

Science Educational Interpretation of Exhibit Characteristics

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Abstract: The purpose of this study was to explore characteristics of natural history museum exhibits from the viewpoint of science education. A total of ninety exhibits for this study were examined in national science museums of Korea and Japan. Exhibits of Tokyo national science museum were again divided into two groups: the old and traditional types, and the new and renovated ones. Even though analyzing data was not undertaken through quantitative statistical process, the interpretation of the data was valid enough to fulfill the purpose of the research. While there were clear changes and differences between the old and the new types of exhibits in Tokyo national science museum, the old part of Tokyo museum was similar to one in Korea. Based on analyzing the new types of Tokyo museum, the current movement in the field of natural history museums of Korea explicitly has been toward utilizing more science education concepts and ideas.

Keywords: natural history museum, exhibit characteristics, informal science education

Introduction

Learning in museums and similar instructions is called informal learning to differentiate it from the formal learning that occurs in school settings (Diamond, 1999). Interpretation of informal educational settings exemplified by natural history museums has attracted more science educators since 1990s. The venues of such research are so various that the studies were undertaken through observing visitor behaviors, counting the time spent by visitors, and analyzing interactive exhibit characteristics (Sandifer, 2003).

Several studies have already been undertaken to explore the potential of science educational inception by examining exhibits and internet resources from the worldly well known museums (Hawkey, 2001; Shin and Lee, 2003; Shin et al., 2004). The informal settings is easily presented to enhance student learning in the science education field: according to Hein (1995), the way to build or establish the knowledge in museums is quite similar to how people construct their own ideas and knowledge

since it happens spontaneously and through interaction with the world and other people. Most of the findings from the previous studies strengthened the role of natural history museums as an informal educational entity. This study was prepared to answer the following research questions: "How do the different characteristics of natural history museum exhibits interplay with science education perspectives?"

Background

Context of the Study: Two National Science Museums in Korea and Japan

Two large urban science museums were the settings for this study. First the national science museum of Korea is located at Daejeon. The museum started in 1945 and the current one in Daejeon was opened in 1990. This government-sponsored organization consisted of 102 staff members including 19 researchers. The number of exhibits and samples is 10,441 items. It has a half million visitors a year and over 60% of visits were school visits. An annual budget is over 10 million U.S. dollars and most of the expenses are supported by the Korean government.

Secondly the national science museum of Japan

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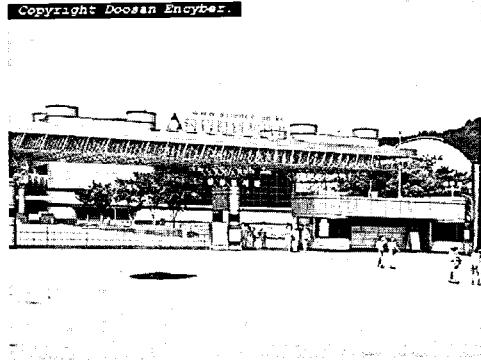
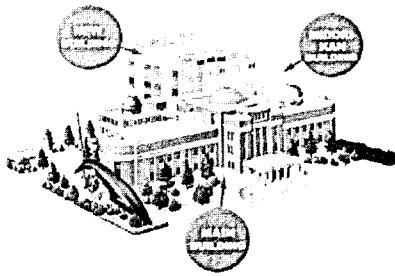


Fig. 1. Pictures of National Science Museums in Tokyo (Left) and Daejeon (Right).

is located in Tokyo. This museum is also fully supported by the Japanese government. However it recently became an independent organization. The museum holds 3.3 million items. It has 830,000 visitors in a year and only 10% of the visitors are school visits. The size of the annual budget is 30 million U.S. dollars. Its staff consists of 150 members including 52 researchers in the field of natural sciences and science education.

These two museums are representative of Asian science museums for they may well have unique features which are not shared with other renowned museums in U.S. and Europe. Several features of the two museums are quite compatible to each other, for instance the budget and number of visitors. However, the number of exhibits and sample items of the two museums are quite different, and the pattern of visiting is clearly distinguished in the Tokyo museum. That is, most of visitors are with their family and friends in the case of the Tokyo museum. It is apparent that people pick the museum out of several recreation choices. Such result is deeply related to the on-going efforts of the Tokyo museum to attract visitors. One of such efforts is the new extension building of the Tokyo museum recently established as called the New Building.

