



Educational and enjoyment benefits of visitor education centers at botanical gardens

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ABSTRACT

The beautiful scenery and rich diversity of plant species in their living collections have been helping botanical gardens (BGs) attract visitors and thus serve as a base for public education on biodiversity. However, outdoor plant collections and landscape provide limited information for interpreting the field of biodiversity science as a whole. As a complement, a new tendency is to set up visitor education centers (VECs) inside BGs. In order to understand the extent that VECs can enhance the educational function of BGs, we conducted a study in five BGs containing VECs throughout mainland China. Our study indicated that the educational function of VECs worked fairly well despite the great variation among the BGs' VECs. In all five BGs investigated, visitors to the VECs believed that they gained significantly more knowledge compared to those that did not visit VECs. Meanwhile, the VECs' educational roles were significantly associated with demographic characteristics. In most BGs, visitors that were older, with a lower educational level, from a non-local province as well as those who had visited the garden more than once tended to have a better experience in learning compared to those who did not visit the VECs. Furthermore, in two of the five BGs, visitors to the VECs had significantly higher satisfaction than those who did not visit the VECs. The study results highlight the importance of improving educational facilities such as setting up VECs to allow BGs to play a better role in biodiversity conservation.

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1. Introduction

Botanical gardens have become some of the most popular travel destinations and entertainment sites for local people, attracting more than 200 million visitors annually (Willison, 2006). Throughout history, the primary purpose for establishing BGs was to collect and preserve medicinal plants (IUCN, 1989; He et al., 2005). However, the functions of a modern BG have moved beyond plant collection. Public education, ex-situ conservation, and scientific research have been proposed as three major roles that BGs need to play (Wyse Jackson and Sutherland, 2000). Furthermore, the International Agenda including the Convention on Biological Diversity and the Global Strategy for Plant Conservation, emphasizes the need for BGs worldwide to target education as an important component of biodiversity conservation and highlight the need to increase the understanding and awareness of the value of biodiversity (UNEP, 1992; CBD, 2002). Thus, education is becoming one of the fundamental tasks for modern BGs.

New tendencies have also emerged in many BGs in terms of educational context, from the traditional training in botany and horticulture to biodiversity science, with the focus on enriching

visitors' knowledge of the environment and enhancing environmental consciousness, although the degree of this shift has varied among different BGs (Miller et al., 2004). Biodiversity science is the scientific study of the nature and status of Earth's biodiversity with the aim of protecting species, their habitats, and ecosystems from excessive rates of extinction. BGs harbor unique advantages for biodiversity science education. The rich plant collections in BGs can provide visual illustrations of the diversity of the plant kingdom and the beauty of plant diversity. BGs might be the only places in some cities where people can touch nature and learn about plants (Willison and Greene, 1994). Many BGs are research institutes with expertise in biodiversity science, which can provide updated knowledge-based educational programs and present the urgency of environmental protection, both locally and internationally (Barata et al., 2006).

The educational programs inside BGs are usually conducted outdoors (Dillon et al., 2006). Traditionally, BGs have employed some interpreting facilities such as plant labels, posters, and nature trails (He et al., 2005). Although these outdoor facilities may easily be incorporated into a garden's landscape and beautiful scenery, they often suffer from a limitation in relation to presenting the entire field of biodiversity science. Therefore, to complement these outdoor facilities, some indoor facilities such as visitor education centers (VECs) have been set up in some BGs. An estimation from the Botanical Garden Conservation International (BGCI) database indicated that about 10% of the 2820 botanical gardens worldwide

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have established educational facilities like VECs. It has become a common practice for BGs to use VECs to perform educational functions (Wyse Jackson and Sutherland, 2000).

VECs are facilities that are affiliated with BGs, national parks, or other tourist destinations, which feature displays about regional natural history, botany, and horticulture. In contrast to formal museums, which often focus on housing and caring for collections of artifacts and other objects of scientific, artistic, or historic importance, VECs place emphasis on display and education. Most VECs use voucher specimens, panels, and some participatory displays to present knowledge and stories. Some VECs may also include an information desk, bookstore, lecture room, and temporary themed exhibitions. Nonetheless, the main purpose of a BG's VECs is to promote its educational function.

However, so far, few studies have examined the extent that a VEC in a BG can enhance its educational function. Numerous studies have been conducted to explore the impact upon visitors of visiting a traditional museum (Dufresne-Tasse and Lefebvre, 1994; Borun et al., 1995; Prideaux and Lee-Jaye, 1999; Jeong and Lee, 2006). Compared to museums, zoos, and other learning institutes, it has been found that BG visitors are probably "less motivated to learn" (Bitgood, 2002; Ballantyne et al., 2008). Therefore, there is still a question about the best setting for education or learning in a BG such as VECs.

