

Thoughts on the Planning and Design of Environmental Education Sites From the Perspective of Pro-Environmental Behavior Intervention



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ABSTRACT

Pro-environmental behavior (PEB) can help facilitate sustainable development, and PEB intervention strategies are developed to guarantee PEB effects. However, in most cases PEB intervention is attached less importance than environmental education. There is no specific programming for PEB intervention, and a full-cycle framework for planning and design that includes site operation and maintenance stages is still absent. Based on literature review and the authors' experience on environment education activities, this article summarizes the PEB intervention strategies applicable to landscape planning and design, and comes up with a planning and design framework for environmental education sites, which consists of stages of site investigation, PEB intervention planning, development of design briefs, facility planning and design, maintenance and management programming, post-occupancy evaluation, and adjustment. The framework would provide guidance for the landscape planners and designers to improve PEB intervention effects, and offer new insights and tools for site operators and researchers.

HIGHLIGHTS

- Applies research findings of behavioral intervention in Conservation Psychology into landscape planning and design
- Takes pro-environmental behavior intervention as the base for developing design briefs
- Proposes a full-cycle framework for the planning and design of environmental education sites

1 Sustainability and Pro-Environmental Behavior

Along with global climate change, resource depletion, and biodiversity loss, sustainable development has become a strategic

agenda for many nations^{[1][2]}. Pro-environmental behavior (PEB) that helps facilitate sustainable development^[3] could be fostered by activities ranging from vegetation planting and protection, biodiversity conservation to carbon footprint reduction and

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resource recycling. These activities can take place in community gardens^[4], environmental education bases^[5], natural reserves^[6], special parks/gardens^[7], and national parks^[8]. Since the establishment of China's first launch of environmental education bases for primary and middle school students in 2013^[9], more sites for environmental education have been built over the past decade. By the end of 2021, there had been nearly 200 such sites in Beijing^{[10]~[13]}, including landscape and greenery education bases, eco-civilization promotion and education bases, and garden centers, in forms of community gardens, special parks/gardens, campuses, natural reserves, learning bases^①, and residential areas.

PEB intervention strategies are developed to guarantee PEB effects. Over the past decades, psychologists have been attempting to interpret PEB-related cognitive, emotional, and social factors based on theoretical and empirical research^[14], exploring strategies and measures that help foster PEB^[15] and have been applied in fields of energy^{[16][17]}, ecological conservation^[18], public transportation^{[19][20]}, hotel management^{[21][22]}, public administration^[23], community governance^{[24]~[26]}, industrial design^[27], etc.

As to the research and application of PEB intervention strategies in landscape planning and design, some focuses on physical environment, including landscape narrative design^{[28][29]}, environmental education building designs^[30], visualization of ecological education^[31], and education facility design^{[32]~[35]}; some focuses on intangible resources, including experience sharing about environmental education^{[36]~[38]}, planning of environmental education programs^[39], and organization of public participation^[40]. However, in most cases PEB intervention is attached less importance than environmental education, which is not given enough emphasis in traditional planning and design practice as well. There is no specific programming for PEB intervention, and the form and type of used PEB intervention strategies are also limited. Besides, a full-cycle framework for planning and design that includes site operation and maintenance stages is still absent.

This article attempts to introduce PEB intervention strategies into landscape planning and design by answering the following questions.

① In some existing literatures, the areas for educational purposes in general parks are also regarded learning bases. In this article, learning bases refer to the environmental education sites that are built specially to provide group courses and services on environmental education for schools or organizations.

1) What PEB intervention strategies can be used for environmental education sites?

2) How to integrate PEB intervention strategies into landscape planning and design?

And 3) what should be included in the planning and design framework for environmental education sites?

Based on literature review and the authors' experience on environment education activities, this article summarizes the PEB intervention strategies applicable to landscape planning and design, and comes up with a planning and design framework for environmental education sites that combines PEB intervention with site planning and design methods and stages. The framework would provide guidance for the landscape planners and designers to improve PEB intervention effects, and offer new insights and tools for site operators and researchers.

2 Related Theories and Concepts

2.1 Concepts

Adopted from Conservation Psychology, PEB means the behaviors that "consciously seeks to minimize the negative impact of one's actions on the natural and built world."^[41] Similar concepts include "environmentally responsible behavior," "sustainable behavior," and "conservation behavior."

In Conservation Psychology, PEB intervention is used to encourage PEB^[42]. The environmental education sites discussed in this article refer to public green spaces that introduce PEB intervention strategies into their planning, design, construction, and operation processes, in order to foster and stimulate PEB. The PEB discussed in this article includes individuals' behaviors inside and outside environmental education sites.