Tokyo National History Museums: the Old vs. the New

As mentioned above, the new extension building

or the New Building was new not only physically but also in terms of contents. The main feature of the New Building is its design. In the design and planning of the New building science educators and their ideas were driving forces. One gallery in particular was solely designed by science educators who were on staff in the museum. This gallery currently attracts most children and families for it provides various research opportunities dealing with natural environment for city dwellers. Instead of displaying several samples in glass boxes, people can walk through the exhibits as well as touch and play with them. One corner of the room there is an information desk where docents and retired science teachers help to explain the exhibits to visitors and to experience their own experiments and observation. For the investigation, the study separated the Tokyo museum into two parts.: The old and the new building. The old one contains the exhibits that have been in the museum since the museum began. Therefore it is hardly believed that contemporary discussions and research in the museum research impact these exhibits. Rather it followed the traditional way of exhibition and methods. In contrast to the Old Building, the New Building showed several features which were found in world famous museums. High technology and multi-media were used more frequently and it is clear that the exhibits were deliberately concerned with the “learning of visitors”.

Prior Research on the Exhibit Characteristics

The ways in which exhibits attract and hold visitor attention have seemingly always been on the mind of exhibit developers, museum directors, and museum researchers. A number of exhibit characteristics relating to attracting power and holding time have been addressed by prior research.

Peart (1984) determined that concrete exhibits (three-dimensional objects) had greater attracting and holding power than abstract exhibits. In an analysis of five different exhibit styles, Boisvert and Slez (1995) found that exhibit Styles 1 (large, novel, and concrete exhibits), 2 (small, concrete, and interactive exhibits), and 3 (staffed demonstrations) attracted more visitors than exhibit Styles 4 (abstract, instruction-driven interactive exhibits) and 5 (abstract, computer bank or books). Overall, the superiority of concrete interactive exhibits in terms of attracting power and holding time has been verified by a number of researchers (Koran et al., 1986; Melton, 1972). Also Sandifer (2003) found that technological novelty and open-endedness were defined as meaningful exhibit characteristics that contributed to the holding of visitor attention in a science museum.

In a different kind of analysis, Hein (1995) suggested that educational theory or positions can be applied to museums. He created four types of museum exhibits by combining learning theory and theory of knowledge as follows:

- Systematic Museum: didactic learning/knowledge is independent/learning is passive and incremental
- Discovery Museum: heuristic learning/knowledge is independent/learning is constructed from ideas and experiences
- Orderly Museum: behaviorist learning/learning

is passive and incremental /knowledge is constructed

- Constructivist Museum: learning is constructed from ideas and experiences/ knowledge is constructed)

Shin and Lee (2003) studied the exhibit characteristics of four worldly famed natural history museums. They found that distinguishing characteristics of sample exhibits were accessibility, multimodality, and relevance. All the target museums are located in western countries. This study focused on two museums in Asia and the differences between two studies, if any, could be discussed in the context of cultural difference.

Method

Target Exhibitions

From three target resources which are the New Building and the Old Building of Tokyo science museum, and the Daejeon science museum. Respectively 30 permanent exhibitions were selected from each museum.

Analyzing Instrument

Drawing from our own observation and a review of the literature, this study identified seven exhibit characteristics that attract the attention of visitors as well as enhance their learning during the visit. A total of seven items were chosen as followed.

From the work of Borun and Dritsas (1997)

- Multisided: the family can cluster around the exhibit
- Accessible: Interaction allows for several sets of hands (or bodies)
- Multimodal: appeals to different learning styles and levels of knowledge as well as multi-media

Table 1. Target Sample Exhibition

	Dinosaur/Geohistory	Earth Science (Astronomy)	Paleontology/Ecology/Biology
Tokyo-the New	10 samples	10 samples	10 samples
Tokyo-the Old	10	10	10
Daejeon	10	10	10

All the exhibits above were observed and pictured by authors for the study.