The degree of satisfaction has been used to evaluate tourists' experiences (Bramwell, 1998). Positive feelings about the goods or services of a travel destination could lead to another visit and attract other potential tourists (Bramwell, 1998; Kozak and Rimmington, 2000; Oppermann, 2000). However, a visitor's satisfaction is a complex mental process and is influenced by the visitor's travel motivation (Fodness, 1994; Gnoth, 1997), tourist attraction's carrying capacity (Manning et al., 2002), and so on. Therefore, it would be worthwhile to explore how the VECs in BGs affect visitors' satisfaction. An understanding of the effect of visiting a VEC on satisfaction would contribute to the evaluation of the VEC's educational function.

In this study, we established the following two hypotheses: (1) A functional VEC in a BG can improve visitors' experiences in relation to knowledge acquirement. As mentioned above, the outdoor interpretation system in a BG might not be sufficient to provide relevant information about plant science and biodiversity conservation. As a complement, a VEC might be helpful in improving the visitors' accessibility to information related to conservation and botany while visiting the BG. (2) Although EDUCATION is not the primary objective of most visitors (Darwin-Edwards, 2000; Connell, 2004; Crilley and Price, 2005; Ballantyne et al., 2008; He and Chen, 2011), as an unexpected additional experience, visiting a BG can help them update their knowledge. Thus, a functional VEC may also enhance visitors' satisfaction. We intended to test these two hypotheses using an experimental investigation.

2. Material and method

2.1. Research sites

Among the 200-plus botanical gardens or arboreta in China (Wen, 2008), about 20 BGs contain VECs (authors' observation). In order to ensure a broad geographical representation and sufficient sample size based on the total number of visitors annually (Table 1), the following 5 BGs were selected as the research sites: Xiamen Botanical Garden (Xiamen BG); Wuhan Botanical Garden, Chinese Academy of Sciences (Wuhan BG); Beijing Botanical Garden (Beijing BG); Kunming Botanical Garden, Chinese Academy of Sciences (Kunming BG); and Xishuangbanna Tropical Botanical

Garden, Chinese Academy of Sciences (XTBG) (Fig. 1, Table 1). Both the Xiamen BG and the Beijing BG are administered by the Urban Construction Bureau, while the other three BGs are affiliated with the Chinese Academy of Sciences. The basic information on these BGs and their VECs is listed in Tables 1 and 2.

2.2. Questionnaire design

A two-page questionnaire (in Chinese) was prepared for the interview (Appendix A). The questionnaire included questions related to the following areas: (1) main objectives of the visit, (2) experience during the visit, (3) degree of satisfaction with the visit, and (4) demographic information of the interviewees.

We used the Likert Five-point Scale with the choices of "very disagree, disagree, neutral, agree, and very agree" to examine the degree of experience gained from the visit, with scores of 1, 2, 3, 4, and 5, respectively, distributed to the choices. Nine descriptions were used in the questionnaire, including three statements about knowledge acquirement and six about other experiences (Appendix A). We used the following three questions/statements to examine the satisfaction degree for the visit: "willing to revisit," "willing to recommend the site to friends and colleagues," and "assessment of the entrance fee" (Anderson, 1996; Yoon and Uysal, 2005; de Rojas and Camarero, 2008). We examined the first two statements using the Likert Five-point Scale, while the last question was examined by a structured choice (Appendix A). A brief introduction of the survey and concise and clear instructions about how to fill in the questionnaire were also distributed.

An on-site survey was carried out at the main exit of each BG to ensure that the respondents had finished touring the garden. With the exception of XTBG, the BGs did not provide a tour guide during a visitor's tour; the visitors often walked around the gardens based on their own preferences. For XTBG, about 50% of the visitors asked for an XTBG tour guide (authors' observation), where the interviewees in this study included both visitors with tour guides and those without tour guides. In order to avoid any bias while sampling the interviewees, from 10:00 to 17:00 each day, we randomly selected visitors and invited them to complete the questionnaire; this was continued until we had a sufficient number of respondents. We tried to interview <40 visitors per day (the number occasionally reached 70 interviewees per day because of the extremely high number of visitors). In order to verify whether they had visited the VEC inside, a photo of the VEC was shown to the respondents when they answered this question. The questionnaires that were carefully completed, with all of the questions answered, were considered to be qualified questionnaires. When the interviewees filled in the questionnaire they were always next to one of the authors (He). It was obvious that insufficient attention was given to about 5–15% of the questionnaires, and these were excluded from the statistics. The survey was conducted from July to October of 2009, and in January of 2010, with ~20 days and ~400 questionnaires per BG, for a total of 114 days for all 5 BGs with 1865 qualified questionnaires (~85% of the collected questionnaires qualified). The sample size and information about the interviewees' social demographic characteristics are listed in Table 3. The time period for each group of interviews was primarily based on the authors' availability and scheduled to avoid special exhibition activities in the target BGs.

