermore, Website access to the VSMC site may be changed in the future without notice. This includes the addition, revision, or deletion of museum links and exhibits.

The objective of this study was to provide the best possible explanation and analysis of the information given the limitations of the available information and data. The events in this dissertation were reconstructed using the information that was obtainable.

Chapter Summaries

The following chapters in the dissertation are outlined as follows.

Chapter I provides an introduction to the research problem.

Chapter II reviews and discusses the significance of the literature related to the following themes: museum theory using the philosophy of constructivism, the historical development of museums including the advancement of online exhibits, the evaluation and effectiveness of the development of museum exhibits, and concludes with examples of online museums that have moved across geographical boundaries.

Chapter III introduces the research methodology, including data sources and the analytic procedure. This chapter describes the methods of data collection utilized by the Computer Network Information Center in order to facilitate the creation and modification of the Virtual Science Museum of China's Giant Panda Exhibition. This chapter focuses on historical data collected by the CNIC during 2004 and 2005.

Chapter IV describes the initial phase of the Giant Panda Exhibit, portraying the establishment of the initial Giant Panda Virtual Exhibit, which began to materialize in the latter half of 2000. The CNIC designed a preliminary university questionnaire to assess the design of the Virtual Science Museum of China's Giant Panda Exhibition. The purpose of the data analysis in Chapter IV is to determine which items in the initial exhibit needed revision and which items were viewed as needing no further modifications.

Chapters V-VII explains the modifications made based upon user feedback as the exhibit moved from the Chinese version to the English version. Each chapter reviews the suggestions and modifications made to each version of the website. Email messages and internal documents were examined to understand how decisions were made about the implementation of the modifications. The last chapter ends with a report of analysis of the effect the public input had on the first iteration.

Chapter VIII concludes with the implications of the research, recommendations for future studies, and a summary.

CHAPTER II

REVIEW OF THE LITERATURE

This chapter reviews and discusses the significance of the literature and is divided into four sections. The first part of the chapter examines museum theory in regards to experiential learning and the role that constructivism plays within museum education. This examination includes background material from three renowned educational philosophers: Dewey, Piaget, and Vygotsky. Both Piaget and Vygotsky agree with Dewey that understanding is never passive, but involves active construction through exploration and reflection. The section concludes with supporting documentation from a leading contemporary museum theorist, George Hein.

The second part of the chapter reviews the historical development of museums from ancient Egypt's collections to today's technologically advanced online museums. At one time the museum experience was available only to the elite of society, but technological progress has allowed museums to be accessible in almost every school and home.

The third component of the chapter looks at the evaluation and effectiveness of the development of museum exhibits, from the conceptual development of exhibits to their evaluation, practice, and use within education.

Lastly, I have provided pertinent examples of online museums that have partnered schools with museums in hopes of promoting tolerance, diversity, and cultural awareness. By moving to online exhibits, these museums have been able to move across geographical

boundaries and allow students to make meaningful historical connections that might not otherwise have been possible.

Museum Theory

According to Ansbacher (1998), there are six significant questions regarding museum theory, which continue to guide museum development today:

> Can we develop a theory for learning in museums? What kinds of experience do we want visitors to have at exhibits? How and what do visitors learn from their experience? How can exhibit effectiveness be evaluated? What is the difference between education and entertainment? How does experience-based learning relate to school curricula and standards? (p. 37).

Covering the breadth of each of these questions is a huge challenge for any researcher.

If we consider learning theory within museums, we must recognize the role that the philosopher and educator John Dewey (1859-1952) held in museum education. Museums were important to Dewey, as he and his family made frequent visits to them. In fact, Dewey's Chicago-based Laboratory School, which he founded in 1896, included numerous visits to museums. Dewey consistently described the ideal school as an institution that includes libraries and museums in an organic whole in which life-experiences and specialized experiences, such as reading and museum visits, were to be unified (Hein, 2004, p. 418). "All genuine education comes about through experience;" Dewey (1938) adds that this "does not mean that all experiences are genuinely or equally educative" (p. 25). Furthermore, Dewey (1938) noted that no two visitors will have the same experience, and therefore a museum must be developed within "the range of the capacity of the

students… The immature cannot study scientific facts and principles in the way mature experts study them" (p.80). According to Hein (2004), Dewey asserted that "a museum is exemplary not because of the strength of the collection, but because it comes from the local life outside the school and has been used to organize and analyze the results of experience...Museums should grow out of life experiences and be used to reflect back on life" (p. 420).

Jean Piaget (1896-1980), Swiss biologist and psychologist, contributed to the field of museum studies through his work with development stages--- sensorimotor, preoperational, concrete, operational and formal operational. Like Dewey, Piaget realized that children must acquire knowledge in stages. Expanding upon the theoretical perspective of Dewey, Piaget's stages of cognitive development led to a constructivist theory of learning where learning is a process of constructing meaningful representations and of making sense of one's experiential world. The basic tenet of constructivism is that people learn by doing rather than observing. "The very expression 'hands-on', which is in current vogue, especially in the context of interactive centres, is tangible recognition of the power and importance of 'concrete operational' learning…Learning in which understanding is physically and perceptually supported by material experiences" (Russell, 1994) In the article *Museum Learning on Line,* Clarke (2001) characterizes Constructivism in regards to learning:

- Learning is contextual: the learner's physical, personal and social environment shapes the learning process.

- Learning is holistic, affecting all aspects of cognitive, physical, emotional, social and cultural development.
- Learning is rooted in experience. The role of the teacher is to orchestrate a meaningful and memorable series of experiences and motivate the learner to actively engage with them.
- Learners make choices about their learning.
- Learning occurs over time and is cyclical and web-like, unlike the linear development envisaged by the Behaviorist model.
- Questions are used to motivate, challenge, allow learners to compare their views with others, and evaluate learning outcomes (p.12).

Piaget's philosophy provides a challenge for museum designers. Museum designers must realize that visitors may not all be in the same cognitive stages. Children, who have not developed the ability to think abstractly, may not always be excited to visit museums with static exhibits. Exhibits must allow for stages of development and be centered upon the learner.

The Russian psychologist, Lev Semenovich Vygotsky (1896-1934), added a dimension to Piaget's constructivist model; his philosophy was known as social constructivism. Vygotsky (1926/1997) called the social environment the "lever" of the educational process (p. 49). Vygotsky believed that the teachers of children should organize the environment in a way which would arouse interest while allowing the child to make his own meaning. "Meaningful learning results when a person is able to actively construct and find personal meaning within a situation"

(Falk and Dierking, 2000, p. 41). The social interaction between the student, teacher, and other students reinforces their increase of knowledge.

Another caveat of Vygotsky's theory of social constructivism is based upon the premise that cultural backgrounds are tied to learning. "Each person is unique; a composite of their individual history and experience... However, rather than a singular history, each person is actually the product of multiple histories" (Falk, 2004, p.S88).

Other components of Vygotsky's theory include scaffolding and the *zone of proximal development*. Scaffolding occurs as a classroom teacher uses questioning strategies, models, analogies, and clues to help their students interpret data and form understandings of concepts (Marek & Cavallo, 1997). Vygotsky's often-quoted definition of the *zone of proximal development* is

> The distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers (Vygotsky, 1978, p. 86).

In developing exhibits, designers must realize the importance of development levels. In their article, *Intrinsic Motivation in Museums,* Csikszentmihalyi and Hermanson (1995) support Vygotsky, stating that museums must consider whether exhibits increase in difficulty, assist visitors with different levels of knowledge, and make provisions for the visitors' increasing levels of competence (p. 74).

In his book *Learning in the Museum*, Hein, a noted contemporary theorist, supports the role that constructivism plays in museum exhibit design and museum learning. Based upon the work of Dewey, Piaget, and Vygotsky, Hein (1998) describes concepts essential to the constructivist museum: (1) knowledge is constructed in the mind of the learner; (2) learning engages the visitor through active participation; and (3) the museum must be designed to be accessible physically, socially, and intellectually to the visitor.

Hein goes on to discuss four types of museums: Systematic, Discovery, Stimulus-Response and Constructivist. Hein believes that although many theories exist within a museum environment, the constructivist museum focuses more on the processes of museum development than on the content. Furthermore, constructivism forces us to value and honor diversity by recognizing learners' backgrounds and by appreciating and being accepting of cultures other than our own (Hein, 2001, p. 9). Hein (1995) realizes that although there are many types of museums, examples of constructivist museums are harder to find. Exhibits that allow visitors to draw their own conclusions about the meaning of the exhibition are based on a constructivist principle. In classrooms, a student's knowledge is based upon his/her prior experiences. Museums can build on this concept through technology; rather than passively receiving information, students using virtual websites are now able to see historical information from their own viewpoints. Students construct their own meanings about other worlds while they use virtual science museums, facilitating their understanding of other cultures. However, museums must be careful that they do not proclaim discovery learning and yet design exhibits to only communicate information (Ansbacher, 1998). When looking at the design of museums, Guzdial and Weingarten

(1995) assert “that it is crucial to develop an in-depth understanding of the learners' unique needs and interests at the cognitive, organizational, and socio-cultural levels in order to design meaningful and productive technologies for learning”.

Museum Development

The first museum (called a “mouseion”) was established in Alexandria, Egypt, in 290 B. C. to house items of scientific, artistic, and historical importance (Wink and Phipps, 2000). The Mouseion, built by Ptolemy in the vicinity of the royal palace, contained the famous university and academic library. Museums later moved into churches and monasteries but were not accessible to the general public. It wasn’t until after the Renaissance period that the Ashmolean Museum was founded in 1683 and was incorporated into a second floor building at Oxford University.

According to the International Council of Museums (ICOM), today’s definition of a museum is described as “a non-profit making, permanent institution in the service of society and its development, and open to the public, which acquires, conserves, researches, communicates and exhibits, for purposes of study, education and enjoyment, material evidence of people and their environment” (ICOM, 2001). To meet the requirements of a museum, the ICOM (2004) has identified that entities must fall under at least one of the following eight categories:

- Natural, archaeological, and ethnographic monuments and sites and historical monuments and sites of a museum nature that acquire, conserve, and communicate material evidence of people and their environment;

- Institutions holding collections of and displaying live specimens of plants and animals, such as botanical and zoological gardens, aquaria and vivaria;
- Science centers and planetaria;
- Non-profit art exhibition galleries;
- Nature reserves;
- International, national, regional, or local museum organizations, ministries or departments or public agencies responsible for museums as per the definition given under this article;
- Non-profit institutions or organizations undertaking conservation, research, education, training, documentation and other activities relating to museums and museology;
- Cultural centers and other entities that facilitate the preservation, continuation and management of tangible or intangible heritage resources--- living heritage and digital creative activity (ICOM Statutes art.2 para.1).

According to the International Council of Museums (ICOM, 1997), museums across the world have been transforming over the last century. Cultural systems of different countries and regions put museums on a developmental course that could remove past and present inequalities in cultural representation of diverse people (para. 9). Moving from the ancestral passive style of museums, in which curators controlled collections, today's museums recognize the importance of allowing visitors to actively participate with exhibits. This, combined with opportunities for social interaction, contemplation, inquiry,

and challenge, suggests that museums have the potential to provide an ideal constructivist learning environment (Packer, 2004, p.21).

Virtual Museums

Perhaps sensing the future, John Cotton Dana (1917), founder of the Newark Museum, wrote “Museums of the future will not only teach at home; they will travel abroad through their photographs, their text-books, and their periodicals” (p. 25).

A virtual museum does not house actual objects but is rather a digitized representation of objects and exhibits. A virtual museum is a collection of digital electronic artifacts and information resources including paintings, drawings, photographs, diagrams, graphs, recordings, video segments, newspaper articles, transcripts of interviews, numerical databases, and a host of other items that may be stored on the virtual museum's file server (McKenzie, 1997).

According to Jonathan Bowen (2000), producing a website based upon artifacts within a physical museum can be quite challenging. One should not try and recreate a physical museum experience. Online museums are complementary to traditional museum services and should be used as a tool to encourage visits to actual museums (p.7). Moving beyond just perusing the walls of a physical museum, virtual museums enable their guests to take part in a gallery filled with digital images, videos, and sound at any time of day.

When looking at museum content, according to McKenzie (1997), a quality virtual learning experience would need to incorporate the following:

1. An online collection that is substantial.

2. Rich content offerings.

3. A "lobby" or entrance that is both inviting and user-friendly.

4. A collection that would take dozens of visits to explore the contents.

5. Many different kinds of learning activities suited to different age levels and learning styles.

6. A virtual visit that increases desire for a "real time" visit to the original museum building.

Virtual museums have the capability to create hubs of learning in which the students are able to construct new knowledge instead of only rote memorization. Within schools, the virtual museum environment moves from a teacher-centered environment to a learner-centered one where students construct new information based upon their previous knowledge. Students in a virtual world, learning about other cultures, are able to work independently of one another. Students create, build, and negotiate multiple media when constructing knowledge in Web-based learning (Gallini, 2001). Students move from an outside dialogue with an instructor to an internal dialogue, constructing cognitive concepts within. Like Vygotsky and Hein, Tsai (1998) recognizes that knowledge is also constructed and based upon socio-cultural factors. Museum designers must conceive an exhibit as a way to create an experience that leads to inquiry: students asking questions and seeking answers (Ansbacher, 1998).

China is not alone in its quest to disseminate information about their science exhibits to the public. According to the Association of Children’s Museums (2005), there are approximately 341 ACM Children's Museum Members, representing a total of 23 countries from around the world. Over 100 of these museums are located in the United

States. At the Tech Museum in San Jose, CA, the Science and Technology Center in Boston, MA and the Chicago Children's Museum in Chicago, IL, projects are currently taking place to meet the needs of educational systems through virtual learning environments (Bell, &, Rabkin, 2002). These museums explore diverse content areas and provide modules to engage students and provide authentic science inquiry. Although there are many formal visitor studies that have taken into account the physical representations of museum exhibits, few studies have been done on virtual exhibitions.

In a statement made by the European Commission in regards to advancing museum technology, the Commission stated:

> Europe's cultural and memory institutions are facing very rapid and dramatic transformations. These transformations are not only due to the use of increasingly sophisticated technologies, which become obsolete more and more rapidly, but also due to a re-examination of the role of modern public institutions in today's society and the related fast changing user demands. These trends affect all the functions of the modern cultural institution, from collection management and scholarly study through restoration and preservation to providing new forms of universal and dynamic access to their holdings (European Commission, 2002, p. 6).

According to Hennes (2002), techniques are only now becoming available that could enable a widespread realization of genuine, inquiry-based experience in museums just as Dewey originally envisioned for schools (p. 110). "The exhibit experience is distinct from its intellectual and material resources…. the visitor's experience ceases to be

one of browsing an encyclopedia, of reading a library from one shelf to another, of viewing arrangements of objects in the hopes of discovering relevant meaning among them" (p. 112).

Exhibit Effectiveness

Assessing the effectiveness of an exhibit should be an integral part of museum design. Hein declares that "Museum educators need to do more than challenge their visitors; they need to constantly challenge themselves, examine their practice, and reflect on the extent to which it matches –both in process and in content – the theory they espouse" (Macdonald, 2006, p.350).

While assessing particular outcomes, we must look not only to how technology is being utilized within the classroom and how the instructional technologies are designed, but also we must evaluate the design of the technology itself. This is especially critical with online exhibit experiences. As user input is collected and analyzed, it is fed back into the design process, resulting in progressive refinement and improvement of the system under design (Vergo, Claire-Marie, Karat, Pinhanez, Arora, Cofino, et al., 2001). Nielsen (1994) emphasizes that usability principles should apply to Web design and incorporate user evaluations into the design process first through a heuristic evaluation, followed by usability testing with a redesign of the product after each phase of evaluation. The evaluation of any web-based learning environment must encompass not only the educational process but also the process associated with the functional usability of the technology (Sheard, & Markham, 2005). This evaluation approach reflects the interests

and needs of the stakeholders. There should be a continual assessment of an exhibit to meet the needs of the visitors. According to Ansbacher (1998):

> Finding out what visitors are actually seeing and doing at the exhibit is relatively easy and can be accomplished by direct observation perhaps supplemented by interviews. If this is done as an integral part of the exhibit-development process, it can ensure that an exhibit will succeed in engaging visitors as the developers intend (p. 8).

According to Miles and Clarke (1993), there are three types of museum usability evaluations: front-end, formative, and summative (p. 699). Bitgood and Loomis (1993) refer to the three stages of evaluation as the planning, preparation, and installation model.

Front-end evaluations identify the audience's existing knowledge of the subject, misunderstandings, and guests' expectations of the exhibit. Front-end evaluations, referred to by Bitgood and Loomis as the planning stage, can uncover, examine, and then set aside our own preconceptions about visitors so that we can see and understand more clearly what they know, believe, and are interested in (Dierking and Pollock, 1998). This is usually done with visitor surveys and initial museum exhibitions. Korn (2003) reaffirms this notion and adds that a "front-end evaluation is most valuable to exhibition developers when it is conducted to help exhibition teams understand how their visitors think about the ideas they want to address and present in the exhibition… The team must know exactly what it wants the exhibition to be about, what the exhibition's primary 'take-home' messages are, and who the exhibition is for" (p. 22). Korn conveys that two important

caveats must be considered when designing exhibits: when to ask the questions and what questions to ask.