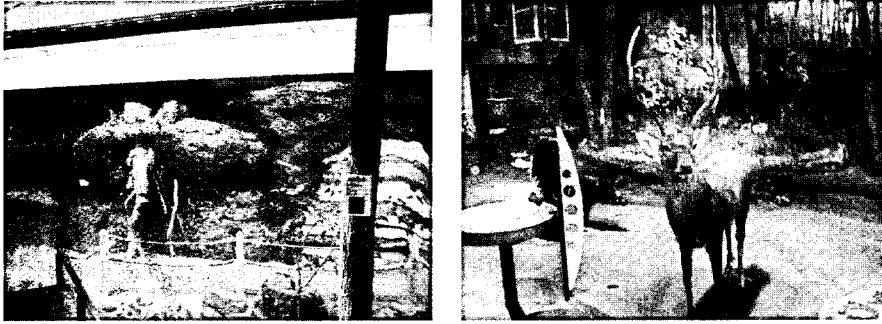


Fig. 2. Two Exhibits from Tokyo Museum New Building.

- Relevant: provides cognitive links to visitors existing knowledge and experiences.

From the work of Sandifer (2003)

- Open-Ended: allows for the achievement of multiple visitor-set goals
- Technological Novelty: contains visible state-of-the-art devices through the use of technology, illustrated phenomena that would otherwise be impossible or laborious for visitors to explore on their own.

From the study of Hein (1995)

- Educational Concern: should be systematically presented to the visitors in a manner that makes it easiest to comprehend.

The authors allocation of particular categories of each exhibit was based on their experiences as science educators, and was grounded in their literature reviews on informal learning and museum study through visiting and observing natural science museums and science museums. Equally as important, these characteristics were present in enough materials that a valid descriptive analysis was possible. The average of agreement rate pertaining to each item by two researchers was employed for establishing an inter-rater reliability. It was 0.8 and differences between graders were statistically negligible.

Findings

Analyzing Exhibit Characteristics

The examples of analyzing characteristics of

each exhibit from three categories of subject museums are introduced with pictures.

- Tokyo Museum-New Building: Following pictures were taken from the NewBuilding exhibition gallery of the Tokyo Museum. Both were multisided so that people gather around the exhibits and even play with them. A stuffed deer in the right picture can be touched and felt. The exhibit contents are concrete enough to make visitors feel as they are walking in the woods. It is characterized to be open-ended and very relevant for it is a familiar situation and setting. It is also multimodal because at least three methods of exhibition were used.

From the perspective of education, this exhibit was evaluated high. Visitors are able to figure out what the underground looks like by simply pushing button of exhibits as seen in the picture on the left of Figure 2. They find bugs, various layers of soils and sedimentary rocks. Instead of explaining verbally or in written form, this exhibit allows people to understand by themselves according to their own level of understanding and prior-knowledge. Even children can enjoy the exhibits since they are located low enough for small kids to reach. Also they minimized the use of written explanation and jargon in a long paragraph. If Hein (1995) visited this exhibit and evaluated it, he would rate this to be a constructivist museum.

- Tokyo Museum-Old Building: Figure 3 shows two exhibits from the old Building of the Tokyo museum. The exhibits are not multi-

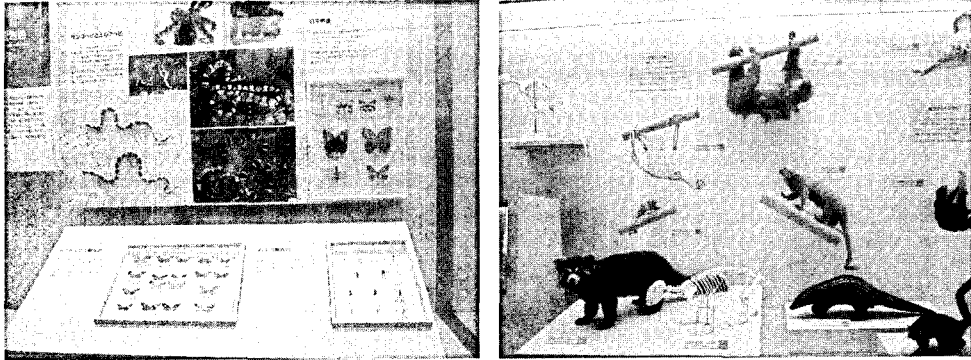


Fig. 3. Two Exhibits from Tokyo Museum-Old Building.