Among research efforts, the connotations of environmental education and natural education overlap each other sometime. In practice, natural education focuses more on fostering people's perceptions, feelings, and emotions about the nature and on the alleviation of nature-deficit disorder; while environmental education aims to promote sustainable lifestyles and economic modes, paying attention to both natural and built environments to facilitate behavioral changes. Although the PEB intervention strategies discussed in this article can be applied beyond environmental education purposes, all those scenarios here are referred as "environmental education sites"—this is a conventional term used in the profession, and "site" highlights the close ties of PEB intervention with humans and societies.

Notably, the public green spaces designed without clear goals for PEB intervention are not discussed in this article.

2.2 PEB Intervention Strategies

Adopting the PEB intervention strategies with theoretical basis can effectively promote individuals' understanding and performing of PEB, as well as the establishment of related evaluation methods^[15]. In this article, PEB intervention strategies are selected from *The Oxford Handbook of Environmental and Conservation Psychology*^[43] (published in 2012) and the *Environmental Psychology: An Introduction*^[44] by British Psychological Society (re-published in 2019), both of high authority and comprehensiveness.

Generally, PEB intervention strategies can be grouped as for person-level approaches and context-level approaches^[42]. Table 1 lists nine strategies that are applicable for environmental education sites^{[15][42][45]~[47]}. According to psychological research, person-level strategies that emphasize the bond of inner drive and behavior are applicable for bio-centrics, because these strategies value life and the nature the most. The context-level strategies are more suitable to egoists and altruists, because they value the material benefits, convenience, interpersonal relations, and social honors brought to individuals through PEB^[42]. To maximize the effect of PEB intervention, multiple strategies should be combined in the planning and design of environmental education sites for varied user groups.

Table 1: PEB intervention strategies applicable to environmental education sites

Types	Connotations	Intervention strategies
Person-level	PEB intervention via influencing individual's inner drive, i.e. cognition, consciousness, emotions, and attitudes (Source: Ref. [42])	Goal setting: determining realizable PEB intervention goals (Source: Ref. [15])
		Environmental education: promoting knowledge about and efforts to environmental issues, and offering guidance for related solutions through courses, activities, exhibitions, etc. (Sources: Refs. [42][45])
		Campaigns: increasing the awareness of broad public about environmental conservation (Source: Ref. [42])
		Prompts: providing explicit and direct guidance or warnings for individual's specific behaviors (Source: Ref. [15])
		Commitment: guiding the public to promise in a written form to perform certain PEB, or not perform a behavior having negative impacts on environment (Source: Ref. [15])
		Feedback: informing the public the consequence of their behaviors, such as the consumption of water/power/gas, the amount of carbon footprints, and possible environmental impact (Source: Ref. [15])
Context-level	PEB intervention via changing the surrounding social or physical environments (Source: Ref. [42])	Social norms: social norms refer to the beliefs, attitudes, and behaviors widely accepted by the society, which reflect individual's personal perception about the society; activities, environments, and atmosphere can be created to convince individuals that PEB is favorable, where persuasive technology can be employed in place of manual labor to promote social norms (Source: Refs. [42][46])
		Change/adjustment of behavioral outcome: encouraging individual's certain behaviors with incentives (reinforcers) while using disincentives (punishers) to decrease unexpected behaviors (Source: Ref. [47])
		Convenience: creating favorable conditions or removing barriers to increase PEB (Source: Ref. [47])

NOTE

Persuasive technology can provide "social feedback" with intelligent systems. For instance, human-face robots can warn the user by saying "you have consumed too much energy" or flash red lights when the user's energy consumption exceeds certain standards.

3 Application of PEB Intervention Strategies in the Planning and Design of Environmental Education Sites

Applying PEB intervention strategies in the planning and design of environmental education sites needs to determine specific intervention forms and physical requirements for PEB intervention (i.e. design demands), which should cover the full-cycle process including site investigation, PEB intervention planning, development of design brief, facility planning and design, and operation and management programming (Table 2).

Currently, most planning and design projects lack clear PEB intervention goals, but only some educational courses and campaigns are considered after the completion of project planning and design. As a result, the forms/approaches of PEB intervention adopted in these projects usually depend on organizers' *ad hoc* decisions, which may vary from time to time. Systematic PEB intervention programming of various PEB intervention strategies

is thus prerequisite to developing design briefs. Existing planning and design practice often overlooks the intervention programming and does not pay enough attention to indirect implant forms integrated with other functions (the 6th), displaying users' resource consumption and the impact on environment (the 10th), building favorable ecological environment (the 11th), and displaying achievements of PEB intervention on the public (the 12th); and persuasive technology (the 13th) will be an important interest of PEB intervention in future.

