

THE TYPES OF PHYSICAL ENVIRONMENTS FOR FOSTERING CREATIVITY AT NATURAL HISTORY MUSEUMS

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Abstract

This study purposed to explore the types of physical environments perceived to stimulate creativity. The target settings were two informal education institutions in America, Smithsonian National Museum of Natural History and American Museum of Natural History. Research procedures were 1) physical environmental characteristics of gallery and exhibit photographs were categorized, 2) content analysis of the 62 photographs by 3 independent raters scaled each setting according to the categories developed, and 3) potential creativity of photographs was rated by 129 middle school students, which was defined as degree of they would feel to stimulate individual creativity. Cluster analysis identified the most and least creative types of galleries and exhibits separately.

Keywords: informal education, museum education, creativity, physical environment

1. Introduction

This study purposed to explore the types of physical environments perceived to stimulate creativity. The importance of the effect of environments on the creativity of an individual has been emphasized recently since many researches of creativity has taken a system or confluent perspective which has a position that creativity doesn't exist exclusively in mental process of an individual, but emerges from the interaction between a person and socio-culture.

Recent conceptualizations of creativity have suggested that physical environment could play an important role in facilitating the development of creative processes and products (Amabile, 1988). However little empirical studies have been conducted to the ways in which the physical environments affect individuals' perceptions and experiences of creativity. Some exceptions to this trend were several studies in the area of work environments (i.e., Alencar & Bruno-Farir, 1997; McCoy & Evans, 2002; Stokols, Clitheroe, & Zmuidzinas, 2002).

The target setting of this study was environments of informal education, museums which give variable activities of experience beyond physical limits of schools, take 'objects' to the core of education differently from schools which usually deliver content by 'discourses and letters', and attempt to make exhibition more attractive by providing more active roles to the visitors.

Museum environments have many possibilities of fostering creativity because the implicit principles of informal education are similar with the ones of creative education. The activities of informal education are voluntary and self-directed essentially and motivated mostly by internal interests, curiosity, exploration, operation, and fantasy. Csikzentmihalyi (1995) proposed that free-choice learning could lead to 'the flow'. The informal learning cannot be occurred by instructions and control but by 'play and exploration' (Oppenheimer, 1972), which is also an important aspect of creative people devoted to his/her work (Csikzentmihalyi, 1999). Also in informal learning, failure and

competition, which are known as explicit restrictions on creative performance (Amabile, 1996), do not play major roles (Oppenheimer & Cole, 1974).

2. Methods

2.1 Selecting Photographs

Target settings were two informal education institutions in U.S., The Smithsonian National Museum of Natural History and The American Museum of Natural History. In February 2005, in the two museums photographs were taken by 11 researchers who are members of the project, 'Toward an agenda for advancing research of 21st century science culture with emphases on the exhibit-education system and visitor behaviors in out of school settings: Natural History Museums'. Digital cameras were used.

The initial pool of about 10,000 photographs were reviewed and evaluated by five assistant researchers in terms of photographic quality. From this pool, the authors selected 62 photographs (22 from gallery, 40 from exhibit) using two criteria: (1) their representativeness of galleries and exhibits where the photographs were taken, and (2) degree of stimulating creativity. Photographs of an exhibit were selected from only two galleries, dinosaur and fossil, and earth science, to reduce factors unrelated to physical environment.

Eight raters majored in science education assessed 62 photographs for adequacy against science curriculum for middle school using 3 point scale. The degree of stimulating creativity was also assessed with 3 point scale by projecting each photograph for approximately 1min. As a result, six photographs were replaced.

Finally, the photographs selected were pilot tested and final photographs were decided.

2.2 Analysis of Physical Environment of Museums

2.2.1 Pilot test

The purposes of pilot test were two-fold: to check subject's responses before the final test, and to extract variables of physical environments of exhibition empirically, because research studies about physical environments concerning creativity were very rare, especially in museum settings. 39 participants were asked whether each photograph stimulated their creativity, and then to provide the reasons for their answers. Each photograph was showed on 52 inch projection TV for approximately 1 min. The pilot test took 90 minutes. As a result of pilot study, three photographs were replaced because of ambiguity.

2.2.2 Analysis of physical environments

All possible physical characteristics of museums were extracted based on precedent research on creative environments and museums and the results of pilot test.

Physical environments extracted at gallery level were consisted of 6 categories involving 16 sub-categories: spatial form (size of space, size of passage, rectilinear, and diversity of shape), light, internal organization (natural appearance, openness, dynamics, complexity of exhibits, and crowd of gallery), color (warm and cool color), visual communication (external and internal communication), and modernity.