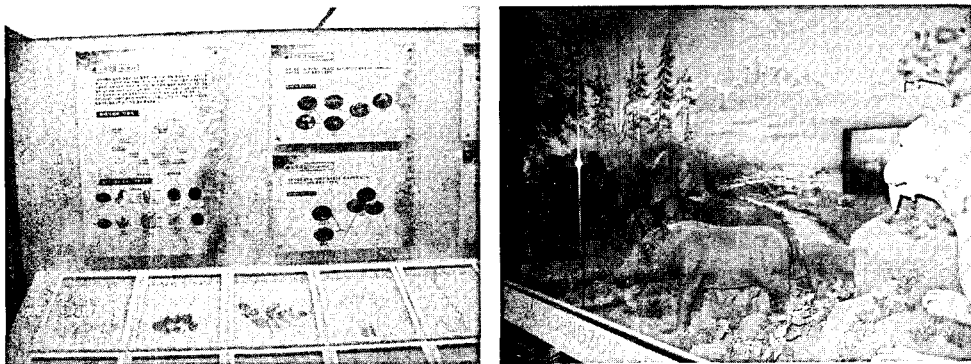


Fig. 4. Two Exhibits from National Science Museum in Daejeon.

sided since the stuffed animals and samples were stored in a glass box. They appear to be very traditional exhibition styles. Specimen and stuffed living things were displayed with written paragraphs contains a high degree of jargon and using fonts of letter which were quite small. Such explanations hardly appeal to children and laypersons since reading such a jargon would be just like reading a foreign language. However from the perspective of educational concern, these exhibits were systematically presented. In addition, for student groups who must fulfill a homework assignment on describing the ecology of a certain area, the exhibit on the left would be very helpful.

Also viewing the exhibit on the right visitors can make connections between stuffed animals and their skulls. Also it can be learned that certain characteristics of skulls are related to their habitats

and eating habits.

- National Science Museum-Daejeon: Pictures below were taken from the museum in Daejeon. The exhibit on the left of Table 4 used several methods of exhibition including parts of plant specimen, written explanation and illustration. It tried to deliver the idea of plant evolution. Therefore, it is multimodal as well as educationally considered. However, it was not evaluated to be relevant because the explanation was academic and like sentences in school textbooks or encyclopedia. Presenting it with whole plant specimen in a way which illustrates how such plants grow currently in our local environments, the exhibits would be more favorably rated. The picture on the right shows stuffed animals in a form of diorama. It recreates how different kinds of animals coexisted in a Cenozoic ecology. Such stuffed animals

Table 2. Scoring Results of Characteristics of Exhibits in Daejeon, Tokyo-Old Building, and Tokyo-New Building

Exhibit Characteristics	Daejeon	Tokyo- Old	Tokyo- New
Multisided	50 (%)	17 (%)	50 (%)
Accessibility	67	60	86
Open Ended	17	46	80
Technological Novelty	10	13	53
Multi-Modal	23	60	63
Relevant	7	19	50
Educational Concern	33	40	70

attract visitors attention. Also the explanations were not scientific and quite minimized so that people could draw their own conclusion from this exhibit based on their backgrounds. The limitation of this exhibit is that stuffed animals were confined in a small space and inside the glass show case. Yet it was coded to be open-ended and multimodal since visitors would understand the exhibit in diverse ways rather delivering a given information.

Exhibit Characteristics

Table 2 indicated the results of evaluating target exhibitions by using the checklist developed in this study. When looking over the sample pictures of each museum, it was determined that there were visually identified differences between the New and the Old Buildings of the Tokyo museum. Meanwhile the Old Building of the Tokyo museum shared similar tendencies with the Daejeon museum. These observations were confirmed when we applied the checklist. In most exhibit characteristics, the New part of Tokyo museum outnumbered the other two museum settings.

First multisided exhibits were not impressively presented in Old Building of the Tokyo museum compared to the other two museum settings. It is notable that the New Building of the museum of Daejeon showed multisided exhibits in a half of sample exhibits.

Accessibility was well considered in all three museum settings. Still the Tokyo museum-New Building was outstandingly accessible. Technological novelty was quite low in the Old-building and

in the Daejeon museum while it was rated high in the New-Building.

The question of whether the exhibits were open-ended was also answered the most positively by the New-Building of the Tokyo museum. In terms of multimodality of an exhibit characteristic, the New and the old building of Tokyo museum could not be differentiated from each other. Rather the Daejeon museum was a little lower with regard to this characteristic.