The approach of indirect implant forms integrated with other functions can be adopted to influence almost all kinds of site users. In reality, except for learning bases, the other types of environmental education sites do not serve a higher proportion of visitors with intention of environmental education or behavioral change. Indirect implant forms integrated with other functions in the site is required considering general visitors' needs for service. For example, a tourist diner of an environmental education site can provide tablecloth and placemats with the evolution history

Table 2: Combination of PEB intervention strategies and landscape planning and design

Intervention strategies	Intervention forms/ approaches	Design demands (physical requirements for PEB intervention)	Stages
Environmental education	1. Interpretation system	Educational buildings/structures and exhibition facilities	PEB intervention planning; facility planning and design
	2. Courses	Educational buildings (independent, or part of a mixed-use venue within the site)	PEB intervention planning; facility planning and design
	3. Environmental services	Independent venue, or part of a mixed-use venue in the site	PEB intervention planning; facility planning and design
Campaigns	4. Campaign events	Outdoor open spaces for groups and supporting facilities	Facility planning and design
	5. Fixed display	Indoor/outdoor exhibition facilities	Facility planning and design
	6. Indirect implant forms integrated with other functions	Transportation, accommodation, catering, cultural products, sanitation, etc.	Facility planning and design
Prompts	7. Signs	Combining with regulations of facility use and user management	Facility planning and design; operation and management programming
Commitments	8. Signing events	Open outdoor space for groups and supporting facilities	Facility planning and design
	9. Commitment display	Indoor/outdoor exhibition facilities	Facility planning and design

Continued

Table 2: Combination of PEB intervention strategies and landscape planning and design

Intervention strategies	Intervention forms/ approaches	Design demands (physical requirements for PEB intervention)	Stages
Feedback	10. Displaying users' resource consumption and the impact on environment	Facilities with feedback functions	Facility planning and design
Social norms	11. Building favorable ecological environment	Ecological planning, as well as operation and management planning, to create pro-environmental ambience	Facility planning and design; operation and management programming
	12. Displaying achievements of PEB intervention of the public	Displaying environmental service process and achievements, where environmental service usually refers to unpaid environmental protection actions by users, such as garbage collection, vegetation maintenance, and species and environmental survey of the site	Facility planning and design
	13. Persuasive technology	Introducing facilities with persuasive technology to discourage environment destruction behaviors	Facility planning and design
Change/ adjustment of behavioral outcome	14. User management regulations	Specifying the punishments on the environment destruction behaviors	Operation and management programming
	15. Rewards	Developing various forms of reward plans (e.g. credit reward) for environmental services	Operation and management programming
Convenience	16. Environment-friendly facilities and amenities	Applying green buildings and energy-conserving, low-impact facilities	Facility planning and design

NOTE

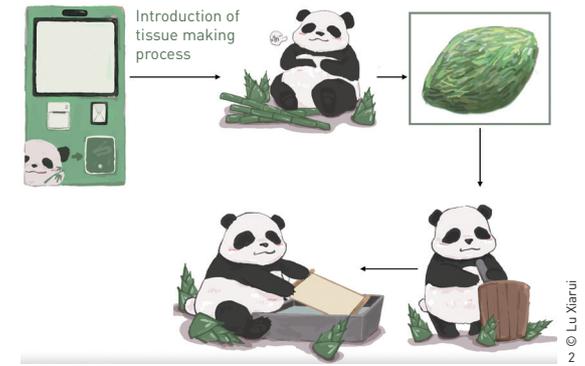
Campaign events (the 4th intervention form) can be carried out in both indoor and outdoor environments, while the outdoor is more suggested to attract as more individuals as possible.

of panda (Fig. 1). A zoo can use interactive entertainment facilities that simulate animal's reactions to feeding, satisfying visitors' curiosity about the animals' diets while avoiding casual feeding (Fig. 2). The facilities can also sell environment-friendly products (such as the tissues made of panda wastes), and the income can be used for wildlife protection and related education projects, and the usage will be displayed on the interface of the facilities. Reward sticker printers (displaying knowledge of animal behaviors and wildlife protection) designed for children can be introduced in the resting area as well (Fig. 3).