2.3. Data analysis

We used a backward conditional linear regression to test the influence of VEC visitation on the travel experience (Gelman and Hill, 2007), as well as the effect of the demographic characteristics

Table 1
Basic information on botanical gardens (BGs) in this study.

BGs	Year established	Area (ha)	Annual visitors	Species collected (Taxa)	Accessibility	Entrance fee (RMB)
Xiamen BG	1960	227	1,000,000	6300	Within city	40
Wuhan BG	1956	70	700,000	7500	10 km from downtown	30
Beijing BG	1956	400	2,500,000	10,000	23 km from downtown	5 (50 RMB extra to enter greenhouse)
Kunming BG	1938	39	400,000	4000	11 km from downtown	8
XTBG	1959	1100	600,000	12,300	Countryside, 57 km from the nearest airport	80

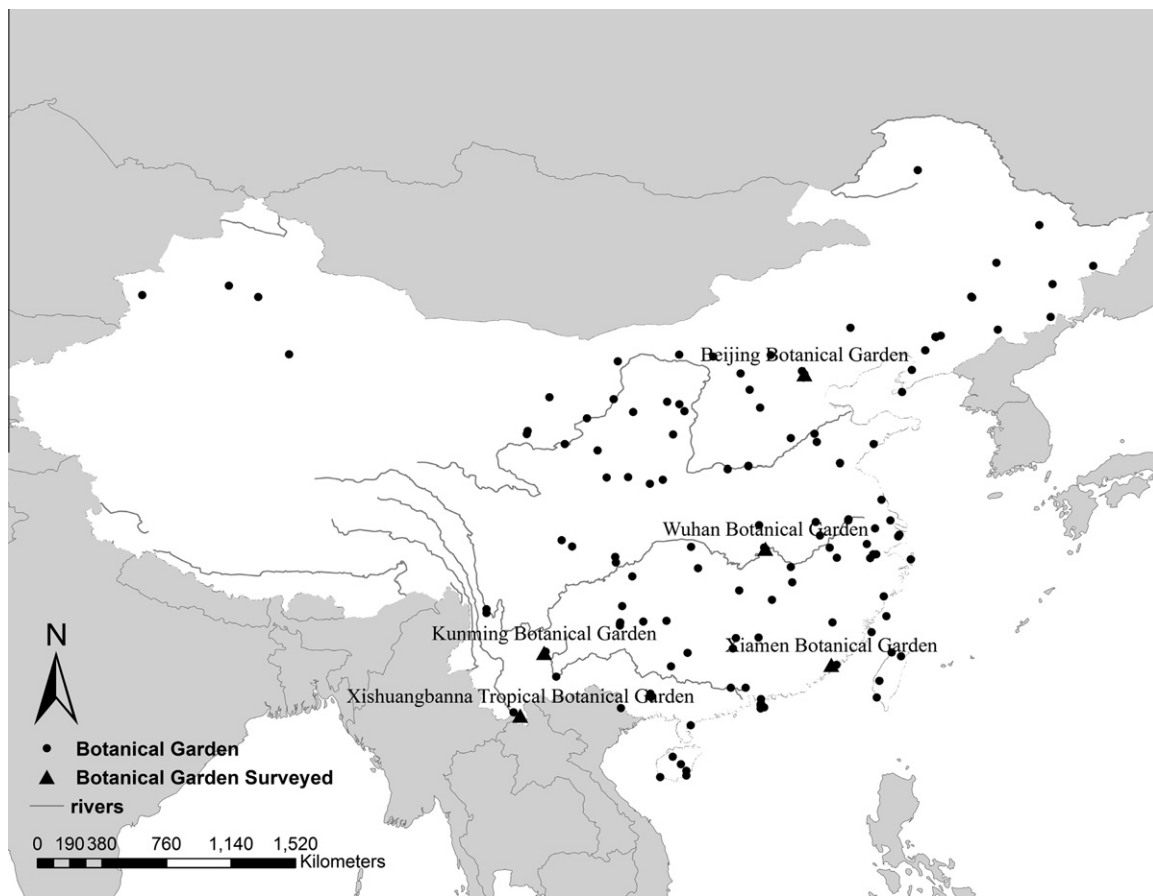


Fig. 1. Distribution map of Chinese botanical gardens (after He et al., 2005) and five botanical gardens surveyed in this study.

