

Promotion and Practice of Environmental Knowledge: The Experience of National Science and Technology Museum on Planning Special Exhibitions for "Taiwan Sustainable Campus"

Tzu-Hsiang Ger, Mei-Tsen Chen, and Chi-Shu Tseng

National Science and Technology Museum,
720, Jiouru 1st Road, Kaohsiung 807, R.O.C., Taiwan

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ABSTRACT: To present the essence of sustainable development education of Taiwan in museum exhibits, National Science and Technology Museum (NSTM) has been working to the best of our ability and creativity over the years. As part of government plans of promoting sustainability concept, two dedicated exhibition were curated by NSTM with different approaches. In the Achievement Exhibition of 2004, campus settings such as classrooms, campus stores, and educational gardens were designed in the exhibition hall to introduce concepts and ideas of recycling, soil permeability and water retaining capability. Unlike the precedent 2004 exhibition comprising fragments of knowledge, the "Planting Trees vs. Educating the Young: Taiwan Sustainable Campus Achievements" exhibition of 2009, systematically categorized exhibits into different sections of "Low Carbon Lifestyle and Renewable Energy Commercialization", "Healthful and Efficient Learning Environment", "Sustainable Ecosystems", and "Sustainable Campus Education", providing a more complete and systematic presentation of in a museum setting and corresponding more to the expectation of the academic circle and professionals. A survey of the visitors was also conducted through questionnaire during the 2009 exhibition to study audiences' familiarity with the topics as well as efficacy of the exhibition. Results showed that visitors did benefit from the exhibition in understanding more of the concepts of "Sustainable Campus", while the concept of sustainable energy, to certain extent, also inspired the introduction of NSTM.

KEYWORDS: Sustainable Campus Education, environmental knowledge, exhibition, green museum.

1 FOREWORD

In the aftermath of the 921 earthquake, Taiwan took a completely revolutionary approach to the problem of rebuilding. Sustainable campus promotion uses sustainable business concepts in the building of green ecological campuses. The concepts are then extended outward from the campuses to promote the full recovery of industry and infrastructure in communities all around Taiwan and create low polluting living environment to make progress towards sustainable development.

Characterized as an education reform taking local circumstantial measures and giving equal consideration to both software and hardware, Taiwan Sustainable Campus Program aims at creating a progressive, safe, sanitary, healthful and human-based learning environment. Comprising various related projects, implementation of the program has transformed diverse technologies into systemized environmental knowledge. For example, in the category of "Resources and Energy Recycling," the knowledge of water recycling that covers rainwater harvesting and water purification is presented in schools.

During the promotion process for the sustainable campus transformation program, National Science and Technology Museum not only played an important role with respect to the recording the development process, different exhibition techniques were adopted to introduce the multi-year achievements of the sustainable campus program and systemized environmental knowledge to the general public.

2 DOCUMENTATION ANALYSIS

2.1 SUSTAINABLE SCHOOL

There are different names for school sustainable development around the world such as sustainable school, eco-school, green school, health school and high performance school. The promotion plans for sustainable campus environment issues at these schools differ based upon the development focus of each country [1].

Derived from the trend of thought of Sustainable Development [2], the concept of Sustainable Campus has been defined by the academic circle as in four aspects: school premise planning and campus management; school environment policies (including school environment audit and survey); teaching and learning based on campus resources; campus life.

The elements and targets at sustainable campus programs in Taiwan mainly focus on the achievement and maintenance of sustainable development campus systems with regard to the school's own campus ecological environment, building space, environmental education, education & environmental management and eco-friendly living practices [3].

2.2 PROGRESS OF TAIWAN SUSTAINABLE CAMPUS DEVELOPMENT

- Green school partner webpage. The green school concept was introduced to Taiwan in 1998. Educators set up a web sharing platform so schools that emphasize environmental education can freely and spontaneously share their experiences over the Internet.
- New campus movement. The 921 Earthquake that struck in 1999 caused serious damage to some school buildings and environmental destruction. From infrastructure requirements to post-disaster awakening, campus rebuilding is not just about making school buildings more sturdy and secure, environmental reconstruction sustainability concepts were also included.
- Green school promotion. Green schools with environmental awareness and practical capabilities create sustainable development learning spaces by employing green building and eco-school environmental reconstruction techniques so that school environments can uphold sustainability, ecology, environmental protection and health principles.
- Sustainable campus program. Develop wide-ranging sustainable campus program through adaption to local conditions, subsidies that encompass both hardware and software and receiving support from green universities and vocational techniques [4]. In view of escalating global warming, "carbon balance" and "wholesome learning" became the centerpiece of the development project.