Displaying users' resource consumption and the impact on environment can significantly improve the effect of PEB intervention. Normally, people are not sensitive to the energy

consumption and environmental impact caused by their behaviors, which can be alarmed via visualization and quantification of interactive facilities. Such feedback facilities or devices help users better realize the consequence of their behaviors and make adjustments, thus to increase their awareness of PEB. For example, the interactive facilities in the Future iValley of Beijing Wenyuhe Park record visitors' carbon credits earned in marathon and virtual riding events, directly showing the carbon emission caused by their behaviors.^[48]

The idea of building favorable ecological environment is not new. In traditional planning and design projects, this idea is advocated more for the sake of environmental protection and users' mental and physical health. From the perspective of PEB intervention,



1. An assignment for environmental education site design: a diner in a zoo.
2. An assignment for environmental education site design: an interactive facility in a zoo
3. An assignment for environmental education site design: the resting area in a zoo

however, it means to build a trustable site for the target users, for the sake of conveying intervention implications. For example, for the sites with forests, the over use of chemical insecticides would undermine the ecology and environmental quality, which would lead to users' negative impressions about the site, furtherly undermining the effect of PEB intervention. Therefore, proper maintenance measures should be formulated to help environmental protection after facility planning and design.

More spaces and facilities should be designed for displaying PEB intervention efforts of the public, e.g., presenting the process or achievements of environmental service activities participated by the public. For example, in a carbon footprint education activity organized by one of the authors in the Shuangxiu Park of Beijing, children were encouraged to make science posters on the square of the park. Normally, the squares in park are the most densely populated area and an ideal venue for educational activities, but which are often found lacking enough supporting facilities for displaying posters—only a few of facilities can be deployed at the access or marginal area of the square, neglecting how users experience and interact during the activities (Fig. 4). This problem is usually caused by the designers' lack of experience about PEB intervention and inadequate understanding of users'

needs. Therefore, designers should make analysis on the process, forms/approaches, and outcomes of public participation in PEB intervention at the stage of PEB intervention programming to optimize the effect of such activities.

Limited by budgets and market demands, persuasive technology has not been widely applied in environmental education sites. Along with the increasing integration of technologies with landscape design, persuasive technology can be used in more environmental education sites and replace manual labors in user management. In essence, persuasive technology should aim at giving intervention prompts without arousing users' resistance, rather than technological innovativeness. Unlike prompts by traditional broadcasting, persuasive technology can be used in combination with intelligent systems to provide behavioral feedback in a subtle way. This is promising in the exploration of landscape facilities in future.

4 Planning and Design Framework for Environmental Education Sites

The performance of PEB intervention in environmental education sites depends highly on the operation, maintenance, and

user management after project completion. However, in China many projects fail to achieve their envisioned performance, due to the clients' lack of practice and experience of developing design briefs that match the site's operation and management capacities. Therefore, the planning and design framework for environmental education sites should fully consider operation needs, and post-occupancy management and maintenance programs should be developed as well. In addition, scientific and systematic performance evaluation is less seen at the operation stage of most projects, where simple user satisfaction surveys (on courses, activities and events, interpretation systems, etc.) are taken that hardly help designers learn about design shortcomings. Thus, this article proposes a planning and design framework, consisting of stages of site investigation, PEB intervention planning, development of design briefs, facility planning and design, maintenance and management programming, post-occupancy evaluation, and adjustment (Fig. 5).



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4. There was no display facility for posters on the square (taken in January 2022)
5. Planning and design framework for environmental education sites (new projects start with the stage of site investigation, and renovated projects with post-occupancy evaluation)