Table 2
Basic information on visitor education centers (VECs) in this study.

BGs	Year established	Size (m ²)	Theme of exhibition	Items of services
Xiamen BG	2009	574	Garden introduction and information about plants, birds and insects in the garden	Interpreters, activity area for kids, takeaway brochure
Wuhan BG	2006	1000	Botany, BGs around the world, exhibition for three gorges, wetland, and nearby protected area	Electronic interpretation
Beijing BG	1996	800	Flower exhibition, environmental health, information on national plants	Interpreters on request
Kunming BG	2001	320	Botany and plant usage	Interpreters
XTBG	2004	2200	Tropical rainforest and its natural history; indigenous knowledge and cultures of ethnic groups; tropical plant usage	Interpreters, takeaway brochure, bookshop

Table 3
Proportion (%) of respondents in different categories in each BG.

Categories	Xiamen BG	Wuhan BG	Beijing BG	Kunming BG	XTBG
No. of respondents (No. of VEC visitors)	402 (122)	401 (132)	262 (49)	400 (229)	400 (287)
<i>Gender</i>					
Male	39	43	47	46	53
Female	61	57	53	54	47
<i>Age</i>					
<20	19	22	8	24	5
20–30	31	41	47	51	39
31–40	30	25	33	16	32
41–50	12	7	6	5	16
>50	8	5	6	4	8
<i>Educational level</i>					
High school	30	32	16	23	22
Junior college	21	19	23	28	33
College/university	40	38	38	45	38
Graduate school	9	11	23	4	7
<i>Residence</i>					
Local province	55	74	55	80	22
Other provinces	45	26	45	20	78
<i>Company</i>					
Alone	4	3	5	3	3
Family	62	66	56	38	27
Friends/colleagues	34	31	39	59	70
<i>Monthly income (RMB)</i>					
<2000	44	59	36	74	40
2000–4000	34	30	31	23	46
>4000	22	11	33	3	14
<i>BG attendance</i>					
1st time	54	66	29	47	85
2nd time	6	15	8	15	9
3rd time or more	40	19	63	38	6
<i>Time spent in BG</i>					
Less than 1 h	2	2	1	2	0
1–2 h	32	28	10	14	18
2–3 h	38	51	40	31	63
3–5 h	21	15	35	41	16
More than 5 h	7	4	14	12	3

Table 4
Linear regression analysis of variables for VEC visitors versus VEC non-visitors.

Items of travel experiences	Xiamen BG			Wuhan BG			Beijing BG			Kunming BG			XTBG		
	β	<i>t</i>	<i>P</i>	β	<i>t</i>	<i>P</i>	β	<i>t</i>	<i>P</i>	β	<i>t</i>	<i>P</i>	β	<i>t</i>	<i>P</i>
EXP 1	0.287	3.569	0.000	0.022	0.309	0.757	0.073	0.765	0.445	−0.006	−0.090	0.928	0.082	1.153	0.250
EXP 2	0.348	4.121	0.000	−0.003	−0.039	0.969	0.144	1.207	0.229	0.107	1.400	0.162	0.111	1.373	0.170
EXP 3	0.429	4.964	0.000	0.214	2.579	0.010	0.378	2.739	0.007	0.221	2.754	0.006	0.165	2.033	0.043
EXP 4	0.254	3.628	0.000	0.040	0.602	0.547	−0.040	−0.355	0.723	0.024	0.367	0.714	0.028	0.372	0.710
EXP 5	0.348	4.163	0.000	0.124	1.597	0.111	0.056	0.392	0.695	0.158	1.797	0.073	−0.032	−0.433	0.665
EXP 6	0.300	3.877	0.000	0.114	1.466	0.143	0.375	2.980	0.003	0.141	1.726	0.085	0.148	2.032	0.043
EXP 7	0.437	4.778	0.000	0.267	3.245	0.001	0.501	3.909	0.000	0.255	2.843	0.005	0.290	3.015	0.003
EXP 8	0.176	2.391	0.017	−0.054	−0.712	0.477	−0.090	−0.809	0.419	0.106	1.356	0.176	−0.019	−0.268	0.789
EXP 9	0.485	5.186	0.000	0.170	1.880	0.061	0.216	1.568	0.118	0.311	3.439	0.001	0.284	3.305	0.001

