Botanical education of the Lee Kong Chian Natural History Museum

Botany has always been an inseparable part in natural history as well as in Lee Kong Chian Natural History Museum (LKCNHM). In the museum, botanical education is comprised of three parts, which are indoor exhibition, outdoor gardens and also the exterior landscape of the museum. Regarding botanical education, LKCNHM hence achieved an irreplaceable and unique style of knowledge delivery.

Presenting the significant highlights of the botanical section, this paper serves to provide an ordered presentation of the advantages and disadvantages for the botanical education of Lee Kong Chian Natural History Museum. In addition to analysis, comparison with similar facilities in Hong Kong would also be conducted so as to propose some scopes for LKCNHM that worth further improvements.

Landscaped exterior wall

The exterior wall of Lee Kong Chian Natural History Museum has demonstrated an extraordinary example of botanical landscape design (Figure 1). Viewing from the outside, it looks like an egg that is hatching. The concrete wall represents the shell while the green plants are inside the egg. Apart from its eye-catching appearance and the metaphor of possibilities, the architecture also shows an exemplary balance between construction and environment. (Yabuka, 2015) With a shield of native plants added on the outside, temperature inside the museum can be lowered and thus the extensive use of air-conditioners would be reduced despite the hot and humid weather. As a lively example showing the perfect integration of greenery and architecture, it demonstrates a sound application of botany in daily life and leads the trend of sustainable development.

Figure 1 The exterior wall of LKCNHM (Bao, 2015)

Outdoor Gardens

The outdoor gardens consist of three parts, which are Phylogenetic Garden, Beach to Land Forest and finally the Mangroves, Swamps and Dryland Forest. Species featured in these three gardens come from different habitats, yet they are all endemic to South-east Asia or even to Singapore only.

The first one, Phylogenetic Garden (Figure 2), showcases a wide selection of plants, ranging from mosses and ferns to gymnosperm and angiosperm. Not only does the garden present the evolutionary development of plants, but also allows visitors to learn the taxonomy and diversity of plants. On top of it, the Beach to Land Forest and the Mangroves, Swamps and Dryland Forest, as their name suggest, showcases plants from a series of habitat. With these three outdoor gardens, visitors are able to see beyond the texts and observe the plants closely without going to different habitats. As a result, they can increase their understanding on various plants efficiently and conveniently in a place.

Figure 2 Phylogenetic Garden (Lee Kong Chian Natural History Museum, 2016)

Indoor Exhibition

Unlike the outdoor gardens, exhibits in indoor zones are of various forms. Apart from live sample, herbarium specimens, microscopic slides as well as plant models and videos are also showcased. The various ways of presentation allow visitors to enrich their knowledge in a more interactive and interesting way, which makes their memory last.

Among all the exhibits, the most giant exhibits are models of two flowers,

which are *Rafflesia arnoldii* (Figure 3) and *Amorphophallus titanium*. Although both of these flowers emit a terribly unpleasant smell of rotten flesh, they are not closely related to each other. *Rafflesia arnoldii* has the largest and heaviest single flower whereas *Titan Arum* has the largest unbranched inflorescence, with cluster of flowers arranged on a stem of only one branch. (Davis, 2008) In spite of its terrible smell, these two flowers play a crucial role in South-east Asian tourism industry as travelers love to pay a visit to local villages for observing flowers in person, thus local villagers can benefit a lot from these odorous flowers. (Nazaruddin, Fadilah, Zulkarnain, Omar, Ibrahim, 2014)

Figure 3 3D model of *Rafflesia arnoldii*

Added to flowers, the plant exhibition in Lee Kong Chian Natural History Museum features indigenous tree species as well. Amongst all the tree exhibits shown, the slice of remains of *Hopea sangal*, which is commonly known as Changi Tree or "Chengal Pasir", is undoubtedly the most precious one as it has already been extinct in Singapore. The wood of Changi Tree Changi Tree has great historical value as it gave the name of region near the airport. (Blackburn, 1999) Besides, its wood is exceptionally durable and thus was commonly used to make furniture in the old Singapore.