After the initial planning stage comes the preparation stage, when museum designers can collect data on the visitor responses to preliminary content (Bitgood and Loomis, 1993). During the development phase, in order to refine and improve the design and delivery of the exhibit, a formative evaluation takes place. During the design and development, formative studies help in evaluating prototypes and aid in the museum redesign for clarity, comprehension, accessibility, and ease of use (Dierking and Pollock, 1998).

Summative or installation evaluations identify areas that need improvement after the museum exhibition has been completed and publicized. Miles and Clarke state that at this stage, it is usually too late in the process to make major revisions (p. 700). However, Bitgood and Loomis (1993) acknowledge that "evaluation results from all three stages of museum development and can contribute significantly to the success of an exhibition" (p. 691).

Rather than limiting an evaluation to just one model, Sheard and Markham (2005) advise us to be flexible, responsive, and adaptive to changing evaluation needs. "The evaluator [needs] to look at [the] data collection methods that can be seen as being appropriate to the current state of the evaluation process…. acknowledging that in a complex study there is no single evaluation approach" (p. 356).

Korteweg and Trofanenko (2002) assert that teachers can contribute to the development process of a museum's website through the development and evaluation

process. By linking their curriculum to the museum, teachers can connect the student audience to the museum's educational intent. "As teachers are best able to judge how their students are responding to museums' Web activities and technical designs, there is a wealth of data and information that museum professionals may gain from closer interactivity with their teacher-collaborators". Mayer (2004) suggests that a variety of instructional methods can lead to constructivist learning and that this learning is more about appropriate processing rather than on hands-on activities or class discussions. "Students need enough freedom to become cognitively active in the process of sense making, and students need enough guidance so that their cognitive activity results in the construction of useful knowledge." According to Mayer, "Various forms of guided discovery seem to be best suited to meet these two criteria" (p.15).

In this research, the museum designers at the CNIC acknowledged the importance of feedback from both the teachers and the students through the development and planning stages in order to create new and better designed museum exhibits.

Virtual Learning Museum Examples

The following examples provide illustrations of online museums that have much to teach us about the potential of partnering museums with schools in hopes of reaching a larger audience.

Four Directions: Four Directions is a project funded through a U.S. Department of Education Challenge Grant to promote the development of culturally responsive teaching through the means of technology for Native American students (The National Museum of the American Indian, n.d.). Over a period of five years, the project has involved nineteen

American Indian schools in ten states, four university partnerships, and two museums. Twice each year, the Smithsonian Museum and the Cultural Resource Center in Suitland, Maryland, invite four to six students (fifth grade or higher) along with their teachers to spend a week with the museum staff . The students learn to create and develop interactive virtual exhibitions based upon artifacts from their own communities. According to Melissa Carrillo of the Smithsonian Latino Center, "with the online environment, we can reach far more people, and further explore issues of representation leveraging the success and popularity of interactive experiences particularly with younger audiences." Students from several of the Four Directions schools decided which items in the exhibitions they wished to feature to create a virtual tour of the museum through the eyes of American Indian children (Roy & Christal, 2000). "It has provided a venue for cultural collaboration that reaches out to the global community through the World Wide Web".

Through the virtual museum project, the glass display cases were removed from the cultural artifacts and displayed for the entire world. One of the children involved in creating a virtual museum from physical artifacts stated:

> Just think, we'll never be this close and have this kind of access ever again. . . He knew how special the moment and how special the privilege was to have access like that because all the time we've taken field trips to the museum, not once have the cases been opened (Christal, 2003, p. 153).

Remembrance: Reflection: Response: Since 1993, the United States Holocaust Memorial Museum (USHMM) has reached millions of visitors through museum programs that are designed to help visitors learn the history of the Holocaust and reflect upon the

moral and ethical questions raised throughout history. In response to such large public demand, the USHMM created an online Website: *The Holocaust: A Learning Site for Students*. The site is a reflection of the Museum's permanent exhibition, *The Holocaust.* The vision of the USHMM was to make the resources available to students who might not be able to visit the museum.

Teachers and students from Hunterdon Central in Flemington, NJ and six school districts from diverse geographic and socioeconomic settings in the United States participated in the development and refinement of the U.S. Holocaust Memorial Museum's (USHMM) Student Outreach Site, using primary source documents, such as photographs, maps, and letters from the museum (Davis, Fernekes, &, Hladky, 1999, p. 34).

The students were able to pose questions to museum experts, sharing their thoughts and feelings in addition to communicating with other students around the world. "Even though our high school is three hours and three states away from the United States Holocaust Memorial Museum, we felt as if we were there every day in the spring of 1997" (Davis, et.al, 1999, p. 34).

One middle-ability student wrote, "I feel this Internet-based program is helping me learn a lot about the Holocaust ... even though it's hard work and sometimes confusing to find answers to the questions" (Davis, et.al, 1999, p. 37) Another student wrote: "We wrote a message to one of the people [survivors] about how strong they must have had to be to take all the hatred comments" (p. 37). The students were engaged throughout the process, had a higher level of knowledge, had a stronger desire to visit the physical museum, and showed a greater level of complex thinking.

The USHMM has continued with its development of online programs and exhibitions to honor the memory of the victims of the Holocaust. One such museum exhibit is *Remembrance, Reflection, and Response: Service project to honor a child of the Holocaust,* where students reflect on the past, remember a forgotten child, and respond to combat genocide by paying a visit through an online field trip. "History is usually written by the victors," Mr. Berenbaum Chairman of the Museum's International Relations Committee, said. "The idea was even if we die, at least we will leave behind the material to tell our story" (Hevesi, 2008).

Through the construction of the English version of the Virtual Science Museum of China, the Computer Network Information Center recognized an opportunity based on the unique characteristic resources of China to develop international cooperation while "promoting the sharing and common construction of science popularization resources, the trans-cultural understanding and communication as the core contents, and to establish a network platform for the discussion and communication of science popularization in education between China and the world" (GLORIAD, 2004).

From the literature reviewed in this chapter, it was found that there are a limited number of studies completed using online virtual science museums. Exhibit design, particularly in this electronic setting, is a complex task. To design exhibits from the perspective of a visitor's experience requires a reconsideration of the way we define "experience" and a re-evaluation of the purposes of museums and other visitor attractions" (Hennes, 2002, p.115). From the conception to the development and usage of online

museums, designers must focus on the learner's needs and evaluations must be conducted in all phases of exhibit development, the focus of the present study.

CHAPTER III

METHODOLOGY

Introduction

Research centered upon the Chinese Information Center exhibition of the Giant Panda Exhibit. The central focus of this descriptive case study is to provide a story which began with the conceptual stage of building a virtual science museum and includes the design, implementation, promotion, and usage of the Virtual Science Museum of China.

One of the first steps in designing a virtual interface is to develop the appropriate content to house within each exhibit. In order to develop the framework for each museum interface, the Chinese Network Information Center realized that usability testing was of utmost importance when designing virtual interfaces for public audiences. The creation of a virtual science museum exhibition is a process that is not completed with just the building and design of the site, but must also incorporate feedback from the public who use the exhibit. The following questions guided this study:

(1) What was the process of the development of a virtual science museum?

(2) What role did public audiences play in the design and implementation of the Virtual Science Museum of China (VSMC)?

The study relied on extant data, which focused on historical data collected by the Chinese Network Information Center during 2004-2005. The data included: 1) documents, letters, memoranda, agendas, and formal study reports, 2) physical artifacts gathered

during a visit to China, including notebooks, photographs, video-footage, and computer output information, and 3) archival records including charts and survey-data.

Although this research involved surveys, the goal of the study was not to obtain mere quantitative results, but rather to look at all of the documents as part of a story. Permission to use the data has been granted through the National Science Foundation's (NSF, 2004) East Asia and Pacific Summer Institutes Program (EAPSI) in conjunction with the Computer Network Information Center (CNIC) of the Chinese Academy of Sciences (CAS) (see Appendix 1).

The case study, used as the research strategy, will allow a contribution to be made to the organizations involved in creating virtual science museums and describe the future possibilities for virtual museums as a tool for educators.

Data Collection

Data was collected at the Chinese Network Information Center and incorporated data collections from six individual survey locations. The survey data gathered was collected from an initial university survey, two summer camps in Beijing, China, an email sample from U.S. educators based upon a snowball sampling, and a questionnaire focused on both a U.S. middle school and a Chinese middle school audience (see Figure 1).

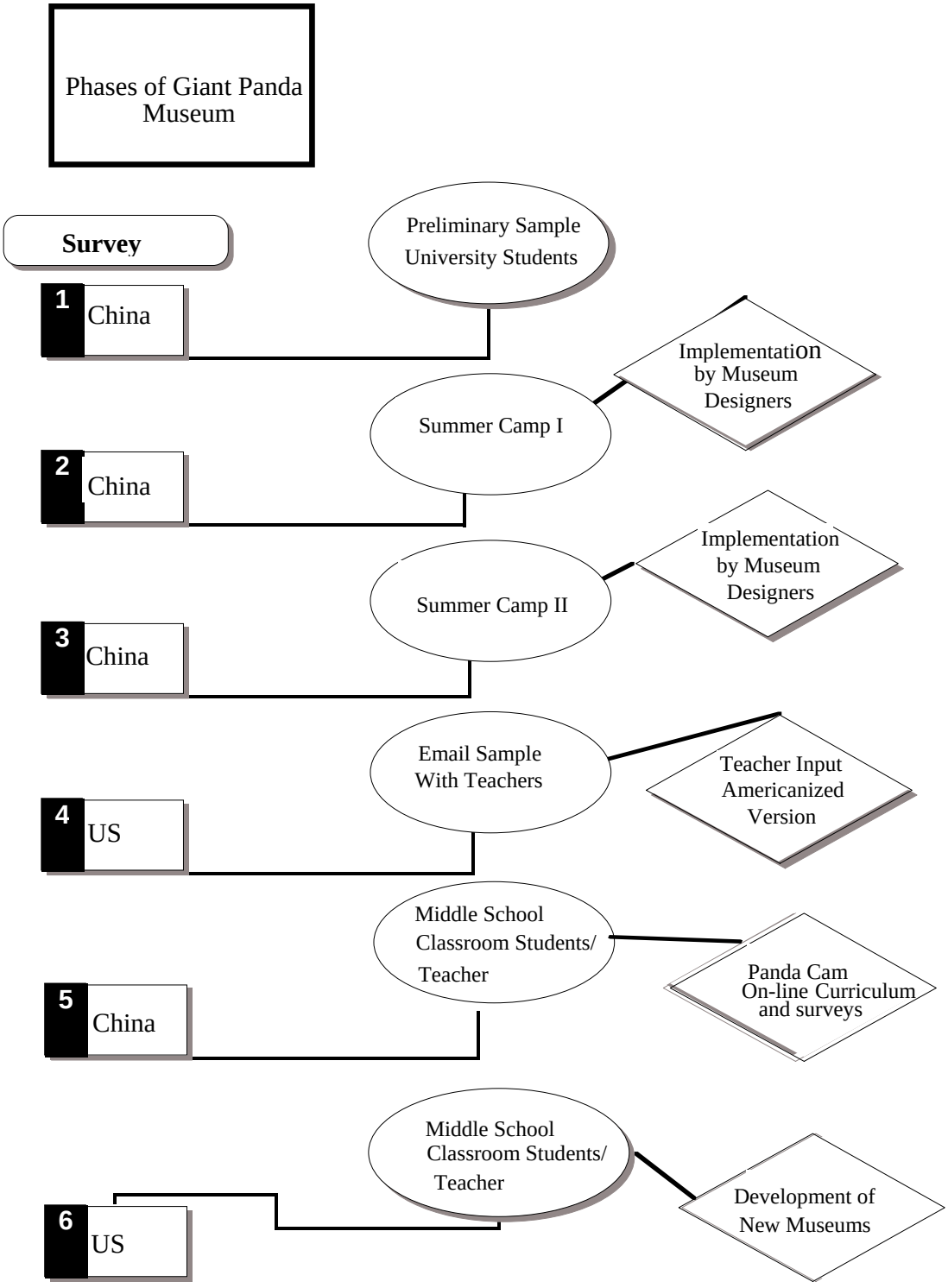

Figure 1: Phases of the Giant Panda Exhibit.

With each survey, the public generated feedback and provided information and the dialogue, which was incorporated into further revisions of the museum exhibit. The students were expected to provide constructive feedback that would go into revising the exhibit. The second stage of field testing involved a shift from the review of the data within the interface to the use of the data within a classroom curriculum. The feedback was shared with museum designers for further improvements to the online exhibit.

The data, already collected, is located in the archives of the Science Museums of the Chinese Network Information Center and the Scientific Database, both subsidiary research institutes of the Chinese Academy of Sciences (CAS), located in Beijing, China. Additional secondary source materials are available at the Global Ring Network for Advanced Applications Development (GLORIAD), founded at the Joint Institute for Computational Science of the University of Tennessee and Oak Ridge National Laboratory, the Information Technology in Science Center for Teaching and Learning (ITS), funded by the National Science Foundation in Washington, D.C. and located at Texas A&M University in College Station, Texas. The Computer Network Information Center collected data from the following survey groups:

Survey Group 1

The initial set of participants in test group one were seventy-eight (n=78) Chinese university students. The CNIC advertised for subject recruitment and collected data during July of 2004. Data was collected through a front-end evaluation using an eleven question survey in the native Chinese language, which

was translated into English by the research team at the CNIC for the American researcher.

Survey Group 2

On July 8, 2004, the CNIC held a summer institute at the Center, which provided the opportunity for approximately one-hundred ten-year-old students to attend a presentation on the Chinese Virtual Science Museum (VSMC). These children were from the famous Zhong Guan Cun School in Beijing, China. Data was collected through a survey created by CNIC in the native Chinese language. Survey results were translated into English by the research team at the CNIC.

Survey Group 3

On August 12th, 2004, forty-six students attended Summer Camp II. Forty-three (n=43) of the forty-six Chinese students, ranging in age from 6 to 18, participated in a survey analysis of the VSMC at a Chinese summer camp sponsored by the Chinese Network Information Center in Beijing, China. The aim of each summer camp was to encourage the children to think about science while learning about the Giant Panda Exhibit. The colleagues at the VSMC provided a forty-five minute lecture with one computer and a projector in the front of the room. The participants included children of faculty and staff members that worked within the local community around the Software Park of the Chinese Academy of Sciences. The students attended local elementary and middle schools in Zhongguancun within the Haidian District of Beijing, which included schools from the Zhongguancun No. 1 Elementary School, the Zhongguancun No.2 Elementary School, and the Zhongguancun Middle Schools. These students participated in

the on-line survey, which can be found at www.kepu.net.cn/gb/index.html. The results of this survey will be discussed in greater detail in Chapter IV.

Survey Group 4

Before creating the American version of the Giant Panda Museum, an open-ended email survey was conducted with six teachers across the state of Texas to ascertain their needs for using virtual science museums within their own classrooms. This pilot study was conducted using a snowball sampling between June and August of 2004.

Survey Group 5

Data collected by the CNIC for the fifth test group involved the Yanqing No. 1 Middle School, housed in a remote suburb of Beijing, China. Forty-eight students, (n=48), ages 16-17, participated in the on-line surveys and curriculum questions on December 9, 2004.

Survey Group 6

The sixth set of thirty-three (n=33) participants came from two individual science classrooms within the United States and all subjects were between 10 and 12 years of age. These students were chosen based on classroom assignments. The chosen U.S. middle school housed the identified gifted and talented fifth and sixth graders and contained a total of 382 students with 60% of the population eligible for free and reduced lunch. In addition, the survey responses from the students' classroom science teacher (n=1) were analyzed. Teacher participation in the study was voluntary. The teacher completed the survey at the conclusion of the student module and questionnaire. Data was collected in April 2005 by the Computer Network Information Center.

Analytical Framework

After collecting and photocopying all of the data it was organized, as Bogdan and Biklen (1992) propose, by breaking the information down into "manageable units, synthesizing, searching for patterns, discovering what is important, what is to be learned, and deciding what to tell others" (p. 157).

In order to achieve this goal, the researcher read through all of the data from the sample groups, making margin notes while obtaining a general sense of the information. I organized the data and inventoried the primary source material into separate files. This organization resulted in the important process of data reduction. Miles and Huberman (1994) describe data reduction as the process of "selecting, focusing, simplifying, abstracting, and transforming the data into something meaningful and manageable" (p. 10-12). Following a Bogdan and Biklen approach, I continued to focus on the research questions so the data collection was not too large. Creswell (2003) discusses the importance of making "meaning" out of the initial information in order to "capture the lessons that are to be learned" (p. 194). I "developed a coding system of patterns and themes" (p. 160). This coding system was based upon topics that emerged through the reading of the data. Merriam (1998) points out that the categories should "reflect the purposes of the research and in effect are the answers to the research questions" (p.183). I revisited the data as many times as necessary to cross-check the emergent categories and themes. All of the coding was done by hand in order to determine meaningful categories and themes.