Items of travel experiences: EXP 1: Feeling relaxed; EXP 2: Improving friendship; EXP 3: Gaining botanical knowledge; EXP 4: Getting close to nature; EXP 5: Seeing many exotic plants; EXP 6: Learning about a variety of plants; EXP 7: Gaining knowledge on environment protection; EXP 8: Enjoying beautiful garden views; EXP 9: Learning about various uses of plants.

associated with VEC visitation. The scores for each statement about the experience gained were regarded as the dependents while whether the visitors had visited the VEC and their demographic characteristics were regarded as the independents. The same method was adopted to test the influence of VEC visitation on the satisfaction degree. A U-test was used to examine the significance of VEC visitation in relation to the knowledge-related experiences and satisfaction degree. All of the calculations were performed using SPSS version 13.0 in a significant level of 0.5.

3. Result

3.1. Effect of VEC visitation on visitors' experiences

In all five BGs investigated, visitors to the VECs believed that they gained significantly more knowledge on plants (refer to experience 3) and environmental protection (refer to experience 7) compared to those that did not visit VECs, which was indicated by both the U-test and backward conditional linear

Table 5

U-test comparing differences in three knowledge-related statements between VEC visitors and VEC non-visitors.

BGs	Knowledge-related statement	Values (mean \pm SD)			Analysis
		VEC visitors	VEC non-visitors	U-value	
Xiamen BG	EXP 3	4.34 \pm 0.70	3.89 \pm 0.83	12019.0	0.000
	EXP 7	4.25 \pm 0.77	3.78 \pm 0.88	11941.5	0.000
	EXP 9	4.16 \pm 0.73	3.65 \pm 0.92	11791.0	0.000
Wuhan BG	EXP 3	4.14 \pm 0.81	3.93 \pm 0.79	14985.5	0.006
	EXP 7	4.14 \pm 0.78	3.86 \pm 0.80	14334.5	0.001
	EXP 9	3.96 \pm 0.92	3.80 \pm 0.89	15856.0	0.065
Beijing BG	EXP 3	4.04 \pm 0.73	3.64 \pm 0.91	3933.0	0.005
	EXP 7	4.14 \pm 0.79	3.62 \pm 0.83	3412.5	0.000
	EXP 9	3.92 \pm 0.89	3.58 \pm 0.88	4070.5	0.011
Kunming BG	EXP 3	4.02 \pm 0.77	3.80 \pm 0.82	16719.5	0.006
	EXP 7	3.85 \pm 0.87	3.57 \pm 0.98	16338.5	0.003
	EXP 9	3.95 \pm 0.90	3.63 \pm 0.90	15519.0	0.000
XTBG	EXP 3	4.31 \pm 0.68	4.11 \pm 0.81	14119.5	0.025
	EXP 7	4.22 \pm 0.86	3.92 \pm 0.89	12948.5	0.001
	EXP 9	4.29 \pm 0.75	3.99 \pm 0.84	13030.0	0.001

Items of knowledge-related experiences: EXP 3: Gaining botanical knowledge; EXP 7: Gaining knowledge on environment protection; EXP 9: Learning about various uses of plants.

Table 6Linear regression analysis of VEC visitation associated with demographic characteristics on knowledge-related experiences^a.

BGs	Knowledge-related experiences	The interaction of demographic characteristics and VEC visitation	Adjusted R^2	β	t	P
Xiamen BG	EXP 3	Gender	0.059	0.264	5.092	0.000
	EXP 7	Residence	0.057	0.307	2.679	0.008
	EXP 9	Residence	0.062	0.173	2.072	0.039
Wuhan BG	EXP 3	Times	0.062	0.131	2.328	0.020
		Age	0.047	0.257	4.366	0.000
		Education	0.047	-0.152	-2.720	0.007
	EXP 7	Residence	0.043	0.246	2.252	0.025
	EXP 9	Age	0.037	0.267	4.099	0.000
Beijing BG	EXP 3	Education	0.037	-0.185	-2.987	0.003
		Times	0.028	0.160	2.932	0.004
		Residence	0.057	0.317	4.097	0.000
	EXP 9	Education	0.042	-0.261	-2.418	0.016
	Kunming BG	EXP 3	Income	0.018	0.154	2.905
EXP 7		Age	0.039	0.132	2.257	0.025
		Education	0.039	-0.136	-2.562	0.011
		Times	0.027	0.134	3.471	0.001
EXP 9		Education	0.025	-0.100	-2.163	0.031
XTBG	EXP 3	Residence	0.025	0.162	2.345	0.019
		Residence	0.023	0.158	3.212	0.001
		Education	0.043	-0.102	-2.061	0.040
	EXP 7	Residence	0.043	0.193	2.594	0.010
	EXP 9	Times	0.043	0.159	2.188	0.029