On top of the Changi Tree, slices of the ten most common trees in Singapore are also featured, including but not limited to Rain Tree and Tembusu Tree. By touching the slices of these ten trees (Figure 4) and using the web gallery of Lee Kong Chian Natural History Museum, visitors can recognize the characteristics of all these trees and distinguish them easily. Furthermore, Wentzscope (Figure 5) is also available in the museum for visitor to observe the microscopic slide and look inside the wood

tissue.

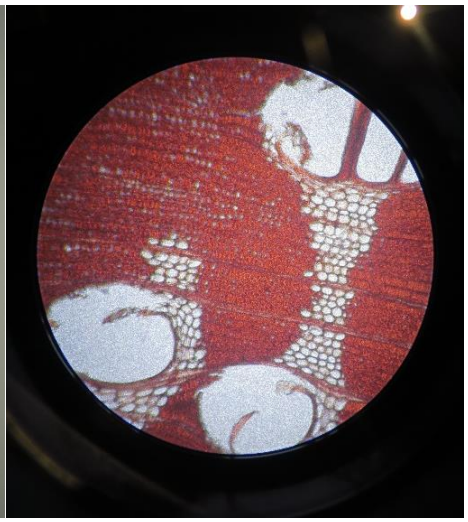

Figure 4 (left) Exhibition of ten most common trees in Singapore
Figure 5 (right) Observation of wood tissue by Wentzscope

Other than flowers and trees, the herbarium sheets of a wide diversity of plants are also featured (Figure 6), from the simple bryophytes to the more complicated gymnosperms and angiosperms. Herbarium sheet is a traditional method of preserving plant specimens. First of all, the specimens need to be spread and dried on newspaper, followed by mounting on white paper and labelling. By looking at various herbarium sheets, visitors can observe the morphological characteristics and differences among the plants clearly, which enhance their knowledge on taxonomy and identification significantly.

Figure 6 Display of herbarium sheets

Apart from just seeing the sample by eyes, there are some more interactive

exhibits which allow visitors to learn in a more interesting way. For example, there is a video clip of an interview with David Middleton about taxonomy. What is more, there is another video clip regarding the use of DNA technology for origin tracking. In the video, the wooden material of a piece of furniture found in Singapore can be originated in other part of Southeast Asia, reflecting that fact of flourish trade in timber around the area. Making appropriate use of the above resources, visitors can learn by using various senses, such as sight, hearing and touch, which allows them to have deep impression and unforgettable memory about what they learn in the museum.

Advantages

With a combination of both indoor and outdoor botanical exhibition zones, Lee Kong Chian Natural History Museum enables visitors to learn from different perspectives in only a place, the museum. As a museum in a university, in spite of its limited land resources, LKCNHM makes good use of space and simulates a selection of habitats, including mangrove, swamp as well as beach and rainforest, so as to present various plant types to visitors. More amazingly, the exterior wall of the museum is used for planting species that are from coastal cliffs. LKCNHM, frankly speaking, is not a giant place but it still offers a wide range of exhibits to visitors. As a result, without going to different places and exhibitions, visitors can still enjoy both indoor and outdoor learning experience. They can enrich their knowledge on plants from models, photos and interactive videos in indoor exhibition zone whereas the outdoor garden allows them to see beyond the screen or pictures to gain more in-depth learning experience in person.

Specifically, the indoor botanical exhibition zones provides intriguing learning experience to visitors by different sorts of exhibits. Unlike the traditional museum, exhibits in Lee Kong Chian Natural History Museum are not only limited to text and photos, but include 3-dimentional models as well as microscopic slides and videos. As a result, student can learn more efficiently beyond the text and photos. The huge 3D model magnifies the characteristic of plant species while the microscopic slides allows students to see beyond their bare eyes. Furthermore, the museum also created the web gallery that include even more text description and photos of the showcased plants. Visitors can simply use their mobile phone or other gadgets to browse the online gallery immediately and thus enhance their leaning journey with the museum.

In addition, the botanical education of Lee Kong Chian Natural History Museum

is not only regarding taxonomy and identification of different plant species, but also about the application and daily life. First of all, the exterior design of the museum is already an excellent example showcasing the balance between environment and architecture. Apart from decoration, the green plants on wall also serves as a shield that reduces heat emitted to the museum, and thus the use of air-conditioners can be minimized. More surprisingly, the green wall is also part of exhibition that showcases plant species from the cliffs near coastal area or on islands. Other than the green wall, there are also videos about timber trade and tracking the origin of trees. On top of basic theory of taxonomy and identification, LKCNHM also focuses on the inseparable relationship between plants and modern life. It makes visitors feel that botanical theory is not that distant from ordinary life, and thus arouses their interest in botany.