The data analysis was revealing the process that went into building the Virtual Science Museum of China. Miles and Huberman's (1994) model of qualitative analysis discusses the importance of data display. By creating visual displays, I was able to discern the logical patterns and relationships within and between the collected data information. Through the reading of the data, I wanted the reader to visit each of the site locations in their minds, visualizing the children and the cultural setting. Media documentation including photographs and video footage contributed to the accuracy and relevancy of this process. I used a narrative passage to describe the categories, themes, and dimensions that have emerged from the data. After reviewing the data I arranged the data, trying to fit topics and concepts into larger categories while revisiting the research questions (see Figure 2). Figure 2 shows the five categories that were developed, including: the demographics of the visitors, the participants' overall view of the content design, the usability and effectiveness of the museum exhibit, and cultural awareness.

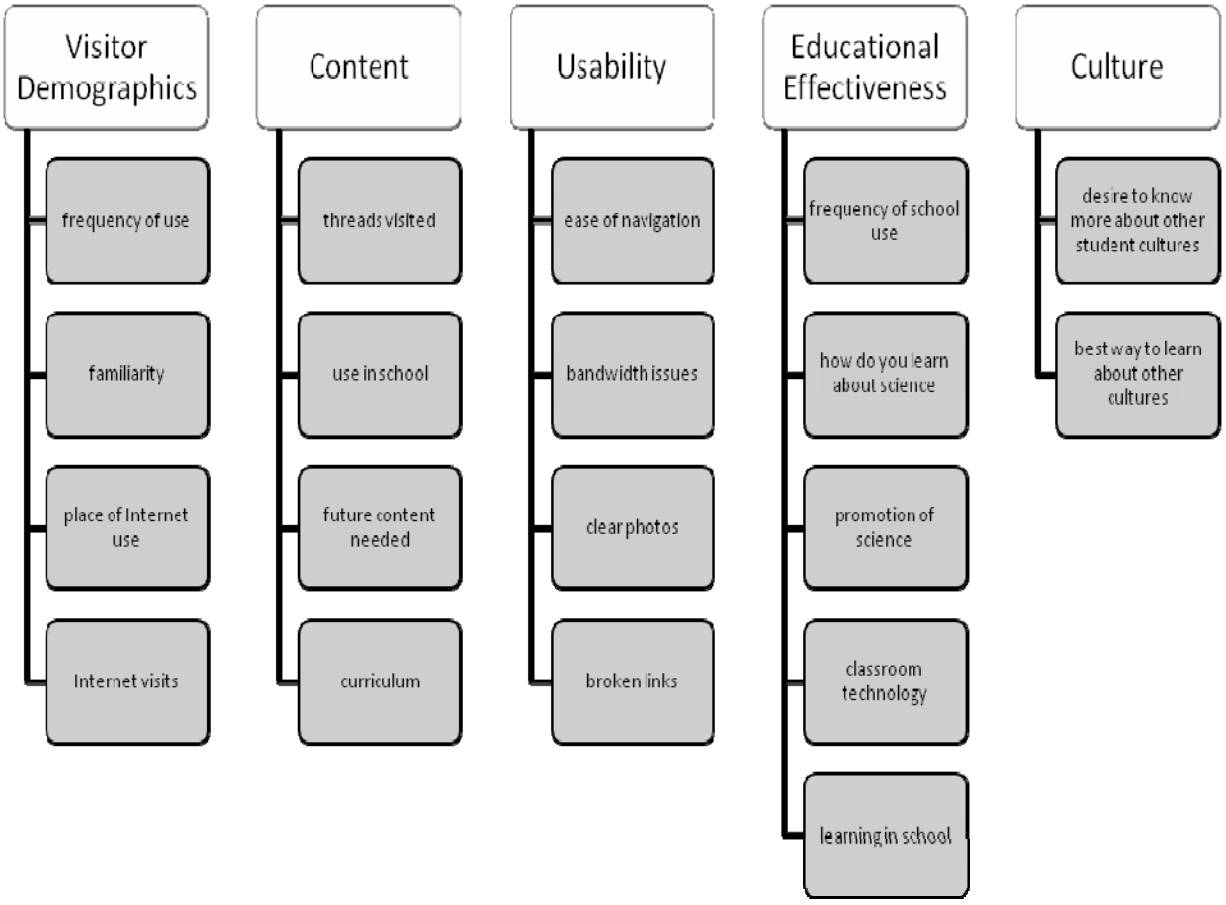

Figure 2: Coding Categories within Collected Survey Data.

To help validate the data collection, I followed the guidelines established by Creswell (2003) in that I used the exact wording from participants, intertwining their quotations into the narrative passages. Using an audit trail of "raw data, analysis notes, reconstruction products, personal notes, process notes, and preliminary development information," as Lincoln and Guba (1985) advise, I was able to show a "confirmability" of the research (p. 320). Consistent with Eisner (1991), I focused on the following three features: the "research must make sense to the reader, the findings need to be consistent

with the evidence presented, and a good study will help the reader understand the situation of the study" (p. 58). Through the analysis of the documents, I attempted to provide a road map for future educational initiatives. This research report is a report that," closely approximates the reality it represents" (Strauss & Corbin, 1990, p. 57).

CHAPTER IV

THE RISING OF A MUSEUM

Introducing the Center

Nestled deep in Beijing's "Silicon Valley" lays the Zong-guan-cun Science Park. The Science Park is geographically situated in the northwestern part of Beijing city; about 10 miles from Tiananmen Square, the political heart of the People's Republic of China. Two of China's most prestigious universities, Tsinghai University and Peking University, are also located in the Science Park. Descending into the center of Zong-guan-cun, located in the Haidian district, through the winding, narrow, cobbled streets, one would come to two gates, guarded from outsiders. The Computer Network Information Center (see Figure 3), one of the many research institutes of the Chinese Academy of Sciences (CAS), is located in the Haidian district.

Figure 3: The Computer Network Information Center. [Photograph]. (CNIC, 2008a).

Designing a Museum

Within the CNIC, one finds an un-air-conditioned room populated with light gray cubicles. Perhaps these cubicles give the Chinese a sense of cooperation and unity, which Gonzalez-Mena (1993) notes is part of the culture in China. Young researchers are huddled around computers engaging in the task of building a new exhibit for the Science Museum of China, with hopes that the museum will one day popularize science to the outside world. The museum exhibit teams sit in rows, grouped by specialization, down each of the narrow corridors of the room. The work of the researchers at the CNIC is promoted through their letters, photographs, emails, databases, video material, and most importantly, their virtual museum site located at www.kepu.net. This project reveals how a group of young scholars became so immersed into their work that they were inspired to create a unique presentation documenting the scientific research and cultural heritage of China to the world through the use of the Internet.

The Virtual Science Museum of China (VSMC) is an online database that incorporates documents based upon primary source materials from scientists and includes audio, video, multimedia gaming, and colorful photographs, all of which provide an in-depth virtual environment. The VSMC's task according to Yun (CNIC, 2004) "is to base resources for the museum from the Scientific Database of China, emphasize the content to be scientific, systematic, creative, authentic, and easy to understand, use the latest IT technology, like 'the' multimedia, and establish interactive platforms for scientists and the public with the 'Interactive Internet'.

Figure 4: Photo of the First Edition. (CNIC, 2006a).

Figure 5: The Revised Chinese VSMC Interface. (CNIC, 2007b).

The original version of the VSMC, also referred to as the *China Popular Science Exhibition,* was opened to the public in Beijing on October 25, 1999. The first museum interface, originally housed only four museums (see Figure 4) , now holds more than 60 virtual science museums written in the Chinese language with thirteen translated into the English language (see Figure 5).

On April 1, 2000, the first mirror site of the VSMC was set up in Taiwan, China, and in March 2002, the English version of the site was put into service at Texas A&M University in College Station, Texas (see Figure 6). The VSMC is comprised of both simplified and traditional Chinese versions and an English version. However, the English version contains fewer museum exhibitions than its Asian counterparts. The "English edition only takes a picture of the VSMC in profile" (Yu, C., personal communication, July 8, 2004).

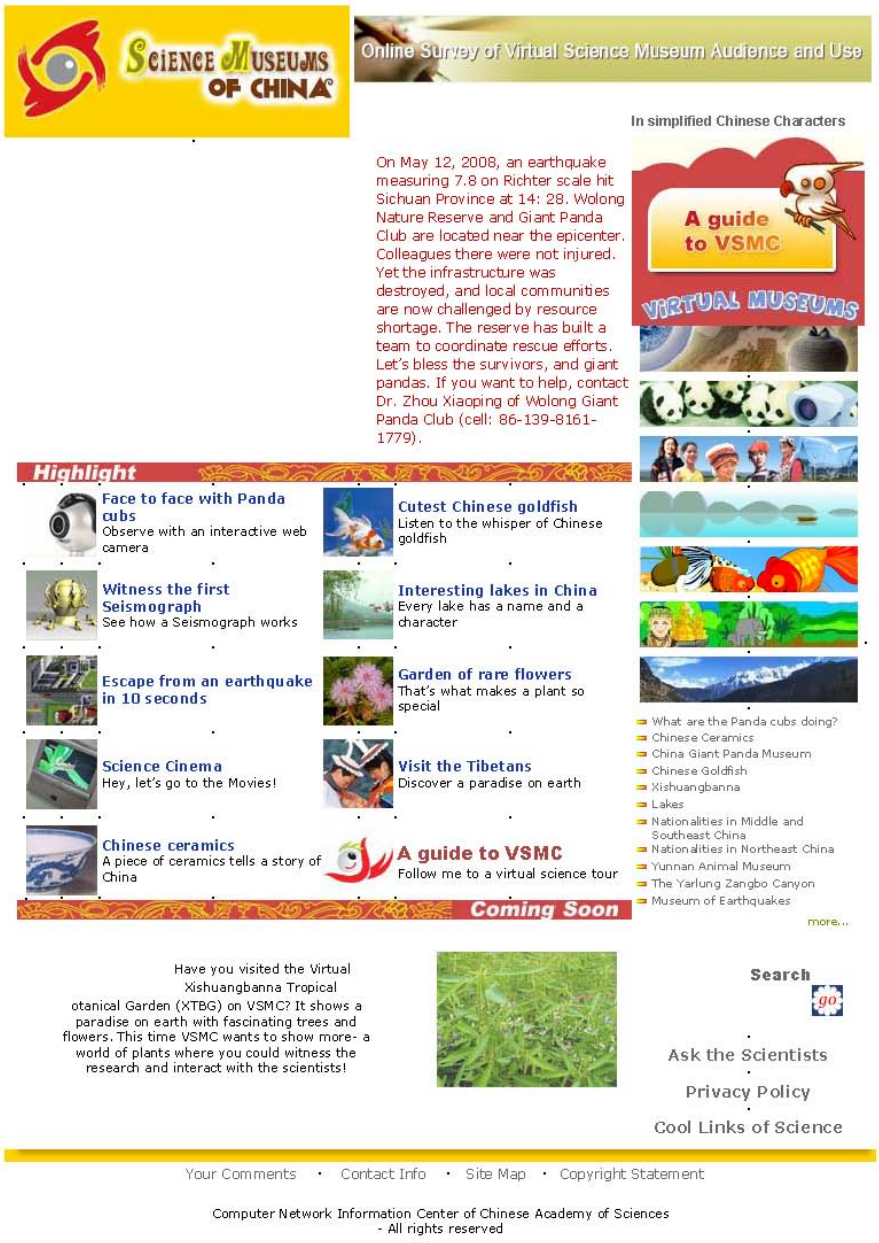

Figure 6: English VSMC Interface. (CNIC, 2008b).

The Giant Panda Exhibit

As the 2000 year came to an end, Yang Shiqing, senior engineer and content developer of the VSMC, brainstormed the idea of creating a giant panda exhibit for China. After contacting the Research Center for the Giant Panda and Wildlife Conservation at Peking University, Shiqing and his design team were disappointed to find that most of the researchers at this center spent a great deal of time in the field. In a personal letter from the editor, Yu (2004) stated the Center "could not provide the material in a short time". In order to facilitate the new panda exhibit, the team contacted the facilities at both the Chengdu Base of Giant Panda Breeding and the China Conservation and Research Center for the Giant Panda in the famous Wolong Nature Reserve.

The Chengdu Research Base of Giant Panda Breeding is located in the northern suburb of the ancient city Chengdu, in the province of Sichuan. In the early part of 2001, the CNIC team began to work with scientists from the Chengdu Giant Panda Museum, a physical museum, which was established in 1992. At the start of the VSMC Panda Exhibition, the Chengdu Giant Panda Museum was the only museum in the world to focus exclusively on pandas. Chengdu released an online version of the Giant Panda Museum, which contained over 10,000 words and more than 80 photographs called the *Panda Adventure,* (http://www.panda.org.cn/).

Located in the mountains of the Sichuan Province in southwest China, a separate physical Giant Panda Museum in Wolong opened to the public in May of 2002 (Wolong Nature Reserve, 2005) The Wolong Research Center developed an online Panda museum based upon the research and conservation taking place within the reserve titled *The Wolong Panda Club* (http://www.pandaclub.net/index.jsp). Wolong is the largest Panda reserve in China. The China Conservation and Research Center in Wolong is home to more than 80 Giant Pandas and an additional museum housing a collection of over 420 specimens, with more than 200 related to the Giant Panda.

The team at the VSMC integrated information from both the Chengdu Giant Panda Museum and the Wolong Research Center to create a site for the public popularization of science to the public. Grounded in the research of over 100 scientists, The VSMC Giant Panda Museum (see Figure 7) was created to be seen around the world at www.kepu.net.cn/gb/lives/giantpanda/index.html (CNIC, 2004).

Figure 7: Giant Panda Museum Interface, Chinese Version. (CNIC, 2004d).

Survey I

As the VSMC's new Giant Panda Museum gained exposure, the CNIC wanted to collect feedback through usability testing to identify the "knowledge, attitude, and interest levels" of the potential consumers, as Bitgood and Loomis (1993) identified as key components in front-end museum evaluations. The first survey sought the general knowledge level of the visitors, focusing on the frequency of visits to the VSMC, the reason for the exhibit visits, and the types of exhibits that the museum guests were interested in.

In a PowerPoint sent to the researcher, the VSMC demonstrated the relationship between science, the design team at CNIC, and the general public (see Figure 8).

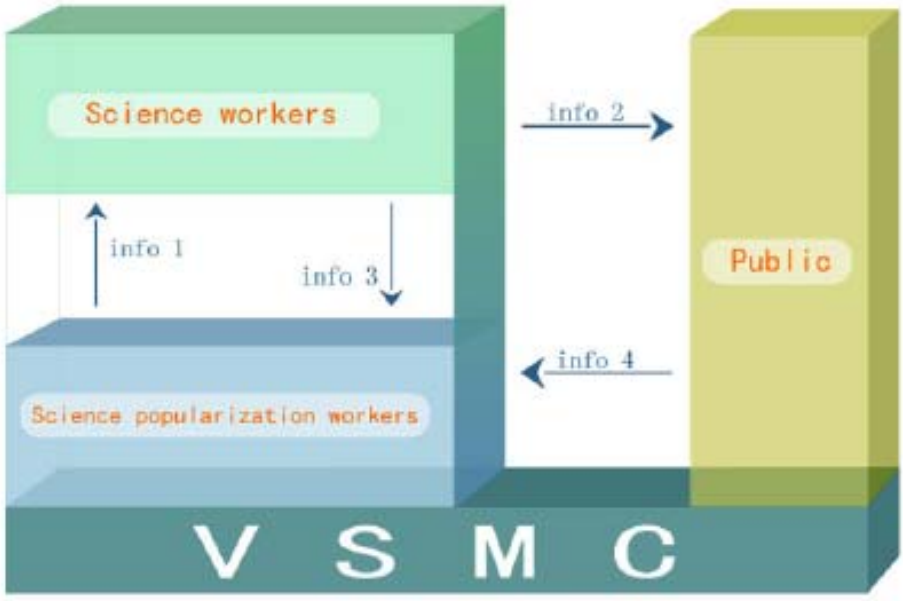

Figure. 8: How It Works on the Internet, Slide 6. (CNIC, 2006b).

According to Yun, Wen, Yu, &, and Chuanru (2005), **"**a one-way pattern for science communication is insufficient. In order to provide better service for the public,

practitioners of science communication need to continuously improve information by receiving and analyzing feedback information from the public" (p. 2).

The first base-line evaluation from the public of the Virtual Science Museum of China was made up of an initial set of Chinese university students (n=78). To market the new exhibit, the CNIC advertised for subject recruitment and collected data during July of 2004. Notices of the summer events were posted through flyers and on the website (see Figure 9).

Figure. 9: CNIC Summer Recruitment. (CNIC, 2004e).