2.3 MUSEUM EXHIBITS

The shared mission of museums and schools is education. Some of the special characteristics of museum education are: able to be learned by all people, no age or learning time limitations, no course standard, and diverse paths of knowledge transmission. Along with world's growing concern on environmental issues, Sustainable Development has become a shared vision of humanity receiving much attention in all aspects of our society, economies, and environment [5].

Covering awareness, knowledge, attitude, skills, evaluation capacity and participation, the various goals of environmental education, not only reflect sensitivity and sense of responsibility from both individual and group perspectives but address environmental issues with appropriate actions [6]. Museum exhibits can display contents and achievements in a effective way that give more people a chance to understand the importance of environment education and sustainable development [7].

It takes proper processing for information to become knowledge. A museum shall disseminate knowledge with goals in a systematic and well-planned manner [8]. The public listens to museums, and believes what they hear [9]. Museum exhibits use a variety of media to create a context to encourage learning and enable visitors to understand the information transmission method. Therefore, in the museum exhibition area, students learn through real multi-sensory experiences that further enhances the study effects [10].

3 CASE STUDY ON THE SUSTAINABLE CAMPUS EXHIBITION

To present the essence of sustainable development education of Taiwan in museum exhibits, National Science and Technology Museum (NSTM) has been working to the best of our ability and creativity over the years. As part of government plans of promoting sustainability concept, two dedicated exhibition were curated by NSTM with different approaches.

3.1 THE SUSTAINABLE CAMPUS EXHIBITION IN 2004

The National Science and Technology Museum made use of campus space layouts (such as the classrooms, canteen, auditorium and teaching farm), single interactive display units (i.e. recycling classroom desks and chairs to make floor boards and percussion instruments) and presentation activities (i.e. wave power generation and soil water permeability) at the sustainable campus exhibition held in 2004 in order to attract the general public attention to the subject to sustainable campus development.

A variety of exhibits were presented including resource recycling, healthful indoor environment, water resources and energy renewal, and defoliation and compost. A "green" xylophone made from recycled classroom desks and chairs was exhibited in an interactive manner, allowing visitors to play on it and have firsthand experience in material reuse. The importance of water conservation was highlighted by the exhibits of wave power generation, soil permeability and water retaining capability.



Fig. 1.A xylophone made from recycled classroom desks and chairs



Fig. 2. Exhibit of soil permeability and water retaining capability

Based on the concept of sustainable development, a number of display units were kept for reuse in later events [11]. For example, after being re-displayed in other exhibitions in the theme of environment protection, the "green" xylophone was presented to a school, while the display units for rainfall harvesting and reuse were re-displayed in other exhibitions organized by N.S.T.M.

Although the design and planning of the exhibition successfully displayed all key concepts of "sustainability" and awaked visitors' awareness that the improvement of campus environment is feasible, the overall knowledge of material cycles and energy flows in ecosystems was not covered.

3.2 TAIWAN SUSTAINABLE CAMPUS ACHIEVEMENT EXHIBITION IN 2009

At the 2009 Taiwan Sustainable Campus Achievement Exhibition, highlights and information from various examples of adaption to local conditions, transformation results and implementation schedules were converted into exhibit units. The presentation of systematic knowledge was the focus of this exhibit. In other words, the interlocking relationship between natural environment and ecological systems could not be seen as a whole if the exhibit was only displayed in parts. For example, water stability monitoring for school water environment creation, water use and conservation arrangements, rainwater and water recycling and reuse and the eco-technology used with natural filtering cycle systems for drain water cannot be represented by a simple water purification pond. This exhibition drew an excellent response and toured cities such as Taipei and Chiayi. Over 200,000 visitors attended.

The "Planting Trees vs. Educating the Young: Taiwan Sustainable Campus Achievements" exhibition of 2009, systematically categorized exhibits into different sections of "Low Carbon Lifestyle and Renewable Energy Commercialization", "Healthful and Efficient Learning Environment," "Sustainable Ecosystems," and "Sustainable Campus Education," providing a more complete and systematic presentation of environment conservation concepts and knowledge in a museum setting and corresponding more to the expectation of the academic circle and professionals.