At exhibit level physical environments were extracted 8 categories including 8 sub-categories: form (size and diversity of media), light (highlighting), internal organization (natural appearance, complexity of exhibits, and complexity of panel), color (warm and cool color), visual communication (internal communication), modernity, media (picture, painting, natural object, model, and operative media), and title form (length of title, affirmative, and interrogative sentence).

Three independent raters scaled physical characteristics of each photograph according to the operational definitions of categories developed. After training, each photograph was projected on a screen for approximately 1 min. Interrater reliability was computed by intraclass correlation coefficient (ICC) for continuous scale and by Kappa coefficient (k) for categorical scale. The result showed the range of ICC $r=.62 - .87$ for a gallery and ICC $r=.71 - .96$ and all $k_s=1.00$ for an exhibit.

2.3 Creativity Potential Ratings

Potential creativity of photographs was estimated by degree of participants' perception of stimulating their creativity. 128 students (boys 60, girls 68) of a middle school located in Seoul in Korea participated in the main test on July, 2005. The procedure of main study was as follows.

1) The purpose of this study and definition of creativity were introduced to them. Definition of creativity was presented to clarify the different concepts and to avoid some misconceptions about creativity (Alencar, 1995; Alencar & Bruno-Faria, 1997).

2) Each photograph was presented on a 52 inch projection TV for approximately 30-40 seconds, with information about the title of gallery (or exhibit) and the media used, such as microscope, magnifier, computer, video, and button.

3) Participants were asked to rate the picture from 1 to 5 about creativity and interest separately. Framed from the conceptualization that creativity is the ability to fluently generate novel idea (Guilford, 1967) and appropriate solutions (Baer, 1993; Getzels & Csikszentmihalyi, 1976; Lubart, 1994; Runco, 1994) in domain-specific perspectives, the question was as follows: If you had the very special problem for nature or natural science to solve and needed to generate a lot of new ideas, how much would the environment on this photograph help you?

Interest was estimated to distinguish participants' perceptions of creativity from their interests about the physical environments in the photograph. Although interest is one of fundamental components of creative performance, we would like to focus on student's higher thinking as creativity, such as generation of a novel idea or problem of solving, not just interest alone. The question was as follows: If you had a chance, you would like to visit this place (or exhibit) on a photograph?

2.4 Data Analysis

Hierarchical cluster analysis was used to classify the most creative gallery (or exhibit) and the least creative gallery (or exhibit). The analytic steps were 1) physical environmental scores of a gallery (or an exhibit) input were classified according to their similarity by Ward Method. 2) In order to identify the validity of the classified clusters, the significance of the difference among physical environment scores of the clusters was investigated by one way ANOVA. 3) The differences among potential creative or interest scores of the clusters were tested by one way ANOVA. Finally, 4) for the most and least creative cluster, the physical characteristics of each cluster were profiled and described.

3. Results

3.1 Gallery Level

Hierarchical cluster analysis on 22 photographs of galleries yielded four clusters. ANOVA was conducted to test the differences of potential creative or interest scores among the clusters (see Table 1). The results showed significant differences ($p < .05$) in both creative and interest scores and the same rank of four clusters for both of them, which implied that participants rate potential creativity and interest nearly the same at least at gallery level.

Table 1. The results of ANOVA in the gallery level

	Clusters	N	Mean	Std. Deviation	F	Sig.
Potential Creativity	1	4	3.2650	.22782	3.78	.029
	2	3	3.1200	.25534		
	3	4	2.9200	.28705		
	4	11	3.4382	.29092		
	Total	22	3.2691	.32721		
Potential Interesting	1	4	3.3950	.29275	3.46	.039
	2	3	3.3567	.32517		
	3	4	2.9525	.21344		
	4	11	3.5836	.38171		
	Total	22	3.4036	.39277		

The fourth cluster consisted of 11 photographs and revealed the highest scores in creativity and interest. The common characteristics of the photographs were large space, modern and natural atmosphere, complicated display quantitatively and qualitatively and dynamic and open exhibition using the ceiling and wall (see Figure 1).