Showcasing the Museum

The students were first shown excerpts of the existing VSMC Website through a short educational demonstration provided by the editors at the CNIC. The training session

held at the CNIC, which focused on the VSMC exhibits, was provided to excite awareness and interest on the features of the virtual museum site.

Visitor Feedback: Usability, Effectiveness, and Culture

Miles and Clarke (1993) note that front-end evaluations must incorporate questions that identify how well the exhibition that is created will work for the targeted audience (p. 700). When creating a new museum, the first task in always to define who the audience is and what experience is desired (Gano, Kinzler, Koning, Philippo, &, Tarr, 2004).

The initial university survey data collected by the CNIC from the seventy-eight students consisted of eleven questions in the native Chinese language. In order to provide effective communication between China and the American researcher, the survey has been translated into English. An English version of this survey does not exist.

In order to identify the target audience for the new VSMC Giant Panda Exhibition, the CNIC posed questions that included: *1. Are you familiar with the website? 2. How often do you visit the site? 3. When was the first time you visited the Website?*

In response to the question on familiarity, 65% of the university students surveyed in the initial focus group indicated that they had previous knowledge of the VSMC website (question 1). The initial assessment found that 73% of the Chinese university students reported visiting the VSMC site infrequently (question 2). Additionally, 52% of the students reported on the survey that their first visit to the site took place within the previous year (question 3).

Educational Effectiveness: The preliminary survey focused more on popularizing science and technology to the public than it did on the initial museum content. The next

set of questions asked were: 4. *How do you know the Website? 5. How do you learn about science? 6. Has the content of the popular science, which you have read, helped you in school? 7. When do you visit the Website? 8. What activity do you prefer* (when viewing Websites?) *9. What activity will "develop the person who leads to build the whole nation of teenager's science and technology base?"*

One-third of the students mentioned finding the Website on their own through a search engine (question 4). The vast majority, 93% of the students stated on the survey that they spent little time reading information about science and preferred spending time watching television (55%) or surfing the Internet (45%) (question 5). Only seventeen (22%) out of the seventy-eight students noted that they visited physical museum displays to learn about science.

The survey data indicated that two-thirds of all students surveyed responded favorably when asked whether the China Popular Science Website helped increase learning in school (question 6) but only 12% of the seventy-eight students knew of the website through classroom teachers. None of the students who reported to have read the scientific information on the site said that the information they found had a negative effect upon learning (Question 6). However, 22% of the students were unsure whether there was a direct correlation between reading scientific information on the site and learning. Seventy-nine percent of students revealed participating in online activities in the evening or on weekends (question 7). Students reported on question 8 that they least enjoyed online forums and academic forums, showing a preference for an "invented community" or sites on inventions.

Of the students surveyed, 41% preferred having more summer camps in order to continue the spread of popular science throughout China while an overwhelming number of students (n=51) wanted hands-on science and technology training (question 9). Perhaps, the CNIC could make the case that by providing richer scientific content within the virtual museum site more students would become interested in scientific exhibits.

Usability: Vice-Minister of Information Industry, Zhang Chunjian, revealed to the *People's Daily* (2001) that China had 22.5 million Internet users by the end of 2000, roughly one out of every 60 Chinese citizens. Zhang asserted that bandwidth limitations were responsible for the low numbers of Internet users, which was keeping China's Internet from developing fast enough and leaving the majority of people ignorant in the information age. As VSMC exhibits were developed with textual, graphical, and video media information online, the museum designers at CNIC realized the issues associated with limited bandwidth for the users. "With the universal application of media technologies in the succeeding construction of virtual museums and the planned application development of virtual public observator(ies), remote cameras, virtual field trips, computer simulations and 3D visualization… and successive on-line services, it has put forward (a) higher requirement to the width of network band, the stability of data transmission and the safety verification system" (GLORIAD, 2004). Incorporated into the survey, question ten was translated into English for the researcher as follows: *10: How many bandwidths of your family network is having half person to count the use broadband, are you convenient when visiting our Website?* Before translation into English, the original survey question asked

students in the Chinese language *"Do you have enough bandwidth at home to view the website?"*

Out of the 78 students surveyed, 70% of the students noted they had found the bandwidth to be convenient within their family network while 22% found it to be not convenient. Six students (8%) did not answer the question. Given the fact that some students did not respond suggests that they either did not know the answer to the question or that the wording of the question may have been confusing.

Further research could be done to find out if there is a correlation between Internet connectivity speeds and scientific interest levels among students.

Culture/Language: In the initial survey to the university students, there were no questions regarding culture or language issues due to the survey being in their native Chinese language.

Language discrepancies did exist in the translation of the original survey questions for the researcher. To illustrate the language inconsistency after translation from Chinese into English, the answer choices to question four *How do you know our Web Site?* read as follows:

> *"A teacher recommends? A head of family is recommended? Self is searched for and finds? Other irrigation ditch?*

When interpreted in the English translation, almost one-third of the students surveyed chose irrigation ditches as their method of finding the Virtual Museum Website. However, when in the native Chinese language, the language reads as "other pathway or channel", which means something entirely different from a ditch used for irrigation. In the

survey, the irrigation ditch referred to another source other than a search engine, teacher, or family recommendation. According to Wong and Shen (1999), there is an "unconquerable difficulty" in translation between English and Chinese languages (p. 80). In order to promote the transfer of ideas across barriers of language and culture as the new English edition of the VSMC was developing, it was important that the CNIC research team recognized if the terminology was not translated correctly to match its foreign language counterpart, it would be difficult for the end user to comprehend. The final question (11) regarding the broadcast to the students was unclear after translation. For this reason, this question has been left out of the data analysis.

A New Method

After collecting the data from the university students, the researchers at CNIC realized that the survey they had initially used did not collect the type of feedback that the research team was looking for. The initial survey asked questions about the reason participants visited the site and at what time online museum users viewed the site, which served as fundamental information on visitor demographics. However, the questions did not focus sufficiently on the design and content of the Giant Panda Exhibit or usability issues that arose as participants assessed the museum. The initial survey also did not give a clear picture of the possible educational contributions of the site.

The exhibit team decided that further documentation was needed and scheduled two additional summer camps to collect a greater amount of information. Furthermore, new surveys were created from the base-line survey data, which established the student

visitors' perceptions of the VSMC as a whole and assisted the designers in the further development of the exhibit.

CHAPTER V

A SPECIAL INVITATION

Chinese Summer Camp I

In July of 2004, approximately one-hundred beaming ten year olds from the famous Zhong Guan Cun School in Beijing, China, were invited to attend a special morning presentation of the Virtual Science Museum of China. The goal of the program was to listen to the children, watch their faces and gestures, and attempt to ascertain their overall understanding of the website. The children, clad in a spectrum of the traditional red, white, and green ceremonial colors, stood at rigid attention awaiting the announcement that the summer camp had officially opened. Sanctioned and promoted by the official party of China, the children, red scarves tied around their necks, signified their allegiance to the government (see Figure 10). Chanting in mechanized fashion, the students recited the official Internet ethics creed.

Figure 10: Chinese Summer Camp I. (CNIC, 2004f).

The Vice-president of China discussed the importance of future initiatives in science education. Each student was presented a CD-Rom on the use of the Internet labeled “COM”. One of the CNIC researchers, making reference to the political demonstration taking place, remarked “This is the Chinese way of doing things.”

After a ten-minute break, the students were instructed to move into the Scientific Database Center Complex. Once dismissed from the central arena, the once proper students melted into a pool of boundless energy as they headed into the building, which was to house the special science presentation.

Chen Yu, Editor of the VSMC Website, stood in front of the regime of children and told them of the new exhibit. Armed with a desktop computer, speakers, a projector, and a wireless microphone, Yu initiated a tour of the Website for the students in a lecture format. As time went by, some of the students, seated at long tables in groups of four to five, began to prop their faces up with their hands, seemingly tired. However, as soon as the photographs of the baby pandas (see Figure 11) were passed around the room, the once traditional teaching style of “show and tell” began to come alive.

Figure 11: Baby Panda. (CNIC, 1999a).

After the lecture, students volunteered and were selected by Yu to peruse the new exhibit at the desktop station (see Figure 12). The students giggled as they moved through the Website taking turns navigating the mouse as the other students watched from their seats. At the conclusion of the program, Chen Yu and other representatives from CNIC distributed a survey to all of the students.

Figure 12: Students Viewing the VSMC. (CNIC, 1999b).

Student Survey

The survey questionnaire was designed to collect data that would identify the strengths and weaknesses of the museum in terms of museum design, content, and

usability. This survey included a total of twenty questions. The survey (Appendix 1), written by the CNIC in the native Mandarin Chinese language, began with:

> Dear Little Friend from Haidian District. Welcome to our website! VSMC will become a five year old child in this October. Through this survey, we want to hear your comments and suggestions about this website, so we would be able to provide better service for you and your friends. We do care for you and every other. We would be appreciated if you could fill in the personal information part at last. Every participant will get a small gift from VSMC.

The surveys took 15 to 20 minutes to complete. As an incentive for completing the survey, the students received a token of appreciation--- a small plastic character drinking cup which resembled a lamb that had the VSMC Website logo stamped across the front.

To stimulate additional interest from Website visitors, the summer camp was recorded on video and posted on the VSMC site (http://www.kepu.net.cn/gb/notice/xly04/xly04_movie/index.html).

At the end of the VSMC demonstration, team members from the CNIC gathered together to discuss the findings in the data. Of the one-hundred students who participated in the summer camp program, data from eighty-eight surveys were collected and shared with the researcher.

The first seventeen questions were written in a multiple-choice format, while questions eighteen-twenty were open-ended to elicit additional information on scientific topics that the students enjoy, with the hope of incorporating these topics of interest into the Website. Students were allowed to choose more than one answer to each question, which led to problems with the interpretation of the data. The number of students who did not answer specific questions was not reported to the researcher.

Demographics of the Students

The first task of the Website designers was to learn more about the identity of the students viewing the exhibit. This was accomplished through a personal information section placed at the bottom of the survey with the following variables: (a) name, (b) sex, (c) age, (d) school, (e) email, and (f) address. This information was not disclosed to the researcher.

Prior Knowledge of the VSMC

The first portion of the survey, questions one through six, was devoted to obtaining information on what the students knew regarding the VSMC and incorporated the frequency, length of visits to the museum, and the time of day the student visited the Website.

Question 1 asked students if they knew of the VSMC (www.kepu.net). Fifty-one percent (n=45) of the students had prior knowledge of the Virtual Science Museum of China. Students who answered no (n=43) were asked to "jump to question 11." Of the forty-five participants who stated on question one that they were familiar with the museum, 53% indicated they knew the VSMC through Website links (Table 1).

Thirty-one percent of the student respondents indicated that they received their initial knowledge of the VSMC through a teacher. Many students reported making their initial visit to the museum within the last year (69%). Sixty-nine percent of students also specified that visits to the museum took place now and then and visits lasted less than an hour. Forty (89%) of students reported visiting the exhibits on weekends rather than during weekdays (11%).

Table 1

Prior knowledge of the VSMC

Question	Frequency and Percentage				
1. Do you know of the VSMC?	**Yes** **n=45, 51%**	**No** **n=43, 49%**			
2. Knowledge of the VSMC comes from?	**Television** **n=4, 8%**	**Newspaper** **n=3, 6%**	**Website** **n=24, 53%**	**Teacher** **n=14, 31%**	**Other** **n=2, 2%**
3. How long ago was the first visit made to the VSMC?	**One year ago** **n=31, 69%**	**Two years ago** **n=11, 24%**	**Three years ago** **n=1, 2%**	**Four y.a.** **n=2, 4%**	
4. How often do you visit the VSMC?	**Every day** **n=2, 4%**	**Every 2-4 days** **n=7, 16%**	**More than a week** **n=5, 11%**	**Sometimes** **n=31, 69%**	
5. On average, how long do you visit the VSMC?	**Less than an hour** **n=31, 69%**	**2-3 hours** **n=14, 31%**	**More than 4 hours** **(0%)**		
6. When do you visit the VSMC?	**Weekends** **n=40, 89%**	**Evening** **n=2, 4%**	**Afternoon** **(0%)**	**Other ___** **n=3, 7%**	

Furthermore, almost all (n=77) of the eighty-eight participants indicated on question eleven that they used the Internet at home. The students also recorded school (n=12) or other locations (n=5) as places of Internet use. None of the students marked

visiting Internet bars. This is due to laws in China that state Internet bars are not to admit anyone under the age of 18 (China Daily, 2007).

Museum Content

When students were asked to indicate on question seven whether the VSMC would be helpful to study, only one student answered no whereas thirty-three (38%) answered yes. Eleven (24%) of the students were unsure as to whether the VSMC would be beneficial to their study.

Several questions (9, 10, 12-14) allowed students to choose multiple answer choices. Sixty-nine percent of students noted on question eight that the virtual museums are among their favorite components of the VSMC, with the *Mystery of Life (32%)* and the *World Beyond the Earth* (25%) *Exhibitions* marked as favorites. *The Light of Science and Technology* (19%), *Sparkle of Chinese Culture* (5%), and the *Theory of the Universe* (3%) were identified among favorites. Six responses did not have a corresponding answer choice on the survey.

Out of 105 answers recorded on question twelve, thirty-nine students (37%) reported that scientific understanding could be gained from visits to museums and exhibitions as compared to the newspaper (9%) or television (24%). Thirty-two respondents (31%) marked the Internet as a way to understand science.

In an attempt to gauge student preferences towards particular museum content, question 13 asked "*What would be your most interested part* (of) *an on-line museum*?" Participants were asked to choose from nine topics for future exhibitions and were allowed to mark multiple choices. As Figure 13 reveals, out of the 155 responses marked,

overwhelmingly, animals (32%) were chosen as the topic of choice with plants (18%) coming in second. The environment came in next to last with only eight participants (5%) showing an interest.

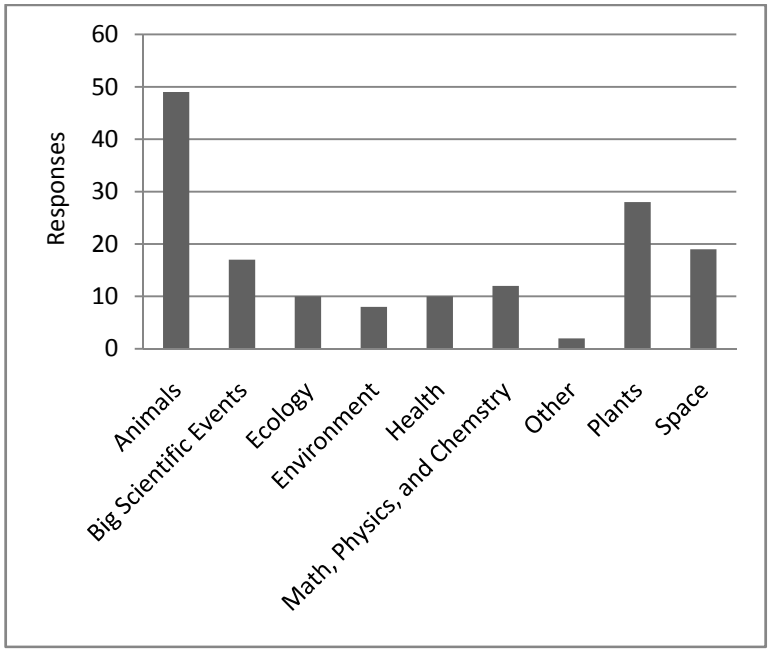

Figure 13: Museum Topics Which Most Interested Visitors.

Out of 135 responses marked on question fourteen, games (29%), motion pictures (40%), and photographs (15%) were listed as favorite ways to learn over stories (10%) and words (5%). One student marked other.

In terms of future recommendations, question ten asked what the future of the VSMC should look like and allowed for multiple answers. Out of the fifty-three responses given, students noted that future museums within the VSMC need to design more games (38%), be more interesting (26%), and incorporate more beautiful designs

(21%). Only five responses (9%) stated the museum needed to be more specific. There were three responses (6%) of other.

Revisions

At this point in the study, the only revision that took place was that the paper and pencil survey was modified and replaced within an online version at http://www.kepu.net.cn/gb/index.html. The new survey contained fourteen multiple-choice questions with five answer choices, two multiple-choice questions with ten answer choices, and no open-response questions. The following modifications to the summer camp I survey were made order to meet the needs of an online audience:

Demographics: The personal information section at the bottom of the summer camp I survey was not included in the revised survey.

Usability: (Questions 1-6): Rather than asking students if they had prior knowledge of the VSMC, the designers provided the website link for viewing and asked the students if the overall Website was easy to use (1). Moving away from generic survey questions to more specific ones, question two (2) asked students specifically if the photographs on the VSMC were clear and easy to use. The original survey questions (3, 4) asking students when and how often they visited the VSMC were edited to find out if the site map was easy and if it encouraged learning. Questions five (5) and six (6) were written specifically to discover if students had difficulties with the exhibit links or the information on the site.