Disadvantages

Lee Kong Chian Natural History Museum showcased over 30000 plants specimens, however, the displaying method of some exhibits is rigid and boring. As a result, visitors may have their mind boggled when overwhelming by the giant amount of displays in such a short visiting time. The showcase of herbarium sheets, sorry to say, is an example. Apart from introducing the most common way of preserving sample, the display of herbarium sheets also aims at showcasing the diversity of various plants, ranging from mosses to gymnosperms and angiosperms. In the exhibition, 24 herbarium sheets are simply hung up in two separate showcases with very little explanatory note, thus making it quite tedious. First, it is not easy to read all the words on herbarium sheets clearly, it would be quite difficult for visitors to comprehend the information. Furthermore, linkage among various herbarium sheets are not well shown, ordinary visitors may find it difficult to appreciate the diversity of plants. It is undeniable that LKCNHM has done an excellent job in maintaining the quality of different exhibits, especially those with great historical value. Nonetheless, it would be better if more explanatory graphics and notes could be inserted.

Furthermore, as mentioned, Lee Kong Chian Natural History Museum created the online gallery for visitors to access for further information of different plants, however, it is not a convenient way for every visitors. It is because visitors need to prepare their own gadgets and get connected to the internet by themselves. Although there is a QR code printed on the visitors' guide brochure, it is not an easy way for some visitors. Firstly, as the e-gallery is a website but not a mobile application, not everyone would have prepared suitable gadget, such as iPad and tablet, for browsing

the online gallery. It would be difficult to read the website via mobile phone as there is a huge amount of information on every page. Secondly, not every visitors would have their gadget connected to the internet and thus the online gallery. Since there is no WiFi spot provided in the museum, it is not convenient for visitors, particularly foreign tourists and those who do not have data plan in their gadget, to access the online gallery for better understanding of the exhibits. It would be better if tablet computers are directly available in the museum.

Comparison with Hong Kong

As mentioned, Lee Kong Chian Natural History Museum mainly consists of two parts, the outdoor gardens and the indoor exhibition zones. As there is no similar one-stop natural history learning centre in Hong Kong, comparison would be made separately for the outdoor and indoor parts. Hong Kong Zoological and Botanical Gardens as well as Hong Kong Science Museum are compared with the outdoor and indoor divisions respectively.

Comparison with Hong Kong Science Museum

As its name suggests, Hong Kong Science Museum educates about various branches of science, such as life science and energy. By the end of 2016, there will be an entirely new permanent exhibition, the Biodiversity Gallery, which comprised Local Diversity Zone and Changes through Time. (Hong Kong Science Museum, 2015) As a result, more local natural history elements will be added to Hong Kong Science Museum. Still, since it is not specialized in local natural history, the number of exhibits regarding local plants is not as huge as Lee Kong Chian Natural History Museum. Also, the information provided in Hong Kong Science Museum is not as detailed and comprehensive as LKCNHM. Nonetheless, the delivery ways of botanical education by Hong Kong Science Museum are more diversified and lively. Apart from models and exhibition boards, which can also be found at LKCNMH, Hong Kong Science Museum also offers mini theatre and virtual binoculars (Figure 7) for botanical education. In the mini-theatre, short video and interactive mini-games about local plant species is played so that visitors can learn more about local plants in an intriguing way. What is more, by using the virtual binoculars, visitors can observe a number of local plant species in various habitats in Hong Kong, like wetland, without going in person. All in all, these two museum are of different styles and have different strength and weakness. Hong Kong Science Museum is more suitable for children and family activities whereas Lee Kong Chian Natural History Museum is

made for students which better knowledge background in Biology.