Items of knowledge-related experiences: EXP 3: Gaining botanical knowledge; EXP 7: Gaining knowledge on environment protection; EXP 9: Learning about various uses of plants.

^a Only the demographic factors with significant value ($P < 0.05$) are listed.

regression (Tables 4 and 5). For other experiences, significant differences between VEC visitors and VEC non-visitors were presented in the experiences related to learning about a variety of plants (refer to experience 6) in Xiamen BG, Beijing BG, and XTBG, while for the experiences related to learning about the various uses of plants (refer to experience 9), significant differences were found in Xiamen BG, Kunming BG, and XTBG (Tables 4 and 5).

The demographic characteristics showed a significant association with VEC visitation in relation to the effects on the experiences related to knowledge (Table 6). The β value in relation to the place of residence was positive for most of the significant associations, indicating that a VEC has a stronger effect on visitors who come from a non-local province. The β value was negative for education, indicating that a VEC has a weaker effect on visitors with a higher education level. The β value was positive for times visited, indicating that a VEC has a stronger effect on visitors who visit a garden

more than once. The β value was positive for age, indicating that a VEC has a stronger effect on older visitors (Table 6).

3.2. VEC influence on visitor satisfaction

The visitors' satisfaction with BGs was, to some extent, influenced by the VEC visitation. In two of the five BGs, visitor satisfaction was enhanced by paying a visit to the VEC (Tables 7 and 8). In the Xiamen BG, the VEC visitors tended to consider the entrance fee to be more reasonable than the VEC non-visitors. For the statement about being "willing to recommend to friends and colleagues," a significant difference was also observed in the U-test, but not in the regression test. In XTBG, significant differences were shown in all three statements related to satisfaction, indicating that VEC visitors showed a significantly higher satisfaction degree than VEC non-visitors.

Table 7
Linear regression analysis of variable for VEC visitors versus VEC non-visitors on visitors' satisfaction.

Indicator for satisfaction	Xiamen BG			Wuhan BG			Beijing BG			Kunming BG			XTBG		
	β	t	P	β	t	P	β	t	P	β	t	P	β	t	P
SD1	0.139	1.421	0.156	-0.143	-1.591	0.112	0.040	0.395	0.693	-0.040	-0.514	0.608	0.255	2.759	0.006
SD2	0.093	1.108	0.268	0.029	0.360	0.719	0.118	1.250	0.212	0.105	1.447	0.149	0.169	2.293	0.022
SD3	-0.118	-2.124	0.034	0.050	0.945	0.345	0.035	0.703	0.483	0.034	0.853	0.394	-0.119	-2.192	0.029

Indicator for satisfaction: SD 1: Willing to revisit; SD 2: Willing to recommend to friends and colleagues; SD 3: Assessment of entrance fee.

Table 8
U-test for mean value differences in indicators of satisfaction for VEC visitors vs. VEC non-visitors.

BGs	Indicators for satisfaction	Values (mean \pm SD)		Analysis	
		VEC visitors	VEC non-visitors	U-value	P
Xiamen BG	SD1	4.36 \pm 0.92	4.22 \pm 0.90	15223.0	0.058
	SD2	4.56 \pm 0.85	4.46 \pm 0.74	15005.5	0.025
	SD3	1.56 \pm 0.53	1.44 \pm 0.50	15193.0	0.042
Wuhan BG	SD1	4.08 \pm 0.94	4.22 \pm 0.80	16547.0	0.232
	SD2	4.39 \pm 0.78	4.35 \pm 0.77	17199.0	0.571
	SD3	1.48 \pm 0.52	1.45 \pm 0.50	17071.5	0.469
Beijing BG	SD1	4.67 \pm 0.52	4.63 \pm 0.66	5184.5	0.929
	SD2	4.65 \pm 0.48	4.53 \pm 0.62	4812.5	0.322
	SD3	1.08 \pm 0.34	1.05 \pm 0.30	5042.5	0.478
Kunming BG	SD1	4.43 \pm 0.77	4.47 \pm 0.77	18927.5	0.518
	SD2	4.48 \pm 0.72	4.38 \pm 0.71	17770.5	0.074
	SD3	1.14 \pm 0.42	1.11 \pm 0.38	18914.5	0.378
XTBG	SD1	4.18 \pm 0.81	3.92 \pm 0.88	13568.0	0.006
	SD2	4.64 \pm 0.64	4.47 \pm 0.71	13936.5	0.008
	SD3	1.34 \pm 0.48	1.46 \pm 0.50	14316.5	0.030