Technology: (Questions 7-10): Question seven (7) asked students how often they use the Internet within the classroom. Question eight (8) was changed to ask what students enjoyed about the Internet rather than what was their favorite part of the VSMC. Question

nine (9) was the same as question eleven on the original survey: *Where do you go to use the Internet?* The original question on real-time broadcasting (question 16) was removed from the survey. Question ten (10) was not included on the original survey and was added to the new survey in order to understand the technology the students used in the classroom to study science.

Design and Content: (Questions 11-12, 15, and 16): On the updated survey, the questions that were specifically related to scientific content inquired as to whether students perceived science as useful (11), what occurred in science classrooms (12), and what scientific knowledge was most important (15). On the original survey, three questions were open-ended to discover the familiarity of scientific websites (question 18), topics (question 19), and scientists (question 20) the students were familiar with. Question sixteen on the updated survey asked for student recommendations for improvement of the VSMC.

Culture: (Questions 13-14): Two questions were added to the new survey to find out if students in China would be interested in learning about students in other cultures.

Summer Camp II: Beijing Middle School Students

On August 12, 2004, the CNIC held a second educational summer camp : an interactive panda virtual field trip. Forty-six students, ages 6-11, living in the community of Beijing's Zhongguancun Software Park were invited to attend. The students attended one of three prestigious schools: the Zhongguancun No. 1 Elementary School, the Zhongguancun No.2 Elementary School, or the Zhongguancun Middle School.

Results from Summer Camp II

The second summer camp was modeled after the July 8th camp and was once again housed at the new Scientific Database Center Complex. Data from forty-three surveys were collected from the summer camp. In email correspondence dated September 8, 2004, Zhyix reported to the researcher, "We have done a survey on 12th of August. It is like the survey on 8th of July. We have opened up an on-line survey at: http://www.kepu.net.cn/gb/index.html. I will give you the result (addressing the researcher)".

Design and Content: (questions 4, 8, 11-12, 15, and 20): Based on the surveys, all but two of the respondents believed the museum encouraged them to want to learn more. Over half of the student participants (65%) felt science was useful to them and the museum encouraged them to ask more questions (n=26). Students reported 53% percent of the time books were used to learn about science. However, visits from scientists (19%), trips to museums and zoos (33%), and the Internet (33%), and laboratory experiments (28%) were also used in their science classrooms.

Question fifteen was open-ended and asked students to list the specific scientific knowledge the students cared about. The numbers of responses were not reported to the researcher. However, a list of interests on the following topics was provided:

- *Many things*
- *Animal Survival*
- *Electricity/Industry*
- *Pandas and Zoos*
- *Animals and the Universe*
- *Animals and Astronomy*
- *Animals*
- *Mysteries of Nature (Aliens)*
- *Astronomy/Biology*
- *DNA*

When students were asked (question 20) what improvements needed to be made to the VSMC-Panda Exhibit, the following comments and suggestions were made:

- *"very good"*
- *The animation should fit, add background music… different music for different "thesis".*
- *Turn .wav. or .avi video files into rm or ram so users can see the download rates.*
- *Hold many presentations about the VSMC for the public*
- *Hope more people know of the Website.*

- *Some military knowledge should be added to the site.*
- *The space is limited and the speed is slow*
- *Through advertisement more and people will know the web.*

It is unclear as to whether there were additional responses listed but not reported to the researcher, or if the students did not provide additional information since the questions were located near the end of the survey, making the answers both hard to analyze and quantify.

Usability (questions 1-5): Usability was measured by asking students to indicate the ease of use. Using a multiple-choice format, with A=Very easy or definitely, B=Somewhat Easy, C= Somewhat Difficult, and D= Very Difficult, students reported overall that there were no significant problems with museum site use or navigation (Table 2).

Table 2: Virtual Museum Usability

Question	Definitely (very easy)	Somewhat (easy)	Not Sure/ (somewhat difficult)	Difficult (or not interested)	Did not Answer
1. Did you find the site easy to use	n=18 (42%)	n=21 (49%)	0% (n=0)	0% (n=0)	n=4 (9%)
2. Were the photos clear?	n=24 (56%)	n=15 (35%)	0%	0%	n=4 (9%)
3. Was the site map easy to navigate?	n=26 (60%)	n=14 (33%)	0%	0%	n=3 (7%)
4. Did the site encourage you to want to learn?	n=23 (54%)	n=14 (33%)	n=2 (5%)	0%	n=4 (9%)

The participants identified very few flaws in the effectiveness of the site pathways. The biggest obstacle noted by the students were issues with a small number of the links not working properly. According to Flowers (2005), the students should make connections between observed usability problems and the design features of the interface, noting what was found to be unintuitive or troublesome and why. A good usability assessment test report would identify many usability problems (p.18). Even though it seemed that the designers at the CNIC attempted to evaluate problems using the site through the survey data, few problems were actually reported.

Technology: (Questions 7, 9-10): The technology section measured educational effectiveness by asking students to indicate *(a) how frequently the Internet was used in the classroom, (b) what technology was used most in their classes, (c) where students go to use the Internet, and (d) what sites they visit most frequently*. Twenty-one students (49%) reported that they used the Internet in the classroom, but the greatest percentage of use took place at home (74%). Data did show that the Internet was the technology of choice most used in classrooms (49%) over overhead projectors (33%) and video tapes (28%). Four students (9%) reported using laser discs.

Culture: (Questions 13-14): Culture was measured by two questions that were written to assess (a) interest levels in other cultures and (b) student feelings on the best ways to learn about other cultures. Sixty-five percent of the students (n=28) surveyed reported that they would definitely be interested in learning about students in other cultures, and that the best way to do this would be through using the Internet (42%) or chatting (4%).

Museum Changes

As a result of the two summer institutes in 2004, using data gathered from observations and the surveys, a major reconstruction of the VSMC website was proposed. This proposal led to an updated and redesigned site, which eventually included two new exhibits. An exhibit on DNA (Figure 14), and a second major addition released to the public in 2005, entitled the *World Year of Physics 2005 (*Figure 15), incorporated the students' content recommendation of electricity.

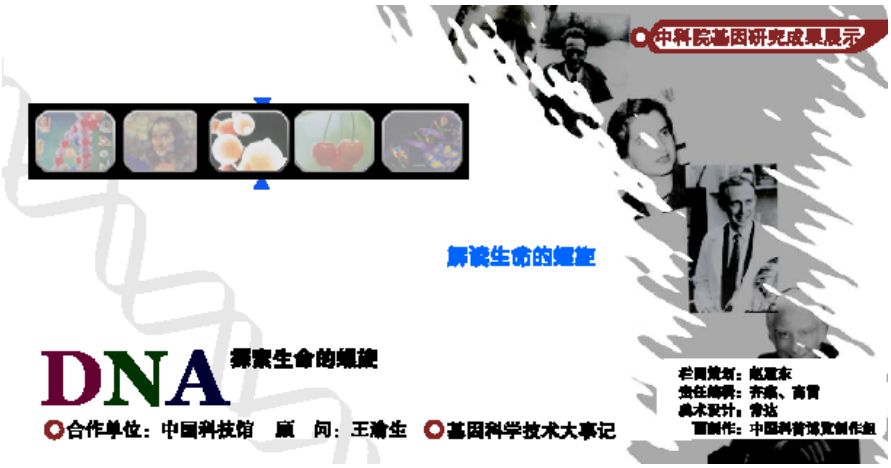

Figure 14: DNA. (CNIC, 2004h).

Figure 15: The World of Physics. (CNIC, 2005i).

The most far-reaching change was a shift in the focus of the CNIC from only a Chinese version of the Giant Panda Exhibit to an English version of the Giant Panda Museum. Chen Yu (personal communication, March 11, 2005) shared with the researcher her vision for the new exhibit: “I think the common wish is that our kids would love the panda, love different peoples, and love the world… it would be nice if the students could learn about panda as well as have some cultural experiences.” The new focus of the researchers at the CNIC was to design the VSMC’s Giant Panda Museum around five main points: 1) “continue” gathering data to improve previous museum versions, including the use of feedback from the VSMC questionnaires; 2) establish an online platform for the

public to talk to scientists; 3) continued organization of activities for the public audience and the scientific culture to communicate to one another, including the broadcasting of such events; 4) provide a wealth of multi-media, including videos with scientists and streaming content; and 5) provide a means to watch animals in “real-time” via the Internet through the construction of virtual panda cameras (CNIC, 2005).

Realizing the students in China were interested in learning about animals, other cultures and wanting to promote global scientific literacy, the design team at the CNIC met to brainstorm the creation of an English version of the VSMC (chapter VI).

CHAPTER VI

MUSEUM TRANSFORMATION

The First American Iteration

The designers of the VSMC Giant Panda Exhibit understood that in order to foster cultural awareness and develop a virtual site that could be used within classrooms; the exhibit would need to have feedback from potential users. This chapter examines the data that was collected and used to create the first American iteration of the Giant Panda Exhibit.

Yun, Wen, Yu, and Chuanru (2005) communicated that in order to establish bridges between the science community and the public, the first step must be to facilitate and gather information. CNIC must "collaborate with U.S. education specialists on curriculum design, guiding Internet users in studying systematically based on the virtual museums and filling in the surveys; practitioners of science communication (need to) collect and analyze data and make suggestions on improving the virtual museums and curriculum" (p.4).

In order to begin the process of recreating the Giant Panda Exhibit into an English version, the design team at the CNIC created a prototype, which contained a preview of the content that would be available to the general public in the English language. Usability tests were conducted by contacting a small snowball sampling of educators from the United States. Six Texas teachers volunteered to give the CNIC feedback on the English VSMC website and make suggestions for the future panda exhibit.

An email from the team at CNIC to the American teachers posed a set of questions listed in no particular order:

As part of my research project, I am working on a virtual science museum project. I would love to get feedback from you. In addition, feel free to forward this site to others: http://international.tamu.edu/ipa/english/index.html. What I am interested in is the American perspective. What might a teacher's expectations be of a virtual science museum? Do you see differences in this site and others you have used? Better or worse? What suggestions could you make as far as the organization, translation into English, outline? Do you see it as kid friendly? The hopes are to install a camera with live feed from the Wolong jungle on panda bears by next week to incorporate into the coming soon panda bear site on the museum. Any suggestions would be greatly appreciated.

The questions were presented simply to allow educators to make suggestions for improvements (if needed) to the original VSMC English website. Through evaluating and reflecting on "what could be", the educators helped refine the original website further and provided a backbone of new information for the English version of the Giant Panda Exhibit.

Educator Suggestions: Because the teachers knew they were involved in a usability evaluation, they were cooperative and felt the site would provide valuable content in the classroom in areas of history or science.

Suggestions for modifications to the content included:

- Add maps to show locations of cities in China to make it easier for the American population to visualize where the bears live.
- Add information about the Chinese culture, including the importance of native plant and animal species.
- Change questionable wording to make it easier to understand.
- Use the Chinese videos (already on the Chinese VSMC) with English dubbing.

Several teachers raised concerns regarding the content featured within the Website. In one email, a high school teacher pointed out that the phrase “shit paddies” was used instead of bird droppings, making it highly likely to be censored in the United States’ public classroom. Another teacher expressed concern regarding the section on earthquakes. The VSMC used the term “people would be flattened to death,” which might need more of an explanation, especially for younger children.

Believing that there would be more appeal to American audiences to utilize the VSMC exhibits, the CNIC originally settled on an exhibit interface in shades of red, white, and blue. However, the overall consensus from the educators was that of establishing culture. An individual teacher remarked, “Do not sacrifice Chinese tradition for what might be seen as the popular culture of America.” “We want to see traditional Chinese customs”. “We want to see the traditional Chinese colors of red and green”.

Although interesting responses were provided to the CNIC, the data was limited in that the teachers were not able to search through the entire museum site. Perhaps the

feedback would have been more focused if the exhibits would have been narrowed to a particular topic.

An American Website Materializes

To design a version that would meet the needs of an American population and incorporate the feedback from the American educators, the following plan of action was embarked on by the CNIC (2004):

a. Check translation for current material from Chinese into English

b. Check new (panda) videos from Wolong (which incorporate) English sound

c. Material processing (added translation, dubbing, designing)

d. Design and make web pages that corresponded to the Chinese content (see Figures 16-17).

e. Release the English version

Figure 16: Chinese Version of the Giant Panda Exhibit. (CNIC, 2004j).

In order to create a replica of the Chinese Panda Exhibit for American audiences, the CNIC contracted with outside translator services. The museum text, tags, and images had to be translated, along with dubbing over Chinese video clips. The major modification to the original VSMC Panda Exhibit included creating a museum design that mirrored the Chinese version, rather than developing a new and different Americanized version.

Figure 17: English Version of the Giant Panda Exhibit. (CNIC, 2004d).

Unlike the red, white, and blue of the American flag, the Chinese site used traditional eastern colors of green, yellow, and red. Additional alterations to the website included adding mountain locations to the map of China on the Interface, which directed museum visitors to the distribution of the remaining panda bears. However, the exhibit designers did not add maps to show specific city locations as desired by the American educator.

To meet the criteria for more suitable content, language modifications were made to the Yunnan Animal Bird's Spirits Exhibit, one of the exhibits within the VSMC. The term "flattened to death" was changed to "pressed down," and a game was added to the earthquake museum so that young children could walk through a simulation on earthquake

protection at http://www.kepu.net.cn/english/quake/game/index.html. This allowed the VSMC to move beyond traditional online exhibits and provide more interactive opportunities.

Furthermore, a new museum was designed to show the world the rare and native plants in China in an exhibit *entitled The Virtual Xishuangbanna Tropical Botanical Garden (XTBG)*. This work was based upon specific international collaboration between the ITS, VMSC, and the XTBG. A time-lapse video ("plants in motion") was created for the VSMC. At the present time, the video is available on the English VSMC but is only available audibly in the native Chinese language http://www.kepu.net.cn/english/banna/movie/index.html.

The CNIC was not only concerned with user feedback on the design of the museum, but also in interest levels of students in regards to future curriculum models in both China and in other countries. "The VSMC wanted to organize face-to-face activities of science communication in schools and nearby communities… under the guidance of teachers, scientists and science communication practitioners, (where) people could observe behavior of the giant panda on their own" (Yun, et.al, 2005, p. 5).

In order to collect additional exhibit information, the designers thought about the needs of the future users and wanted to encourage the submission of feedback and suggestions in designing new modules for the virtual museums through a new online diary posted at http://www.kepu.net.cn/gb/lives/giantpanda/pandacam/diary/index.html (Yun, et.al, 2005) or through the online *Your Comments* section at http://www.kepu.net.cn/english/red/mus01.html.

The CNIC put forth initiatives to field test the new English VSMC version of the Giant Panda Exhibit. One such initiative was the creation of a museum visit worksheet containing a series of questions developed to guide students through the series of modules on the Website (see chapter VII).

And as the new exhibit started to take shape, the VSMC's goals were to allow American students to have a voice in the design process of the Giant Panda Exhibit. The purpose of the new curriculum and Website would be to provide a rich exposure to the richness and diversity of the Chinese culture and to promote an interest in science education.

CHAPTER VII

VIRTUAL EDUCATION

> *People all over the world share the love for giant pandas, but not everyone knows enough about them. A friend told me some foreign kids don't know what pandas eat. No matter (if) you are children or adult(s), we want to tell you something about the pandas and the scientists doing research with them. We want pandas to be understood (CNIC, 2004)*

In the Schools

This chapter includes details regarding the implementation of the new curriculum worksheet (Appendix B), in conjunction with the new English version of the Giant Panda Exhibit, the data collected, and recommendations for the design teams. The CNIC was interested in targeting middle school students in both China and America. In an email to the American research collaborator, Zhyix stated:

> The below draft is about how to evaluate VSMC and make it more appropriate to learners. The following are the research contents: The name of my research is ¡°the educational effect of VSMC¡±. The first part is the theory about net-based education evaluation. This part includes some effective theory about how to evaluate an educational web. The second part is to collect data. We want to collect the data from teachers, students, parents, scientists and other people such as experts in IT. We want to collect data through telephone, mail, talk, questionnaire online and questionnaire offline. The third part is to analysis (analyze) data. The last part

is conclusion: How to make VSMC more effective… how to cooperate with middle schools to know more about students? (personal communication, August 3, 2004)

Using the curriculum worksheet along with the modules found within the panda exhibit, the research and design teams at CNIC began to seek information from teachers and middle school students in a classroom setting.

The original version of the VSMC Giant Panda Exhibit contained thirteen educational modules (Figure 18). These modules were divided into sections to allow students to gather basic facts, while looking at the history, lifestyle, and evolution of the giant bear. Originally, these were constructed just for the Chinese site. However, as the new English edition took shape, these modules were translated and added to the English site at http://www.kepu.net.cn/english/giantpanda/index.html (see Table 3).

Figure 18: Content Areas of the Panda Exhibit-Chinese VSMC. (CNIC, 2004g).