Being relevant to visitors is quite important issue in designing exhibits for it is very much related to the power of holding visitors attention. When exhibits look familiar, it will increase visitors attention. The caution of being relevant is that exhibits should be relevant as well as novel. In other words, even though the overall phenomena and first-glance impression is familiar, the exhibits should move into something unknown and novel behind the phenomena. For example, in the picture on the left of Fig. 2, the land or ground easily found in the front yard was changed into being with cross section of its underground for the spinning the wheel by the exhibit. This characteristic was very well presented in the New Building.

Again the New Building stood out in terms of the characteristic of educational concern. Providing names and locations was not enough to be rated as having "educational concern". If there is a student who needs to study a certain type of extinct of dinosaurs, he/she will go to the museum nearby. Luckily enough he may find related exhibits. Even though the exhibits do not look fancy, the contents can help him/her to examine various aspects of

Table 3. Exhibit Characteristics of Smithsonian Museum in Washington D.C. and National Natural History Museum in London

Exhibit Characteristics	Smithsonian Museum in Washington D.C.	Nat'l Natural History Museum in London
Multisided	58 (%)	29 (%)
Accessibility	92	75
Open Ended	49	18
Multi-Modal	60	61
Relevant	58	54
Educational Concern	54	53

hypothesis and background information systematically rather than providing a printing board of one simple explanation about it.

Discussions and Conclusions

The findings presented in this paper reflect attempts to develop more consistent and more objective approaches to the analysis and evaluation of the practice of museum exhibits. This study tried to avoid the crude scoring. The comparisons among selected museums were, if any, not our intention. Which the Old Building and the Daejeon museum settings showed rather traditional features of museum exhibits which need to be modified and improved, the distinctive and desirable features were found in the New Building of the Tokyo museum. The most interesting feature of the New Building was putting the more emphasis on the science educational perspectives when designing and developing its exhibits.

Then, what made such improvement in exhibit characteristics of the New Building? As mentioned in the introduction of this report, it seems apparent that the most important elements of such evolution was "who drove the changes". More science educators were involved in from designing to constructing of the New building. Again they made continuous efforts to connect with school curriculum and inviting teachers into museums.

In the previous research of Shin and Lee (2003), the data of analyzing exhibition were collected from the Smithsonian Museum in Washington D.C. and the national natural history museum in Lon-

don. Table 3 showed the results of analyzing characteristics of exhibits in the two museums. Glancing over the data of this table and recalling the ones for the New-Building shown in Table 2 would lead you to conclusion that the exhibits in the New-Building are competitive to the two museums which are representatives of the western natural history museums in terms of the characteristics of educational concern and open-endedness. Meanwhile this study could not find any critical differences between Eastern and Western museum exhibit characteristics resulted from the dissimilar cultures based on the data of Table 3.

Natural history museums are in a unique position as the decades old collections that are the core of their existence and characterized by a high degree of fundamental scientific research. As stated in mission statements of natural history museums, they use their collections to promote the discovery, understanding, responsible use and enjoyment of the nature. Among these purposes, "understanding" directly connects to their educational role. Furthermore Hein (1995), Hawkeye (2001), Cox-Petersen et al. (2003), Katz and McGinnis (1999) and so on investigated the museum from the view point of science education. They asserted that collaborative efforts between schools and informal institutions should be more creative and accepting of change. Building on this notion, Katz and McGinnis (1999) suggested that informal science educators proceed cautiously when matching informal science programs to formal science education goals given the fact that their identities are complementary but different. In such context of current

research of science education, this study could be understood.

In early findings of Boisvert and Slez (1995) visitors at a science museum were most attracted to exhibits with concrete presentations, holding power was highest for exhibits with high interaction and concrete presentation, and engagement levels were highest for high interaction exhibits. We propose to add science educational aspects to this exhibit characteristics: making balance of being relevant and novel, and mingling science educational research ideas concerning connection to current formal educational system and educational learning methods such as problem based or context based exhibits. After fulfilling these conditions, we could expect museums to be identified with a learning environment. That is, museums provide a context that encourages meaningful behavior and social interaction that is pleasurable, and hold the potential for learning scientific facts and principles as well as attaining scientific literacy.

Acknowledgment

Support from the Korean Research Foundation is gratefully acknowledged (Project Serial Number: 074-BS1534).

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Manuscript received, February 18, 2004

Revised manuscript received, March 15, 2004

Manuscript accepted, March 22, 2004