Fig. 3. The natural water purification systems

The natural water purification systems on campus utilize rainwater, recycling water, and waste water effectively through various circulation designs. The designs include: 1. Enable the water to circulate naturally because of the difference in height levels. 2. Allow water to be filtered and purified by gravels and plants before going to the ecological water pond. 3. Allow a small ecosystem to filter the water on its own and to revitalize life forms and organisms.

These natural water purification systems help the establishment of an internal water circulation system. It revitalizes water flows in the ecological pond and wetland and promotes water resource reuse. They can also purify the water and minimize water use on campus. The drainage function can help prevent flood.

Chung-li Elementary School in Taoyuan County – natural filtration is conducted via organisms in the water. It offers an ecosystem-friendly learning space for the children.

3.3 QUESTIONNAIRE SURVEY

In 2009, a questionnaire was given to the public at the time of the exhibit to learn about their level of familiarity and effectiveness of the exhibit. The visiting public from January 19 to February 21 served as the population. Purposive sampling was used for surveying at the National Science and Technology Museum exhibition site. For a 95% confidence level, the sample must be 50% of the population so the minimum number for the sample is 384. A total of 968 questionnaires were issued and 968 were received. After subtracting the eight questionnaires that were not completed, there were 960 effective questionnaires that could be analyzed.

As shown in Table 1, most of the visitors in the exhibition, about 60%, are female. In terms of age, children aged 6 to 12 account for about 50% of the visitors, followed by adults aged 30 to 39, youngsters aged 13 to 18, and adults aged 40 to 49. Details are indicated in Table 1.

Table 1. Demographic data of visitors surveyed

	<i>Item</i>	<i>No. of visitors</i>	<i>%</i>
Education background	Elementary school, or below	470	49.0
	Junior high school	78	8.1
	Senior high school	113	11.8
	University/college	243	25.3
	Graduate school, or above	56	5.7
Gender	male	395	41.1
	Female	565	58.9
Age	6-12	462	48.1
	13 ~ 18	121	12.6
	19 ~ 29	78	8.1
	30 ~ 39	155	16.1
	40 ~ 49	121	12.6
	50 and above	23	2.5

3.3.1 GENERAL DISCUSSION

A quiz of seven questions was given to visitors. The first question was to understand their awareness of Sustainable Campus promotion while the other six were to test their knowledge level of this subject. About 66.1% of visitors are aware of the campaign. About half (51.8%) of the visitors got the most difficult question right, and 90.2% got the easiest question right. Details are indicated in Table 2.

Table 2. Exhibition Efficacy

Questions	Answers	Correct answers	
		Counts	%
The timing in promotion of Sustainable Campus		862	90.2
The processes of natural water purification		654	68.8
The use of natural, permeable paving		705	74.3
The handling of high CO ₂ level in a room		841	88.5
Seeds and genetic diversity		493	51.8
The carbon footprint of taking an elevator		695	73.0

In terms of knowledge level of the "Sustainable Campus" subject, education background of elementary school or below as well as children aged 6 to 12 are comparatively lower, while junior high school and graduate school background as well as youngsters aged 13 to 18 are higher.

Adults aged 50 or above as well as university and graduate school background have a better understanding of "The processes of natural water purification" when compared with youngsters aged 13 to 18 as well as high school background.

Adults aged 40 to 49 as well as university and graduate school background have a better understanding of "The use of natural, permeable paving" when compared with youngsters aged 13 to 18 as well as high school background.

University and graduate school background have a better understanding of "The handling of high CO₂ level in a room" when compared with elementary school to high school background.

The question in regard to "Seeds and genetic diversity" is the most difficult question. Only 51.8% of respondents got this question right, while 68.8% to 90.2% got other questions right.

3.3.2 ANALYSIS

This exhibition enabled people who were originally unfamiliar with the concept of sustainable campus to understand its meaning and it was also beneficial to promoting the sustainable campus concept. Results showed that visitors did benefit from the exhibition in understanding more of the concepts of "Sustainable Campus," Results of the survey show that visitors with elementary to junior high school background have less understanding of the topic of "Sustainable Campus." Comprising the majority of visitors to our museum, these groups happen to be the ones unfamiliar with "Sustainable Campus."