Table 3

Content Modules within the Panda Exhibit

Panda Modules	Description
Historical and Modern Distribution of Giant Pandas	Fossil, historical, and modern distribution of pandas
Interesting Life of Giant Pandas	Food, mating, reproduction, diseases, and enemies
Evolution of the Giant Panda	Evolutionary history and fossil evidence
Man's Knowledge about Giant Panda	History and world interest of the Giant Panda
Breeding of Giant Pandas	Artificial reproduction and breeding
Save Our Lovely Giant Pandas	Conservation efforts to protect the panda
Policies and Legislations	Legislation and policies for panda protection
Wolong Nature Reserve	Twenty components of the panda environment
An Overview of Scientific Research on Giant Pandas	An introduction to the Scientific research
The Giant Panda Cinema	Colorful video footage of Giant Pandas
The Giant Panda Contest	Trivia questions set up in a fun format
The Giant Panda Club	A means for the public to donate funding
Kin Discrimination in Giant Pandas	Information on using body odors to recognize kin

The guiding worksheet was designed based upon the VSMC Giant Panda Exhibit, along with corresponding questionnaires to be used in classrooms. The worksheet consisted of 25 questions on the history of China and China's Giant Panda, and was written in both Chinese and English. The assignment was designed to limit the amount of time a student might spend searching aimlessly, and instead direct the student to each content area in the science museum. The worksheet would guide students through the virtual interface and incorporate aspects of constructivism, in that students would actively

participate in the building of new knowledge, reflect upon what they learned, and contribute feedback into the design of a new panda exhibit through a short survey.

The survey was titled *Student Survey on the Giant Panda Exhibit at the Virtual Science Museum of China* and was divided into three sections: VSM Exhibit (usability), Curriculum (design and content), and Technology and Science. The survey consisted of fifteen multiple choice questions, three Likert-scaled rating questions (with one being least and five being greatest), and two open-ended questions. A space was left at the end of each question for comments and explanations if the student wanted to provide additional information. The survey was modified slightly as it moved from the Chinese to the American students.

Results from China

In an email to the researcher, Yu (June 6, 2005) stated, "I have some data of the Panda-Student-Survey attached for you. One hundred curriculum users took the survey, most are middle school students and a few are casual Internet users."

All of the participants (n=100) completed the worksheet and survey, which provided the research team at the CNIC better information on using science exhibits in a virtual realm. Since the worksheet was primarily used as a tool to help students navigate through the Website and not used to collect data on the design of the exhibit, the answers to the module worksheet on panda bears was not supplied to the researcher. For unknown reasons, neither open-ended questions nor Likert-scaled responses were reported to the researcher thus limiting the comparisons between the China and US Middle School

Students. Questions related to culture found on earlier surveys were deleted from the Chinese middle school survey.

Usability: (Questions 1-5): The first set of five questions on the Chinese survey was designed to gather information that would be helpful in identifying any usability problems within the online museum interface. The students assessed the exhibit for quality of the photos, ease of navigation, ease of understanding the terminology, and for links that were broken. In addition, students stated whether using the site made them want to know more.

The results showed that more than half (86%) of the students indicated that the photos were clear (n=43) or somewhat clear (n=43). In addition, 84% of students reported that the panda exhibit was easy or somewhat easy to use (n=42) and understand (n=42). Out of one-hundred student completed surveys, only seven marked the navigation of the Website to be "somewhat difficult," and nine recorded "difficult". Based on their responses, the majority of students did not have navigational problems when exploring the site. In addition, students were asked whether they experienced problems with links not working. Fifty-two percent of the students reported that all of the links were working while only a few students reported broken links occurring once (23%) or a few times (13%). Only twelve (12%) students indicated that they had difficulty with all of the links.

Question three is of particular interest to this project, since it asked participants if the site would encourage them to want to learn more. The data showed that 89% of the students responded favorably when asked if the site encouraged them to learn more about pandas.

Curriculum (Questions 6-9): The responses to the multiple-choice content questions were intended to reveal the length of time it took to complete the worksheet, whether the assignment was completed individually or in a group, the ease of finding the worksheet answers, and student preferences to learning about pandas.

More than half of the students (66%) reported (question 6) that the worksheet assignment took less than one hour to complete. Almost three-quarters of the students (70%) worked independently using the Website and guiding worksheet, while a third (30%) completing the assignment worked with another student. Thirteen other students marked that they worked with the whole class (question 7). When asked how easy it was to find answers in the virtual exhibit (question 8), sixty-two of the students reported that the answers were easy (22%) or somewhat easy (40%) to locate. However, 38% of the students marked that the answers to the lesson were difficult to find in the exhibit.

To assess how the students would like to learn more about pandas, question nine asked students to rate the activity (Internet, textbook, video, and teacher explanation) that they would enjoy most. The responses to this question were not provided to the researcher.

Technology/Science (Questions 10-16): Internet use was measured by a series of five questions (questions 10, 12-15): *How often do you use the Internet--- in the classroom, at home, at school, in an internet café, or in a public library?* The five answer choices were "Daily," "One or more times a week," "One or more times per month," "Less than once a month," or "Never."

Only seventeen percent of the students reported having used the Internet in the classroom on a daily basis, while 35% percent of students reported weekly Internet use.

Twenty-four percent of all students reported monthly use in their classrooms while 21% reported using the Internet less than once per month.

To gather information on what students enjoyed the most about the Internet in order to make additions or deletions to the virtual exhibit, students were asked to rate, with 1 being least enjoyable to 5 being most enjoyable, their Internet preferences (question 11): games, email, news and information, or information about science. Students were also asked to rank each of the following technologies on question 16 that they saw most often in class: videos, overhead projectors, or laser discs. These answers were not provided to the researcher.

The first open-ended question asked was *what would you like to see in the future on the panda bear exhibit and what else would you like to know about panda bears?* The second open-ended question asked students *what recommendations would you make to improve the existing panda museum?* Both questions allowed students to provide feedback to the design team on what was meaningful. Again, the responses to both scaled and open ended questions were not provided to the researcher.

Survey Modifications for America

The CNIC modified the middle school survey in order to obtain additional information from students in the United States. A background section of demographic information was added to the survey, which included age, grade, and sex of the student participants. Of the eighteen questions included in the survey above, sixteen items were not changed including the five questions on usability. Question eight was inserted to assess the overall area of concern the students had with the exhibit. Questions twelve

through fifteen were merged into one question (question 13) to address Internet use. Two new questions (15-16) were added that were specifically related to science education. In addition, questions seventeen and eighteen were added to address the students' attitudes towards learning more about other cultures. Both open-ended questions from the survey above were left in the modified U.S. survey. The comment lines at the end of each question were changed to the question *why or why not,* (please) *explain* or, (provide) *other* (information), in order to require students to construct their own responses and provide the research team constructive feedback from the American students.

Crossing the Border

In a school, on another continent, a teacher and her classes are working through the Internet to learn more about panda bears from a culture that is over 7,073 miles away. The school that is home to that teacher, housed in a renovated old building, accommodates 382 fifth and sixth graders.

Upon entering the premises, students at the refurbished middle school step inside long hallways, filled with old metal lockers on both sides with science classes to the right and language arts classes to the left. A young science teacher, who taught both science and social studies, along with thirty-three of her students, participated in field testing the new curriculum unit on panda bears in the spring of 2005. The class had just completed a study on animals and the teacher was excited to participate in piloting a study for the CNIC. To follow up on the animal units, the teacher introduced to the students the Giant Panda Module, which was based upon the information contained in the virtual learning environment (VLE) of the Virtual Science Museum of China.

Students were instructed to work in pairs and then directed to answer the questions on the worksheet as they went through the content modules on the Website at their own pace; they were assigned wireless laptop computers, and sitting together they worked in a collaborative partnership with another peer. Students were encouraged to take the lesson seriously and answer the questions honestly, since the information would be sent to another country. Data from thirty-one (n=31) of the thirty-three surveys were returned to the researcher.

Perceptions from American Students

Usability (questions 1-5): The survey results showed that over half (61%) of the students in the United States classroom found the VSMC-Panda Exhibit easy or somewhat easy to view (n=19); however, students reported in the open-ended comment areas that the site was "complicated and too spread out," "not well organized," "the language was difficult to understand" ("words were too big"), and it was "hard to find the answers" (question 1).

Similar to the data from the Chinese students (Table 3), the majority of American students (n=29) reported the photos on the site to be definitely (55%) or somewhat clear (39%) and easy to use (question 2). One student stated in the open-response area that they were not sure if the photos were clear while another student stated she had difficulties due to the *"fuzziness"* of the photography.

When question three asked if the site map was easy to navigate (question 4 on the Chinese survey), twenty-one (68%) of the students reported definitely or somewhat. Six students stated that the site map did not apply to them while four of the students noted that

the site was difficult to use. According to the student survey, one comment written was, *"It* (the site map*) was in Chinese."*

Students responded with mixed reactions to the question on whether the site would encourage them to want to learn more (question 4). Almost half of the students (n=17) reported that they were definitely (36%) or somewhat (19%) encouraged by the exhibit (Table 4). Two sixth-graders noted, "I like this a lot better" than usual classes… "It's easier to learn when you actually do it on a computer." Another sixth-grader stated, "I found what I was looking for." A different student that marked she was definitely encouraged, commented, "I love pandas and it's interesting." However, twelve (39%) of the students were unsure of the site and two (7%) of the students stated the site was definitely not encouraging to them, stating the site was "boring."

Numerous (n= 24) students documented that they had difficulty with at least one of the links (question 5). "The cinema videos that had been incorporated just did not play" [6th grader]. Similar to the study done by Vergo et al. (2001), the students liked the idea of a streaming web experience that would lead them through artistic and cultural artifacts where, unlike television, the stream could be paused, replayed, or interrupted for further exploration.

Table 4

Summary of Usability from Middle School Students

Categories	Description	China (n=100)	%	US (n=31)	%
Ease of Site Use	very easy	52	52.00%	5	16.13%
	somewhat easy	32	32.00%	14	45.16%
	somewhat difficult	7	7.00%	11	35.48%
	very difficult	9	9.00%	1	3.23%
Photos	clear and easy	43	43.00%	17	54.84%
	somewhat clear	43	43.00%	12	38.71%
	clear but difficult to use	2	2.00%	1	3.23%
	not clear-difficult to use	12	12.00%	1	3.23%
Site Encouragement	definitely	37	37.00%	11	35.48%
	somewhat	52	52.00%	6	19.35%
	not sure	2	2.00%	12	38.71%
	definitely not	9	9.00%	2	6.45%
Broken Links	never	52	52.00%	5	16.13%
	once	23	23.00%	9	29.03%
	more than once	13	13.00%	7	22.58%
	none worked	12	12.00%	8	25.81%
Understanding Exhibit	very easy	42	42.00%	14	45.16%
	somewhat easy	42	42.00%	10	32.26%
	somewhat difficult	6	6.00%	6	19.35%
	very difficult	10	10.00%	1	3.23%

A 6th grader stated, “We need to view videos, which will rewind, pause, and fast-forward…show us entertainment.” “Make it more fun” another student wrote. When asked specifically which links did not work, two students noted “the panda cinema.”

*Curriculum (*questions 6-10): When asked if the new panda exhibit was easy to understand (question 6), fourteen of the U.S. students noted that it was easy (45%) while ten of the students listed it as being of average difficulty (32%). Six of the students stated that the exhibit was somewhat complicated. Only one U.S. student marked that the exhibit was very difficult to understand.

Although the exhibit seemed to be simple for the majority of students to understand, the curriculum component provided appeared challenging for U.S. students. The amount of time it took for U.S. students compared to the Chinese students varied greatly (question 7). While most Chinese students (66%) reported the panda module to take less than an hour to complete, 41% of U.S. students stated the lesson took more than a day to finish. Only eight students (25%) completed the module within an hour. Eight additional students (25%) chose “other” on the survey and remarked, “I didn’t finish” or (it took) “more than two days.” One student wrote in the response “completion in ten minutes,” but did not select less than thirty minutes on the survey.

When students were asked (question 8), “what was your biggest complaint about using the Internet to do the panda lesson?” ten of the students stated that they had no complaints, while eleven others stated that it just wasn’t interesting to them. Five students (16%) also reported the links did not work while 13% marked the wait time was too long.

Three students chose “other” and two commented, “It’s hard to search for things on it but fun to use,” and “one (complaint) was (that the museum was) in Chinese and I’m English!”

Students were asked (question 9) if “*the panda lesson was easy to find within the virtual exhibit*.” The survey showed mixed reactions from the students. Sixteen students indicated that the answers to the lesson questions were very easy (23%) or somewhat easy (29%),to find, while twenty-three percent of students (n=7) cited finding the lesson to be of average difficulty. Six of the students (19%) recorded that they had an extremely difficult time finding the answers to questions. One student chose “other” but gave no reason for the answer choice.

Difficulty was also found in the vocabulary of the museum. Being quite honest, one student noted, “I couldn’t find “nothing”… “The information is confusing.” In agreement, the teacher seemed to concur. She noted on a survey, “Some students had difficulty understanding terminology, such as the word distribution”… “The students need much more time to play with and experience the site.”

When asked how students would rather learn about pandas (question 10, Figure 19), an overwhelming number of students preferred watching videos (53%) to using the Internet (23%), textbook and worksheet (7%), listening to teacher explanation (10%), or another means (7%).

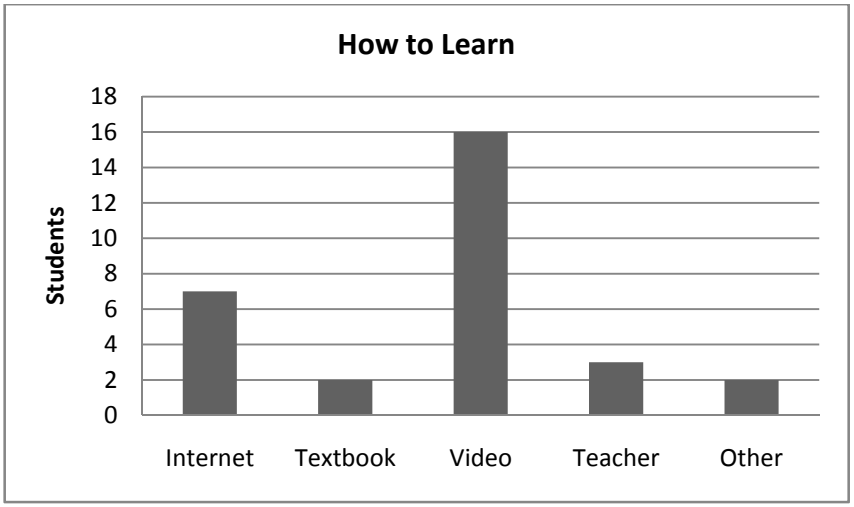

Figure 19: How to Learn More about Pandas

Technology (questions 11-16): There is a growing concern about closing science and technology gaps with better scientific education (Rowand, 2000; Wang, 2005*).* In order to close these gaps, the use of the Internet should be used much more frequently and in a greater variety of ways within our educational system. When asked (question 11) how often students used the Internet within the classroom, none (0%) of the U.S. students marked that they used the Web every day (Table 5). All but seven (n=24) of the students noted that the Internet was used just a few times per month in the classroom. "I believe that for the most part, the students had difficulty with this site due to their lack of Internet research experience," the teacher noted.

Table 5

Summary of Internet Use

Categories	China (n=100)	%	US (n=31)	%
Daily	17	17%	0	0%
Few Times Per Week	35	35%	2	6%
Few Times Per Month	24	24%	24	77%
Less than Once a Month	21	21%	0	0%
Not At All	-	-	4	13%

Note. Dashes indicate the answer was not provided.

When students were asked what they enjoyed most about the Internet (question 12), almost all of the students chose games (71%). A small percentage of students chose using email (16%), news and information (7%), or science (3%). One student chose "other" and listed "*all of them*" as his preference.

Question thirteen asked students to *list all of the places they go to use the Internet*. Most of their time spent on the Web took place at home or at school. Furthermore, none (0%) of the U.S. students reported using the Internet in a café.

Almost half (49%) of the students said they used an overhead transparency projector most in classes (question 14), followed by video tapes or DVDs (29%), and the Internet (16%). One student chose a laser disc player (3%). Perhaps, not understanding the question, another student listed textbooks as the technology instrument used in class.

Students conveyed their thoughts about science on question fifteen and sixteen. Students were instructed to circle all that applied. More than half (55%) of the students recorded that science is useful and 19% stated that science encouraged them to ask more questions (question 15). Rather dishearteningly, only nine (29%) of the students felt that science is just about memorizing a bunch of facts while three others (16%) noted that science is boring. Two students (6%) recorded that science is just too hard to understand.

Finally, the students were surveyed as to what specific activity took place in their science classroom in order to assess how students learned science (question 16). Students were asked to circle all answer choices that applied to them. Not surprisingly, 55% of all students recorded that science was learned mostly through books. At least 39% of students indicated that the Internet was frequently used to learn about science, although 77% of students had noted earlier (question 11) that the Internet was only used a few times per month. Visiting scientists rarely attended classrooms (13%), nor did students take trips to museums or zoos to learn more about science (6%). On an encouraging note, almost one-third (n=10) of the class stated that science was learned through laboratory experiments taking place within the classroom.