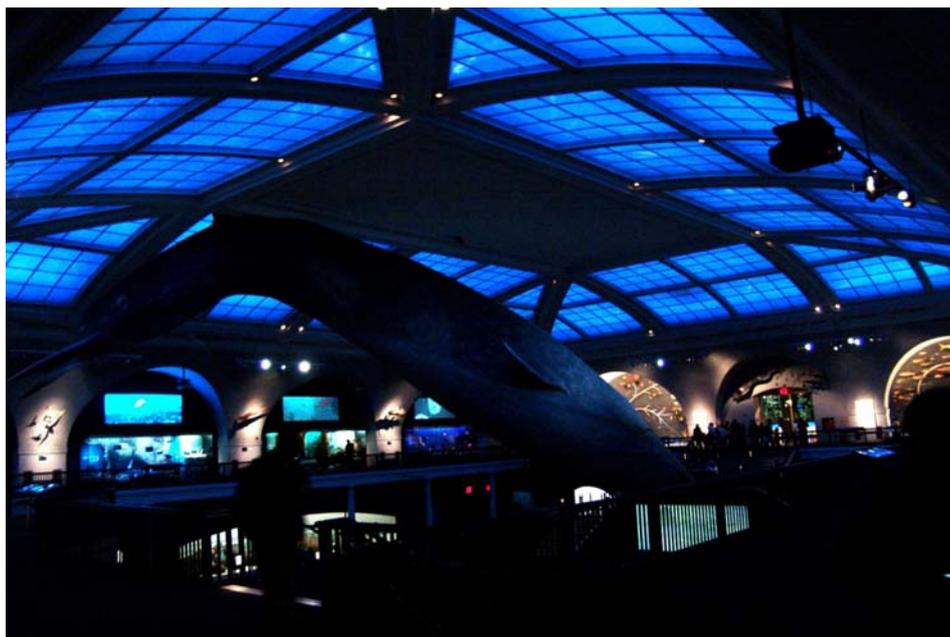


Figure 1. Ocean Life in the American Museum of Natural History

On the contrary, the least of creative and interested types of galleries, the third cluster (4 photographs), was characterized by monotonous, old and static display. The gallery looks calm and neat with spacious passage and simple display using only wall (see Figure 2).



Figure 2. Hall of North American Forests in the American Museum of Natural History

3.2 Exhibit Level

Hierarchical cluster analysis on 40 photographs of exhibits yielded seven clusters. The results of ANOVA showed significant differences in both creative and interest scores ($p < .05$) among the clusters, however, the orders of seven clusters were different for creativity and interest: cluster 5, 3, 6, 1, 4, 2, and 7 for creativity, while cluster 3, 5, 1, 6, 2, 4, and 7 for interest in descending order (see Table 2). It could be interpreted that the physical characteristics embedded in an exhibit stimulated students' potential creativity and interest in different ways.

Table 2. The results of ANOVA in the exhibit level

	Clusters	N	Mean	Std. Deviation	F	Sig.
Potential Creativity	1	9	3.27	.28	2.48	.04
	2	4	3.10	.19		
	3	9	3.36	.26		
	4	7	3.11	.16		
	5	2	3.53	.11		
	6	6	3.36	.29		
	7	3	2.95	.11		
	전체	40	3.25	.26		
Potential	1	9	3.47	.38	3.05	.02

Interesting	2	4	3.23	.28		
	3	9	3.61	.28		
	4	7	3.17	.12		
	5	2	3.59	.01		
	6	6	3.44	.31		
	7	3	3.00	.08		
	전체	40	3.3910	.33		

The fifth cluster (2 photographs), the highest in creativity and the second highest in interest, appeared to have following physical characteristics: replicating the nature with reality. Also the exhibits in this cluster were large in size, modern atmosphere, and using various media, such as, models and computers rather than just natural objects (see Figure 3). The least of creative and interested type of exhibits, the seventh cluster (3 photographs), was used many objects and panels with warm color as much as the fifth cluster. However the seventh cluster had long title, and old exhibits (see Figure 4).



Figure 3. Fossil lab in Smithsonian National Museum of Natural History

4. Conclusion

This study is fundamentally based on the perspective that creativity isn't embedded only inside of an individual, but also constituted by the contexts involved in a society, culture, and history. It suggests that a creativity research should concentrate on how much a community is able to foster a creative genius, instead of exclusively focusing on an



Figure 4. 200-65 million years ago in Smithsonian National Museum of Natural History

individual. According to this perspective, this study could contribute to define characteristics of physical environments of natural history museum which can foster student's creativity, especially in science and technology.

The study suggests that students are able to identify environmental types which could help them bring up creativity and interests. Therefore, in order to establish creative environment, the results implies that 1) the compositional factors doesn't work independently (i.e. the effect of large size of a gallery seemed to operate positively when it was associated with the effect of modernity.), and 2) some physical environmental variables, such as natural atmosphere, modernity, complexity, and dynamic displays at gallery level and modernity and various media at exhibit level, could contribute more to creativity than other variables.

Additionally, physical environmental variables identified in this study can be used to assess the potentiality to foster the creativity and interests of visitors at other institutions.

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