Figure 7 Virtual binocular (left) and its view (right)

Comparison with Hong Kong Zoological and Botanical Gardens

Although both of these garden feature local plant species, the division and presentation of outdoor gardens in Hong Kong Zoological and Botanical Gardens and Lee Kong Chian Natural History Museum are entirely different. The former one includes Green House, Herb Garden (Figure 8), Fountain Terrace Garden as well as six thematic gardens, such as Bamboo Garden and Palm Garden. Meanwhile, the latter one consists of Phylogenetic Garden, Beach to Land Forest and finally the Mangroves, Swamps and Dryland Forest. It is because Hong Kong Zoological and Botanical Gardens aims at displaying plants in a more natural way. It hence displays a greater diversity of plants in the same habitat, which is the terrestrial land. On the other hand, LKCNHM aims at creating a wide range of habitats, such as mangrove and freshwater swamps, for different plants artificially. Compared to Hong Kong Zoological and Botanical Gardens, LKCNHM displays plants from a greater variety of habitats but the diversity of plants shown for each habitat is lower. Also, the number of collections displayed in LKCNHM is also greater. To summarize, the goals of these two gardens are different. Lee Kong Chian Natural History Museum enables visitors to observe different plants in person without going to various habitat whereas Hong Kong Zoological and Botanical Gardens allows visitors to appreciate the natural beauty of different plant species.

Figure 8 Herb Garden (left) and its information card (right)

Improvements

It is undeniable that Lee Kong Chian Natural History Museum showcases a giant number of exhibits. Yet, in order to raise the learning effectiveness and efficiency of public visitors and make LKCNHM a more child- and family-friendly activity spot, the presentation way of LKCNHM requires some room for improvement.

First, the presentation approach of Lee Kong Chian Natural History Museum can be more interactive. Although there is a wide selection of multimedia exhibits, such as 3D model and video, the exhibition would be better if the information is shown in a more interactive way. For example, mini-games about exhibition content can be provided through touch screen so that visitors can have deep impression about what they learn. What is more, similar to Hong Kong Science Museum, a wide selection of virtual journey routes can also be offered via technological equipment so that visitors can choose where they are interested to go for virtual observation. In these ways, visitors can be more involved in the exhibition as their responses are important, and thus their learning efficiency and effectiveness can be enhanced.

Secondly, mobile gadget can be provided for visitors to browse the online gallery. As mentioned, Lee Kong Chian Natural History Museum created an online gallery website for visitors to look for supplementary information yet it is not convenient for visitors. Since each page of the online gallery contains a huge amount of information, it is time-consuming to load the webpage. Therefore, it would be better if an efficient mobile applications can be created for visitors' use. What is more, mobile gadget with supplementary information could also be made available for visitors. The tablet

computers, for example, can be installed in the museum so that visitors can access online gallery in the museum whenever they want. In this way, so that visitors do not need to handle the network connection issues by themselves.

Lastly, more thematic zones can be established in outdoor gardens of Lee Kong Chian Natural History Museum to enrich visitors' experience. Apart from the existing gardens that present the trend of plants through different habitats and evolution, focus can also be put on some specific topics. For example, Hong Kong Zoological and Botanical Gardens established Herb Garden that features a number of medicinal plants. Through visiting the garden, the public can increase their understanding on Chinese medicine as well as the close relationship between plants and human-being. In addition to medicinal plant garden, it would also be better if there are thematic gardens showing plants with specialized structure in LKCNHM, such as the haustorium of parasitic plants and pitchers of pitcher plants. The indoor zone of LKCNHM has showcased the sample of the aforementioned plants, with the chance to observe the living sample closely, visitors' understanding would be effectively increased.

Conclusion

As the only museum showing natural history in Singapore, it is no doubt that Lee Kong Chian Natural History Museum takes a significant and irreplaceable role in Singaporean botanical education. Added to a giant number of exhibits in indoor zones and living plant samples in outdoor gardens, the architecture of the museum is also a vivid example featuring the balance of environment and development. Nonetheless, the general public with little background in science may easily be flooded with such a huge amount of botanical information. Therefore, the presentation of the exhibits in indoor exhibition zones still needs improvement so as to enhance visitors' learning efficiency. The wise use of information technology and interactive tools are some of the key solutions. Besides, for the outdoor zone, in order to make it consistent with indoor exhibition and become more intriguing, more thematic gardens could be established. With the above effort, there is much likelihood that LKCNHM can become a more popular spot for children, students and families in Singapore.

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