Culture: The CNIC posed two questions to the students regarding culture:

Question 17 = *Would you be interested in learning more about students in other cultures?*

Question 18 = *What would be the best way to learn about other cultures?*

The figure below breaks out the results for question seventeen that addressed student interest levels in other cultures (Figure 20). More than 80% of students showed an interest in learning about other cultures. Consistent with Falk and Dierking (2000), in the comment section of the question, students tended to show preference to a real experience over a virtual experience. A ten-year-old wrote, "I would like to learn about cultures with real people talking to us." One sixth-grader said, "I'm not sure how I feel about learning about students from other cultures… I think if we could chat or video-conference with one another, I would learn more."

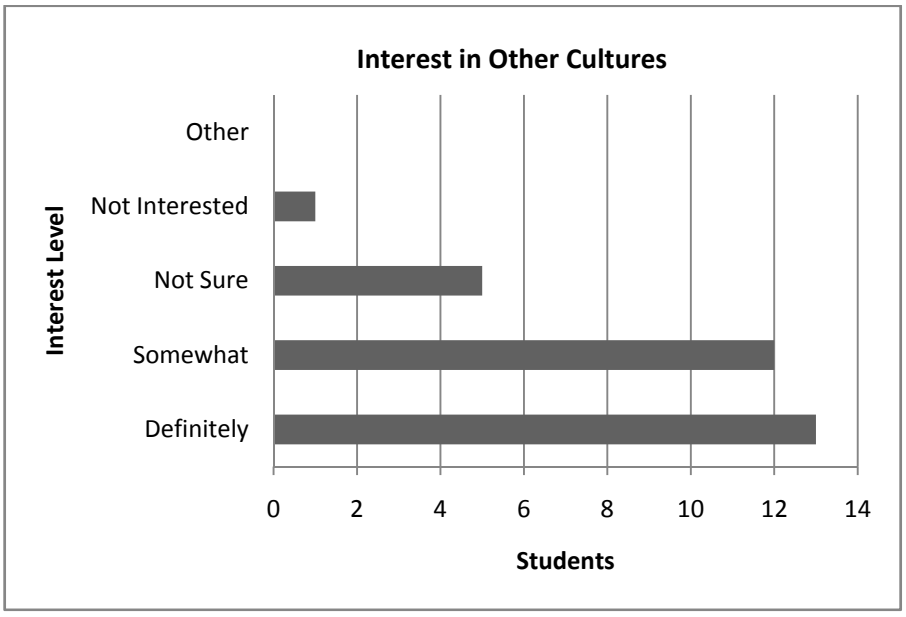

Figure 20: Student Interest in Other Cultures

Choosing from multiple answer choices, the students marked Internet use as the number one way to learn about students from other countries (55%), with books (19%), emailing (16%), and video-conferencing (19%) noted as additional ways to communicate (question 18). One student commented, "We need to go to China to see the pandas and learn about them rather than using the Internet, textbooks, video, or teacher explanation."

The first open-ended question (question 19) asked students a two-part question: "*What would you like to see in the future on the panda bear exhibit?"and* "W*hat else would you like to know about the panda bear?"* Table 6 indicates the student responses.

Table 6

Question 19: What Students Would Like to Know About Pandas

Seven Responses
Where they (pandas) live
What do panda's mostly eat
I want to see their skulls
How do pandas react to people
Pandas are a very rare species and we need to learn a lot about them… Can we see more
How do pandas climb
I want games to learn, not reading unorganized information

Finally, the last question on the survey (question 20) asked students if they had any recommendations to improve the existing panda museum. Overwhelmingly, the number one response from students in the U.S. was that the CNIC needed to develop additional games for the site. Other comments are included in the table below (Table 7).

Table 7

Student Recommendations

Nine Responses
Add more fun stuff
Show that there are more panda bears alive
Add more photos…I would like to know more about the red panda… Please show more photos
Make videos that pause, fast-forward, and rewind… and games
Add games; organize the info a lot better
Can you add more panda noises
I want to see more baby pandas
Show the food they eat
I don't know

Further Refinements

The feedback method of collecting data from both the American and Chinese students was consistent with that of a front-end evaluation (Bitgood and Loomis, 1993; Korn, 2003; Dierking and Pollock, 1998), which provided the CNIC with benchmarks and allowed more appropriate content to be developed and presented for the visitor. Limitations did exist in the data collected in that the Chinese open-ended responses were not reported to the researcher thus not allowing a comparison to be made between the students' similarities and differences.

The new museum alterations used the data collected in addition to the user feedback. Students in the study wanted a way to actually view the panda bears in "real-time", hear the panda noises, see more babies, and view living panda bears. Based upon the user feedback over the course of the study, cameras were set up on November 24, 2004 at a panda kindergarten in southwest China's Sichuan Province. The Panda exhibit feature, a remote web-camera, allowed visitors to view the Panda Kindergarten of the China Research and Conservation Center for the Giant Panda in the Wolong Nature Reserve (Figure 21).

Figure 21. Panda Web Cam [Photograph]. (CNIC, 2006c).

The first Chinese edition of the Panda cam Channel was not officially released to the public until March 2005 (Yu, personal communication, April 9, 2005). The incorporated channel offered an opportunity for the public to remotely watch baby pandas by applying for a password at the VSMC Website--the password allowed for the viewing of six panda cubs in real-time, in which the public could control an interactive camera that panned, tilted, and zoomed. Streaming video recording software was built into the Interface, whereby observations of the panda bears can be made along with a diary where visitors can record their observations (http://www.kepu.net.cn/english/pandacam/diary/index.html). Responses from museum guests could be used to continually assess the exhibit site, contributing to the future revisions of the museum. A diagram of the panda cam is illustrated in Figure 22.

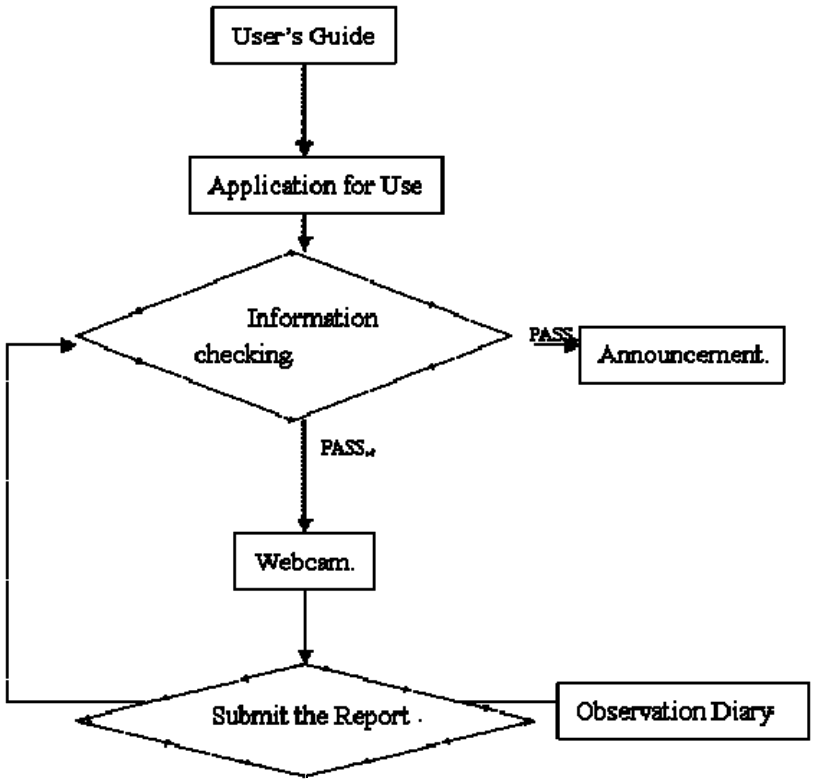

Figure 22: Diagram of the Web-Camera System. (CNIC, 2006d).

Difficulties did arise in that the viewing of the panda bears in real-time was only available and open to the public during limited hours. Stated on the Website is the following information: "First, panda cubs are good kids and sleep on time every day… and they say please visit us during 7 am to 8:30 am, 10 am to 12 am, 2:30 pm to 5 pm, Beijing time" (CNIC, 2007).

Although an English version of the panda-cam was added to the American version of the Giant Panda Exhibit, there were limitations in that students in the U.S. were unable to view the live feeds from within the classroom during normal school hours. To overcome these difficulties, researchers at the CNIC recorded and published, within the

exhibit site, clips of the live panda feeds (Figure 23), which would, as student participants requested, pause, rewind, and fast-forward.

Figure 23: Panda-Cam Interface. (CNIC, 2006e).

Incorporating student feedback, the VSMC designers also added more interesting modules that were easier to understand and met the needs of the user with information technology (including flash technology), additional streaming video clips, and games. These additions included:

Flash programming with in a Lake Museum Exhibit to explain how lakes are formed **(**http://www.kepu.net.cn/gb/civilization/chinaware/xuni/index.html)

Virtual reality within the Xishuangbanna Tropical Botanical Garden to introduce the Garden of Bamboos, Palms, and Trees (http://www.kepu.net.cn/gb/lives/banna/dummy/index.html).

Further games to provide playful learning, such as the Giant Panda Contest, Game against SARS, and Build a Space Shuttle (see Figure 24).

Streaming media technology was used for incorporating the cinemas found within the Virtual City of Ceramics, the Giant Panda Cinema, and the Garden of Xishuangbanna Cinema (p. 3)

Figure 24: Virtual Science Games. (CNIC, 2005).

With the lack of museum trips and visits from scientists being reported (question 16), future exhibit plans included adding email chats and videoconferencing discussions between students and scientists who work behind the scenes. In order to facilitate this, the CNIC posted the journals and diaries that detailed the expeditions of the scientists on the Website. Two such examples that have been added include the journals of the scientist on

the expedition to the Yarlung Zangbo Canyon, found at http://www.kepu.net.cn/gb/earth/canyon/diary/index.html, and the diaries of the scientists in the South Pole expedition, posted at http://www.kepu.net.cn/gb/earth/antarctica/diary/dia700.html.

The museum designers continued to work collecting data from the following activities: Panda-Cam testing in Wolong, Interviews with Panda Researchers, designing Materials for the VRML of the Panda Breeding Center in Wolong, and design of the Website of the Wolong Panda Club.

In addition, further curriculum studies were planned by the researchers at the CNIC. An additional test group was planned for the Jingyuan Middle School, in the city of Beijing. Jingyuan, considered an ordinary school, would involve six classes of twenty students between twelve and thirteen years of age. However, this time, the method of learning would be different from the previous two "in-school" applications. Students from Jingyuan would be able to complete their curriculum worksheets and surveys at home.

In conclusion, this chapter discussed the results of the feedback collected through survey analysis. As the survey examples have shown above, it is important to collect feedback from the end users in order for the researchers at the CNIC to develop a Website that would meet the needs of a variety of audiences.

In the final chapter, I provide my summary of the findings, practical implications, and suggestions for future research.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

Discussion

The purpose of this study was to examine the following questions: (1) What is the process of the development of a virtual science museum and (2) What role do public audiences play in the design and implementation of virtual science museums? In this chapter, I address the most significant findings of the study and discuss them within the framework of prior research studies. Furthermore, I will address the implications of the research and provide recommendations for future studies.

Summary of Main Findings

The interpretation of findings related to the survey data were guided by the research questions. When looking at the process of further developing the VSMC in regards to the Giant Panda Exhibit, the CNIC looked the data collected from six individual survey groups during 2004-2005. As the CNIC continued to conduct evaluations, exhibits were being conceptualized and developed based upon the ongoing collaboration of the museum team intertwined with the feedback from the visitors.

Finding One: A Shift in Thinking

The process of the development of a virtual science museum initialized from the PRC's Popularization of Science and Technology mandate. Given the prevalence of the legal mandates in China, the initial museum exhibits were designed from the perspective of those in power at the CNIC rather than from the visitor feedback. An organization like the

CNIC that is regulated by the government requires a high degree of consensus in order to meet the national goals set forth by legislation and show that a united front exists. When looking at the initial objectives of the researchers at the CNIC, questions surfaced as to whether the philosophy of learning stemmed from one individual at the CNIC rather than from a collaborative team effort. The Website developers were not educational specialists and relied heavily upon the director for most of the Website direction. The VSMC received approval and support from high rank institutions in order to carry out scientific propagation… paying attention to its own advantages (GLORIAD, 2004).

Museum developers, according to Hennes, need not find ways of creating a demand for the material; rather, they must find a way to capture the visitors' attention. Rather than being driven by the theory of constructivism, the designers' objectives were driven by the law. However, as the feedback from the public was received, the researchers at the CNIC began to shift their focus… moving from mere legislation to a better understanding of what the students wanted within the schools. In fact, other than providing survey feedback to the CNIC, as discussed in the preceding chapters, the public did little to influence individual changes within the museum exhibits. It was through the knowledge that was gained from the surveys that the researchers at the CNIC were able to make meaning out of the data. The initial objectives of the site transformed in response to this survey data. In order to design exhibits from the perspective of the visitors' experiences requires a reconsideration of the way "experience" is defined and the purposes of museums and other visitor attractions are evaluated. (Hennes, 2002, p. 115). As the designers desired to have a better understanding of the visitors' needs, the surveys began to change. The VSMC

began to evolve in order to fulfill the need for the exhibits to not only engage students but also to create a place where scientific inquiry could take place. The CNIC took the construction of the English version of the VSMC as an opportunity to attach importance to the cooperation with schools (GLORIAD, 2004).

Finding Two: Less Reading More Doing

Compiling the results of the surveys, the one prevalent theme that students most wanted to see added to the museum was online gaming. It is worth noting that there was not a lot of variance across the student surveys… students in all subgroups showed a preference to using technology to learn about science but were much less interested in clicking through the museum exhibit to read scientific information. Research completed by Wang (2005), Shaffer, Squire, Halverson, &, Gee, (2005) and Vergo, et al (2001) support this finding in that they found that U.S. students preferred spending time in non-academic-related activities such as viewing television, playing computer games, and spending time with friends. Thirty-eight percent of the Chinese students from the Zhong Guan Cun School (Survey II) listed gaming as one of the emerging technologies they would most like to see implemented within the museum site. U.S. students agreed. In the US survey group (Survey VI), students recorded that they wanted the CNIC to make more learning games. In fact, more than half of the US students (71%) used the Internet for online gaming although none of the students specifically listed gaming as a way they learned about science in their classroom. In addition to games, US and Chinese students reported wanting additional videos, photographs, and sound (Table 5). As suggested by Osberg et al. (1997), "All of the students wanted *more of everything*; more time, more

realism, more water, more mud, more animals and plants, more behaviors, more sound, more applications, more environments" (p. 37).

It is evident from this study that students from both countries showed a preference towards online museum exhibits that include interactive entertainment. According to Shaffer et al. (2005), the next challenge for game and school designers alike is to understand how to shape learning in terms of games, and how to integrate games and game-based learning environments into the predominant arena for learning (p. 16).

The survey suggestions led the research and design team at the CNIC to begin to incorporate additional interactive learning games (Chapter VI). In order to capture both video and sound components into the exhibit, the panda-cam was incorporated into the Website through a high-resolution camera. According to Yu, the editor at the VSMC, "The aim will be to encourage the children in doing and thinking about science with the Wolong panda cam, as well as to provide them basic knowledge of the giant panda and VSMC." (CNIC, 2004).

Online museums must be transformed to meet a greater range of interests, combining engaging activities with further educational initiatives.

Finding Three: Linguistic Difficulties

This study brought to light the reality that there were considerable language barriers within the study. The students from the United States perceived the language, after translation, to be too hard and difficult to understand stating that the words were too big, the site was too complex, and the terminology was too hard to understand (Chapter VI).

According to Joo (1999), teachers and students must be cautious when exploring sites with unfamiliar cultural backgrounds (p. 248). "Language influences the way in which ideas are presented and arguments are constructed… translated texts can be obscure, lacking structure if read by foreign teachers or perceived as too direct and offensive" (Joo, p. 249). This was observed in the feedback provided by the snowball sample of American educators. Several examples were provided (Chapter V) of words that were deemed obscene or inappropriate to American educators. According to Dong (2005), the translation of a concept in Chinese–English dictionaries published in China is different from the vocabulary that native speakers normally use (p. 15). The major problem is the lack of equivalence in vocabulary.

According to Pan, Kleiner, and Bouic (2007), survey researchers who conduct surveys that cross linguistic and cultural borders generally place a high premium on formal equivalence and aim for standardization and equivalence of stimulus within the translations of source instruments. As the team at CNIC surveyed the different user groups, the students were not necessarily asked the questions in exactly the same way, which increased the chance of bias and measurement error. For each participant group, the CNIC modified the survey slightly, which was addressed in the previous chapters. Very few details were reported from CNIC on the responses to the open-ended questions on the Chinese surveys. This probably reflects the fact that questions in this format are much more difficult to translate. In order to translate the data from the surveys into English, the CNIC would: 1) find a translator, 2) choose the paragraphs to translate, 3) have an editor agree upon the

translation, 4) document the translation to the Web designer, Webpage maker, and IT Engineer, and finally 5) put the Webpage into service (CNIC, 2004).