Indicators for satisfaction: SD 1: Willing to revisit; SD 2: Willing to recommend to friends and colleagues; SD 3: Assessment of entrance fee.

4. Discussion

Although great variation existed in both the scales and themes of the five VECs, the study indicated that visitors to the VECs believed that they gained significantly more knowledge compared to those that did not visit VECs. The study results support the hypothesis that a functional VEC in a BG can improve the visitors' experiences in relation to knowledge acquirement. Furthermore, for two of the five BGs, visitors who visited the VECs even gained significantly higher satisfaction with their tour than the visitors who did not. This result also partly supported the second hypothesis that a functional VEC may also enhance visitors' satisfaction.

All five VECs provided intensive interpretation by means of panels, attractive displays, and some participatory exhibits on various aspects of botanical knowledge, biodiversity, and local natural history, which are fine complements to the outdoor interpretations of the BGs. Museum-like interpretation approaches were found to be very effective in presenting knowledge and propagating information (Ramey-Gassert et al., 1994; Piscitelli and Anderson, 2002). Thus, it is reasonable to conclude that the VEC visitors felt that they had experienced more in relation to "gaining botanical knowledge" and "gaining knowledge on environment protection" than the VEC non-visitors. An alternative explanation for the difference could be related to the fact that, as in most BGs, visiting the VEC was optional for visitors. Thus, the VEC visitors might have had stronger motivations for learning and could have been ready to gain new knowledge and information compared to VEC non-visitors. Determining which explanation is plausible in this study requires further investigation. Nonetheless, the study results strongly suggested that the VECs in BGs do play a significant role in education.

The VECs' educational function appeared to be influenced by the social-demographic characteristics. A similar pattern has been indicated in other researches for BGs or museums (Smith and Wolf,

1996; Packer and Ballantyne, 2005). For example, a study in Australia found that learning and discovery motivated non-local visitors more than local visitors (Ballantyne et al., 2008). In this study, the visitors' age, educational level, residence, and BG attendance were more closely associated with VEC visitors versus VEC non-visitors. The results suggested that if we wanted to make VECs attractive to a much broader range of visitors, some further methods should be incorporated into the VEC displays. For example, the content of a VEC should be updated periodically or provided with some additional short-term theme exhibitions to attract local visitors (Schulhof, 1990). Older people tended to be more strongly influenced by VEC visitation compared to young people, probably because much of the information was more accessible to adults, with only a limited number of displays that fit the interests of teenagers. Returning visitors were more strongly influenced by the VEC than first-time visitors. One reason for this was probably because, compared to the first-time visitors, these individuals might be much more interested in an in-depth exploration of the garden, including the detailed explanations presented in the VECs. However, further evidence is needed for this conclusion.

The VEC's theme may also influence the educational function. Both in the Xiamen BG and XTBG, local natural history was one of the major themes of the exhibitions. Thus, the educational function for non-local visitors was significantly higher than for local visitors (Table 6). Therefore, a careful and thoughtful selection of a VEC's theme would also be important for any new project to establish a VEC in a BG.

Visitor satisfaction could be enhanced by visiting the VECs in two of the five BGs surveyed in this study. This could be more meaningful than the other effects. As mentioned above, BG visitors mostly came to gain access to nature or enjoy the beauty of the plants and landscape, which was indicated by both this study and other studies conducted elsewhere (Ballantyne et al., 2008;

Ward et al., 2010; He and Chen, 2011). However, the additional educational experience in the tour may have made the visitors feel that the visit was more worthwhile. This phenomenon has also been indicated by other studies. For example, Orams (1997) conducted research on the enjoyment of visitors watching dolphins in conjunction with an educational program compared to those without, and suggested that the educational program did enhance the enjoyment of tourists watching the feeding of the dolphins. This result also adds weight to the argument that education should receive greater emphasis in tourism management in BGs. An educational program did not conflict with the BG's entertainment function but could enhance visitors' satisfaction. Emphasizing the educational role of BGs in their public images could also potentially enhance the BGs' attractiveness to visitors.