Less respondents got the questions "The processes of natural water purification" and "Seeds and genetic diversity" right. As for the former one, although knowledge has been systematically processed, the vast amount of information makes it difficult for visitors to grasp without the aid from a docent, while the eye-catching water plants actually distract visitors from the point of focus. The contents of genetic diversity are comparatively more abstruse. The UK Pavilion in 2010 Shanghai EXPO highlighted an awesome Seed Cathedral featuring seeds of 60,000 different plants to demonstrate the concept of diversity. With limited space and budget, the exhibition in NSTM is simply incomparable.

The questionnaire is used to understand the public's level of understanding of the exhibit's content. Data analyses show that the promotion of Sustainable Campus campaign does benefit from the theme exhibitions. Further exploration into visitors' environment awareness and changes in attitudes and behaviors could be the focus of similar exhibitions in the future. Special exhibits in the future can study environmental awareness and changes in attitudes and behavior more deeply.

The museum curatorial team make the concept of sustainable campus achievement their own belief in practicing the structure of green museum. The improvements are as follows:

1. Recycling: make interesting science toys by using discarded 3D glasses from IMAX cinema.
2. Collect abandoned architectural materials for restructuring eco garden.
3. Build water recycling system: in order to filter and recycle water, the system collect the rain and make it flows between grass and underground collector automatically.
4. Energy education: besides green house and energetic creative competition, we also introduced ISO50001 standard and got the certificate in 2016. Improve energetic management has become one of the most important feature of the museum.

These are undoubtedly the practice of sustainable campus exhibit.

4 CONCLUSION

The inclusive display of environment knowledge is an important mission of sustainable campus promotion. A holistic view of natural environmental cycles and the implementation details of each field's technology must be adopted to achieve a balance between man and the environment.

Starting from presenting fragments of information in the 2004 exhibition to the systematic knowledge dissemination in the 2009 exhibition, NSTM grows together with the achievements in Sustainable Campus campaign in terms of exhibition approaches and technique. However, there is still room for improvement for the interpretation of certain contents.

Museum could think deep and innovate more in the promotion of environmental protection. With one of the best tools of inter-organizational learning, knowledge can be shared among all affiliates participating in the project, while continual communication and dialogue would enhance self-absorbing capability and create more chances for mutual learning [12]. Through the sustainable campus achievement exhibit and participation in environmental protection issues, the National Science & Technology Museum draws inspiration from the spirit of energy conservation and sustainability during the curatorial process to make progress towards the goal of becoming a green museum.

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APPENDIX

【Questionnaire】 Choose one correct answer for each question:

1. Have you ever heard of the term "Sustainable Campus," a campaign launched by Ministry of Education?
 (1) Yes (2) No (3) Not sure.
2. When was "Sustainable Campus," a campaign that would transform both software and hardware in campuses, launched?
 (1) After the flood caused by Typhoon Morakot on Aug/8/2009
 (2) After 921 Earthquake in 1999
3. To suit the measures to local conditions, land layout and vegetation in a campus can be used for natural water purification. If A denotes submerged plants, B denotes floating plants, and C denotes sandstone and emerged plants, what would be the correct sequence of purification?
 (1) A→B→C (2) B→C→A (3) C→B→A
4. One of the best practices of improving soil permeability and water retaining with local natural resources was presented by Tainan Shuang Chun Elementary School's improvement project of permeable paving. Do you know what material they used?
 (1) Clam shells (2) Fish scales (3) Pebbles
5. If the CO₂ level in a classroom is so high that might jeopardize our health, what would be the correct procedures to handle it that would achieve both energy saving and health and comfort? (A denotes turning on electric fans, B denotes Opening window, C denotes turning on extractor fans)
 (1) A→B→C (2) B→C→A (3) C→B→A
6. Collecting seeds of various plants, Kaoshiung Jin Jhu Elementary School established a Seed Observation Area. What would this practice be in terms of biodiversity in Sustainable Campus campaign?
 (1) Genetic diversity (2) Ecological diversity (3) Species diversity
7. Refer to the calculation of Carbon Footprint in the exhibition, calculate and covert the electricity consumed in operating an elevator to move one storey into CO₂ emission.
 (1) 0.218kg (2) 0.436kg (3) Not sure

【Basic Information】

1. What is your gender? Male Female
2. Which one best describes your age?
 6~12 13~18 19~29 30~39 40~49 50 or above
3. What is your education background?
 Elementary school and below Junior high school High school University/college Graduate school and above

Date:

No.