Examples of translation issues are shown below from the university survey done by CNIC, where the intended meaning of questions four and ten, after translation into English, were difficult to determine by the American researcher.

> Chinese Translation (question four): *How many bandwidths of your family network is having half person to count the use broadband, are you convenient when visiting our Website?*
>
> Chinese Translation (question ten): *How do you know our Web Site? "A teacher recommends? A head of family is recommended? Self is searched for and finds? Other irrigation ditch?*

One question was so unclear (question 11) on the university survey that it was eliminated from the data analysis. These preceding questions are just a few of the examples that existed in this study. These issues impacted the results of this study in that data were not provided to fully evaluate the desires of the students.

Therefore based upon these findings, one cannot assume that the translation of a language necessarily translated the concepts and the meanings intended by the designers at CNIC.

Finding Four: Internet Use in Classrooms

Similar to findings by Korteweg and Trofanenko (2002), Rowand, (2000), The National Center for Educational Statistics (1998), and Wright (1999), U.S. Students and

their teacher reported difficulties in site comprehension, little or no classroom time using Internet technology, and overall, a limited understanding of scientific terminology.

In order to develop an online science museum to meet the needs of its users, the exhibits in museums must engage students in ways traditional methods of teaching cannot. A basic tenet of constructivist theory is that human beings are intrinsically motivated or programmed' to attempt to make sense of things (Russell, 1994, n. p.). Perhaps, the first step needs to be to excite and train the teachers before authentic engagement can occur within an online environment. According to the US teacher, her students lacked the experience necessary to research the Internet. However, the data also showed that as the age increased of the students, those that learned of the VSMC through a teacher decreased. For example, only 12% of university students in Survey I were made aware of the site through educators compared to 31% of the ten year olds from China from Survey II. Twenty-two percent of the Chinese university students were unable to recognize a direct correlation between the museum site and learning.

Reflecting on the survey data collected by the CNIC, students marked that they spent the majority of the classroom day learning scientific information through traditional teaching methods. Chinese students from the August summer camp stated that 53% of the time books were used in their classrooms to learn about science while more than half of the US students (55%) studied science through textbooks, paralleling that many of the same issues exists across cultures. In addition to books, US students reported the use of overhead transparency projectors (49%) and video tapes or DVDs (29%) as the most familiar ways they learn about science. When Chinese students were asked what

technology they saw utilized most often in class, the Internet (49%) was marked ahead of overheads and videos. However, when the same students were asked if they actually use the Internet to learn about science, student responses totaled 33% compared to student use in the US at only 16% showing a further disconnect between classroom technology and learning.

In each of the Chinese surveys, the students had the Website modeled for them by the CNIC team. Each summer camp hosted by the CNIC was based upon a 30-45 minute "guided-tour" of the museum before the students were allowed to view the exhibits independently. The U.S. classroom had previously studied animals so the teacher structured the panda lesson as a "self-study" module. Although the Chinese students were given the opportunity to construct knowledge through active participation, as Hein (1998) describes, the American students needed additional guidance to facilitate the construction of "useful" knowledge. U.S. students reported getting lost within the exhibit. The US teacher wrote "the students needed more time with the site." In the Osberg et al. (1997) study, the researchers reported similar results. Students showed an increase in the understanding of science topics in both constructivist and traditional frameworks, but limited knowledge building when they had received no direct instruction.

Implications

For the CNIC, the challenge put before them was to promote China by advancing science globally through a virtual museum site thus allowing an exchange of ideas with foreign countries in addition to their own communities. The implications of the findings in

the preceding discussion point out several recommendations that need to be addressed for future research and practice.

The findings in this study suggest that virtual science museums are educationally valuable and support an alternative to traditional teaching methods. Interactive environments can promote active learning as students make decisions about exploring and interpreting the content area… the environment can be scaffolded to help students construct knowledge and learn with understanding (Buckley, 2002).

However, one recommendation for practical implications is for the designers at the CNIC to work with students and teachers in small focus groups from both countries. Studies that involve direct communication within focus groups with both educators and students would allow museum designers to have a better understanding of the obstacles that hinder museum learning. The researchers need to know what the teachers perceive as problems as they implement the curriculum and how these problems affect the students' view of the VSMC. Those problems may include a lack of access to technology, the skills necessary to use computers, or content that was inappropriate for a wide-range of ages and ability levels. The levels of vocabulary were not analyzed during the creation or translation of the Giant Panda Exhibit which would have assisted in determining if indeed the vocabulary level was a factor in student exhibit use and learning. Although these topics were not specifically addressed in the research questions, as the VSMC moves forward with further museum exhibits, they should be taken into consideration.

Secondly, the data that was supplied by the CNIC to the American researcher provided information in which the exact reliability of each question could not be easily

accessed. Many questions were difficult to understand after translation and open-ended questions were not translated or provided. In addition, the student survey group from the United States contained only 33 students from one middle school. Certainly, this is not representative of the entire country's student body as a whole. Exhibit designers need to have a better representation of the people who intend to use the museum. Indeed, most of the answers that provided real feedback were from the open-ended questions. How powerful this information could have been to this study if the "voices" of the students had been provided from all of the survey groups.

Recommendations for Future Research

From the findings of this descriptive case study evaluating the Virtual Science Museum of China, I offer the following recommendations for the Website developers:

Better evaluations and follow-up mechanisms need to be created. Future research should utilize a larger sample size in order to provide more precise measures, especially with students viewing the English version of the VSMC. Follow-up surveys could be set up to find out how users opinions changed over time as the Website incorporated the student feedback. The museum designers at the CNIC need to know whether the exhibits continue to be used by the same learners in order to show sustained interest levels. In addition, future studies should identify the effect that engaging activities like the added games and panda cameras have on student motivation and understanding. Insights gained from the modifications made would contribute greatly to future museum revisions.

Furthermore, there should be additional opportunities for informal museum designers to work with formal educators regarding the content of the virtual museum

exhibitions. According to the National Science Foundation, research and education collaborations should take place with individual and institutional partners, promoting qualitative improvements, both theoretical and practical, in our collective capacities for understanding and supporting human learning (NSF, 2006).

Curriculum needs to be developed that is grade and age appropriate. Teacher guides could be created and integrated into the Website thus allowing teachers to provide better direction for students when utilizing virtual museums. This curriculum needs to come from educators in the field rather than just by designers of Website content. We need to increase the interactivity or collaboration between teachers and museums to acknowledge teachers' pedagogical experience and knowledge, and teachers' abilities to utilize Web sites in ways not considered or yet perceived by museums (Koretweg, et. al, 2002; Guzdial & Weingarten, 1995).

Conclusion

Throughout this study, the aim was to show how a group of museum designers could develop a museum with feedback from the public that would not only promote a better understanding of China to the world but also to contribute to the promotion of scientific understanding. The Virtual Science Museum of China has continued to refine its museum project.

According to the CNIC, the website “China Popular Science Exhibition,” based on the Scientific Database, has become the most popular scientific website on popular science in China. Since its inception, the Virtual Science Museums of China have reached out to over 48,000,000 users with over 40,000 users per day, as of July of 2006 (CNIC,

2005). In addition, the CNIC won top awards at the 2006 World Summit for museum design for furthering scientific popularization.

However, five years after the inception of the VSMC Giant Panda Exhibit, work with students outside of China has been slow to materialize**.** This may be due in part to proximity, funding, and language barriers.

Research at the CNIC with the VSMC will continue to develop as new exhibit sites are developed and older exhibits are reconstructed. The VSMC has added two new museum exhibits: Ceramics and Seismographs. Furthermore, the CNIC has joined with the Sesame Program to develop a virtual broadcast entitled *I Love Science.*

The researchers at the CNIC continue to collect data through new surveys posted on the Website at: http://survey.sdb.ac.cn/surveyHTML/1184222322473.htm. Additional data has also been collected through the online panda-cam diary. The Website welcomed comments from users:

> "You are welcome to submit an observation diary for other system users to share, and for us to improve the web-camera system. You are also encouraged to share with us any plan for future observation. We would like to suggest you put contents below seriously, and then you might get more chances to make a reservation"
>
> (http://www.kepu.net.cn/english/pandacam/guide/sub.html).

Through continued research and the joint cooperation between countries, a high level of international cooperation in sharing science popularization resources

and science educational and scientific research platforms will continue the merging of information in order to advance the Virtual Science Museum of China to the world.

Epilogue

A devastating earthquake hit China on May 12, 2008 and left the infrastructure in the Wolong Giant Panda Breeding Center and Reserve severely damaged. "The Panda Cam is not accessible now because of an Internet problem at Wolong Nature Reserve caused by Wenchuan Earthquake" (www.kepu.net). In order to facilitate communication with end-users, an online journal was posted to allow visitors to the museum exhibit the opportunity to post feedback and questions about the earthquake and pandas. Furthermore, the CNIC has posted additional video footage for visitors, in order to watch video documentation in lieu of the Panda Cam, showing the pandas in Wolong just hours before the earthquake occurred. This footage is posted at: http://www.kepu.net.cn/english/pandacam/movie/20080512.html.

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APPENDIX A

Chinese Online Survey

中国科普博览调查

（一）大熊猫虚▪博物▪▪▪

亲爱的用户：

您好！

为了了解大熊猫虚拟博物馆使用的情况，建设中存在的问题，使虚拟博物馆更加符合用户的需求，我们特别设计了这种基于虚拟学习环境的探索式学习实验。请你在大熊猫博物馆中认真学习，回答专家设计的问题。中国科普博览将对认真进行实验的用户予以奖励，赠送精美的礼品。

谢谢您的参与。

1 姓名*

2 实验日期*

3 描述一下中国大熊猫栖息地的状况。为什么大熊猫濒临灭绝？*

4 目前世界上还存有多少熊猫？*

5 请写出中国大熊猫生存的地方*

6 大熊猫通常吃什么？它还吃些其他什么东西？*

7 为了生存，如果大熊猫被迫吃营养不良的竹子，大熊猫会有什么样的行为？*

8 举例，大熊猫的天敌都有哪些？*

9 大熊猫通常采用哪些技能来保护自己不受敌人侵害？*

10 大熊猫能与哪些动物和谐相处？*

11 成年大熊猫有多重?

12 熊猫妈妈怀孕的时间有多长？她将会在什么地方产下熊猫宝宝？

13 熊猫妈妈一次能产几个熊猫宝宝？熊猫妈妈如何照顾熊猫宝宝？要照顾多久？

14 描述一下不同阶段的大熊猫特征，刚出生时；一个月大小时；三个月大时：

15 许多资料详细说明熊猫可以用于医学。药剂师们认为熊猫的什么部位可以应用*

- ☐ 皮肤：
- ☐ 油：
- ☐ 尿：

16 熊猫是群居动物还是独居动物？

17 动物园中的熊猫能够活多久？野外的熊猫又会活多久？

18 大熊猫和小熊猫之间的区别是什么*

19 根据记载，西方第一个杀害大熊猫的人是谁？*

20 第一个从中国带走活的大熊猫的人是谁？她是怎么做的？*

21 大熊猫还有什么别名?*

22 成都和卧龙都做过哪些关于大熊猫的研究？*

23 作为一个学生，你准备做些什么来保护大熊猫？*

1 提交 重置

APPENDIX B

Giant Panda Curriculum

The Giant Panda

A National Treasure

Of China

Name _____

Date _____

The Giant Panda Exhibit

Virtual Museums of Science

http://www.kepu.com.cn/gb/lives/giantpanda/index.html

Today you will explore China on the trail of the giant panda bears.

1. Describe what you see happening to the panda bear habitat in China. Why are the pandas in danger of becoming extinct?

2. How many panda bears are left in the wild?

3. Look at the attached map. Plot where the last remaining panda bears in China are on the map.

4. Describe a typical panda diet? What does a panda eat?

5. If a panda is forced to live on bamboo that is low in nutrition, in order to live, what will the panda do?

6. What are some of the panda's natural enemies?

7. What is one skill that pandas have to protect them from their enemies?

8. What are some animals that pandas can live with in harmony?

9. How much do giant pandas weigh at adulthood?

10. How many months does a panda mom stay pregnant? What type of place will she have her cub(s) in?

11. How many babies are born at a time to panda moms? How do panda moms take care of these babies and for how long?

12. Describe the baby cub at:

    a. Birth:

b. One months of age:

c. Three months of age:

13. Many documents have detailed ways that pandas can be used for medicine. What did the pharmacists and empresses believe that the following could be used for:

a. Skin:

b. Oil:

c. Urine:

14. Are pandas solitary or gregarious?

15. How long do pandas live (in captivity, in the wild)?

16. What is the difference between a giant panda and a lesser panda?

17. Who was documented as being the first Westerners to kill a giant panda?

18. Who was the first person to bring a living giant panda out of China? How did she do this?

19. What are some other names given to the giant panda?

20. What type of research is being done at the centers of Chengdu and Wolong?

21. What can you do, as a student, to contribute to the survival of the giant panda?

Resources:

Map of China used with permission from the NYSTROM division of Herff Jones, Inc. Chicago, IL. 60618. http://www.nystromnet.biz/china.html

Panda Bear Clipart provided by subscription to the Graphics Factory at www.GraphicsFactory.com

APPENDIX C

Student Survey

Student Survey on the Giant Panda Exhibit at the Virtual Science Museum of China

Background Information

Age _____

Grade _____

Sex: Male _____ Female _____

VSM Exhibit

1. When viewing the virtual panda exhibit, did you find the site use

a. very easy

b. somewhat easy

c. somewhat difficult

d. very difficult to use

why or why not? _____

2. Were the photos on the site clear and easy to use?

a. definitely

b. somewhat

c. not sure

d. difficult to use

why or why not? _____

3. Was the site map easy to navigate?

a. definitely

b. somewhat

c. does not apply

d. difficult to use

why or why not?_____

4. Did the site encourage you to want to learn more?

a. definitely

b. somewhat

c. not sure

d. definitely not

why or why not?_____

5. Did you find links that were broken and would not open?

a. more than once If so, which links did not work? _____

b. once

c. all the links worked

d. none of the links

worked

e. other_____

6. Did you find the panda exhibit to be

a. easy to understand

b. average difficulty

c. somewhat

complicated

d. very difficult to

understand

explain: _____

Curriculum

7. How long did it take you to complete this lesson on the pandas?

a. more than one day

b. more than one hour

c. 30 minutes to 1

hour

d. less than 30

minutes

e. other_____

8. What was your biggest complaint about using the Internet to do the panda lesson?

a. the wait time

b. the links wouldn't

work

c. not interesting

d. I have no

complaints

e. other _____

9. Were the questions from the panda lesson easy to find within the virtual exhibit?

a. very easy

b. somewhat easy

c. average difficulty

d. extremely difficult

e. other _____

10. If you were given the choice on how to learn more about pandas, would you choose

a. another lesson via the Internet

b. to use the textbook and worksheet

c. to watch a video

d. to listen to your teacher explain about it

e. other _____

Technology/Science

11. How often do you use the Internet in your classroom?

a. daily

b. a few times per

week

c. a few times per

month

d. not at all

e. other _____

12. What do you enjoy the most about the Internet?

a. games

b. email/chat

c. news and

information

d. science

e. other _____

13. Where do you go to use the Internet? (Check all that apply)

a. home

b. school

c. Internet café

d. library

e. other_____

14. What technology do you see used the most in class?

a. videos/DVDs

b. overhead projectors

c. laser disc

d. Internet

e. Other: _____

15. Do you feel that

science (circle all that apply)

a. is useful to me

b. is just a bunch of facts to memorize

c. makes me want to ask more questions

d. is boring

e. is too hard to

understand

16. In science class, we (circle all that apply)

a. have visiting scientist who come and speak to us

b. take trips to actual zoos and museums to learn more about science

c. use the Internet frequently to learn more about real science

d. use mostly books to learn about science

e. do lots of experiments in the laboratory

Culture

17. Would you be interested in learning more about students in other cultures?

a. definitely

b. somewhat

c. not sure

d. not interested

e. other _____

18. What would be the best way to learn about other cultures?

a. Internet

b. Books

c. email

d. video-conferencing

(chat)

e. other _____

19. What would you like to see in the future on the panda bear exhibit? What else would you like to know about panda bears?

20. What recommendations would you make to improve the existing panda museum?

APPENDIX D

Data Approval Form

中国科学院计算机网络信息中心文件

To Whom It May Concern:

Julie Dockery-Delello has the permission of the Computer Network Information Center (CNIC) to use the data contained within the Virtual Science Museum of China (VSMC) within her dissertation paper as long as all of the credit for the information is given to CNIC and is cited within her work. In addition, all information should be linked back to the website, www.kepu.net.

Xiao Yun
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Signature _____
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