Why did the two VECs in the Xiamen BG and XTBG appear to be more influential than the others, as they also affected visitor satisfaction? The reason might be complex, and it would be worthwhile to consider the question based on the VECs themselves. Although the VECs in Xiamen BG and XTBG were different from each other, they shared some traits that the other three VECs did not possess. For example, the participatory settings in these two VECs were well designed and easily available to visitors, and some take-away folders were also supplied inside the VEC. The multimedia room, where videos about the BG and plant stories were played every day, provided the visitors with opportunities to sit down and concentrate on more information/knowledge. Novel, creative, and participatory approaches to displays have been repeatedly demonstrated in other studies on the educational function and attraction to visitors (Rennie and McClafferty, 1995; Fallon and Kriwoken, 2002). Various interpretive approaches have been shown to hold visitors' attention and convey themes to them, and exhibitions with interactive displays appeared to be more successful at holding visitors' attention and consequently enhanced the educational functions (Fallon and Kriwoken, 2002).

In this study, we asked visitors for a self-reported assessment of the educational value of the visit. To some extent, the results indicated the degree of educational function for the tour, while not necessarily being indicators of the real knowledge-gain from the visit. Knowledge enhancement from a visit to a collection-based museum or BG is often a very complex psychological process (Dufresne-Tasse and Lefebvre, 1994). How a visitor visiting a VEC in a BG enhances their knowledge requires further investigation.

In conclusion, for the first time, this study presented a comprehensive investigation of the role of the VECs in Chinese BGs. The study results suggested, in general, that the VECs in the BGs investigated show promising results in relation to enhancing the BGs' educational role. Two of the VECs, which had fine designs and more participatory displays, even helped to enhance visitors' degree of satisfaction with their visits to the BGs. Setting up a well-designed VEC in a BG could become a common practice in the establishment of new BGs to improve the BGs' roles in public education. Meanwhile, BGs should add more educational programs in their tourism management, from the perspectives of both conservation-education and entertainment.

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Appendix A. Survey of botanical garden visitors

Thank you for visiting the botanical garden. This survey is to help us understand how you enjoyed your visit. Please fill in the questionnaire according to the instructions. This survey is part of a study, and the information in it is merely for data analysis. Thank you very much.

Part 1. Please check the most accurate choice.

1. How many times have you visited the botanical garden?

A. This was the first time B. This was the second time C. 3 times or more

2. Your motivation of visiting the botanical garden. Please check the selections that best describe your feelings.

Motivation	Strongly disagree	Disagree	No comment	Agree	Strongly agree
To relax	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
To get close to nature	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
To spend time with relatives or friends	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
To gain knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
To get exercises	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
To spend time alone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
To enjoy the scenery	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. Are you willing to re-visit the botanical garden?

A. Definitely not B. Probably not C. Uncertain

D. Probably yes E. Definitely yes

4. Are you willing to recommend the botanical garden to your friends or colleagues?

A. Definitely not B. Probably not C. Uncertain

D. Probably yes E. Definitely yes

5. How long did it take you to complete the tour of the garden?

A. Less than 1 hour B. 1 ~ 2 hours C. 2 ~ 3 hours

D. 3 ~ 5 hours E. More than 5 hours

6. What do you think of the entrance fee for the garden?

A. Expensive B. Reasonable C. Cheap

7. Did you visit the visitor education center during your tour today?

A. Yes B. No

8. Your experience of visiting the botanical garden. Please check the selection that best describe your feelings.

Experience	Strongly disagree	Disagree	No comment	Agree	Strongly agree
Feeling relaxed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Improving friendship	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gaining botanical knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Getting close to nature	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Seeing many exotic plants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Learning about a variety of plants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gaining knowledge on environment protection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enjoying beautiful garden views	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Learning about various uses of plants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Part 2. Your information.

1 . Your gender : A. Male B. Female

2 . Your age : A. Below 20 B. 20-30 C. 31-40

D. 41-50 E. 51-60 F. Above 60

3. Education level : A. High school or below B. Junior college
C. College or university D. Graduate school
4. Residence : A. Local province B. Non-local province
5. Monthly income : A. Less than 2000 RMB B. 2000–4000 RMB
C. More than 4000 RMB
6. You visited the BG
A. Alone B. With family C. With friends or colleagues
D. Other situation

Thank you for your cooperation.

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