4.1 Site Investigation

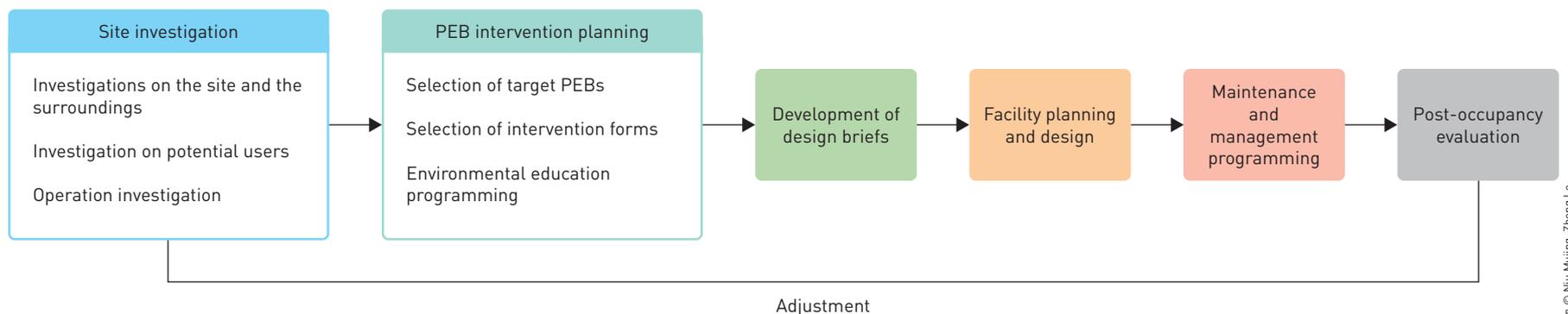
In addition to investigation of the site and its physical and social contexts, further surveys on all kinds of potential users and site operation should be made, especially the ones on the participants of various events, to be aware of their amount and specific needs that is critical to the site design and supporting facility supply, as well as their age, educational background, and visit purpose that determine the service type and scope of the site. All the above should be inspected with proper methods accordingly. Investigations on users in and around the site can employ questionnaires, interviews, and behavior observations, while those on wider group of users beyond the site can refer to the user structure of other similar sites.

Investigations on operation aim to learn about the site's operation plans and human resources, including whether the site is profitably operated, the operators' ideas about the theme and types of activities and events, whether there is a partnership with external institutions, and the accommodation capacity for group activities. The amount, educational background, experience, and competence of activity operators and teachers, as well as the proportion of full-time, part-time, and external employees should also be learned. If the operators do not have such experience for activity programming or there is no determined operator for the sites (such as some community gardens), designers could adopt the operation experience from other similar sites.

4.2 PEB Intervention Planning

4.2.1 PEB Intervention Principles

The PEB intervention strategies for environmental education sites aim at influencing individual's behaviors both inside and outside the site. Three principles for developing PEB strategies here are suggested. First, selecting PEBs which are easier to perform. For example, garbage classification is easier to perform than replacing private cars with public transportation. Second, PEBs



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with spillover^② are recommended. For instance, participants of tree planting activities might be willing to take part in pest control activities. Third, PEB selection should be based on site functions. For example, for places like zoos or botanical gardens that serve for species collection and proliferation purposes, PEBs on biodiversity conservation can be prioritized; for sites like community gardens, PEBs close with people's daily life (e.g. the prompt of environment-friendly products and tips to reduce carbon footprints) are advised.

4.2.2 Selection of PEB Intervention Forms

The PEB intervention forms and follow-up work should be determined according to the operators' capacity of facility maintenance and user management (Table 2). Campaigns, fixed display, signs, and commitment signing and displaying do not require much input of cost and management. Display of PEB intervention achievements only needs a minimum maintenance if designed properly. However, developing user management regulations and reward measures requires a higher operation capability—the former relies on their efficient supervision on users' behaviors, and the latter relies on fine management of activities and events organized in the site. Educational courses and environmental service activities place high standards for organization competences, especially that on information update for course design and interpretation system improvement. Much fund should be invested in displaying users' resource consumption and the impact on environment, applying persuasive technology, and using environment-friendly facilities and amenities, and maintenance investments on facilities should be considered as well. Indirect implant forms integrated with other functions needs sound communication with the suppliers, which may prolong the design process.

4.2.3 Environmental Education Programming

Compared with other PEB intervention strategies, environmental education is the most complicated as it requires dedicated programming, covering resource inventory, mode selection, and employee training (Fig. 6), through an edutainment approach without in quest of quantity.

(1) Educational resource inventory

Educational resources include both guidance of encouraged behaviors and warnings against discouraged behaviors. First of all,

the educational materials should be inclusive, covering the site's natural and built environments, production activities, culture, arts, as well as ecological strategies and green technologies used in site planning and design. Second, topics of education can be developed via links among knowledge highlights—at aspects of timeline, daily life, school education, natural and cultural characteristics, etc. For example, the inventory of the educational resources on edible plants can cover plant sciences, food chains, planting, compost, harm of pesticides and insecticides, food production, diet culture, economic value of plants, etc. Third, specific PEB guidelines should be proposed for individual practice. For instance, to address the problem of food waste, PEB guidelines can suggest buying local and seasonal vegetables to reduce the loss caused by long-distance transportation and long-term stocking, and provide tips for avoiding waste of vegetables in cooking and storage or taking stale vegetables as composts. Lastly, all these knowledge highlights should be classified to develop a unique educational library of the site.

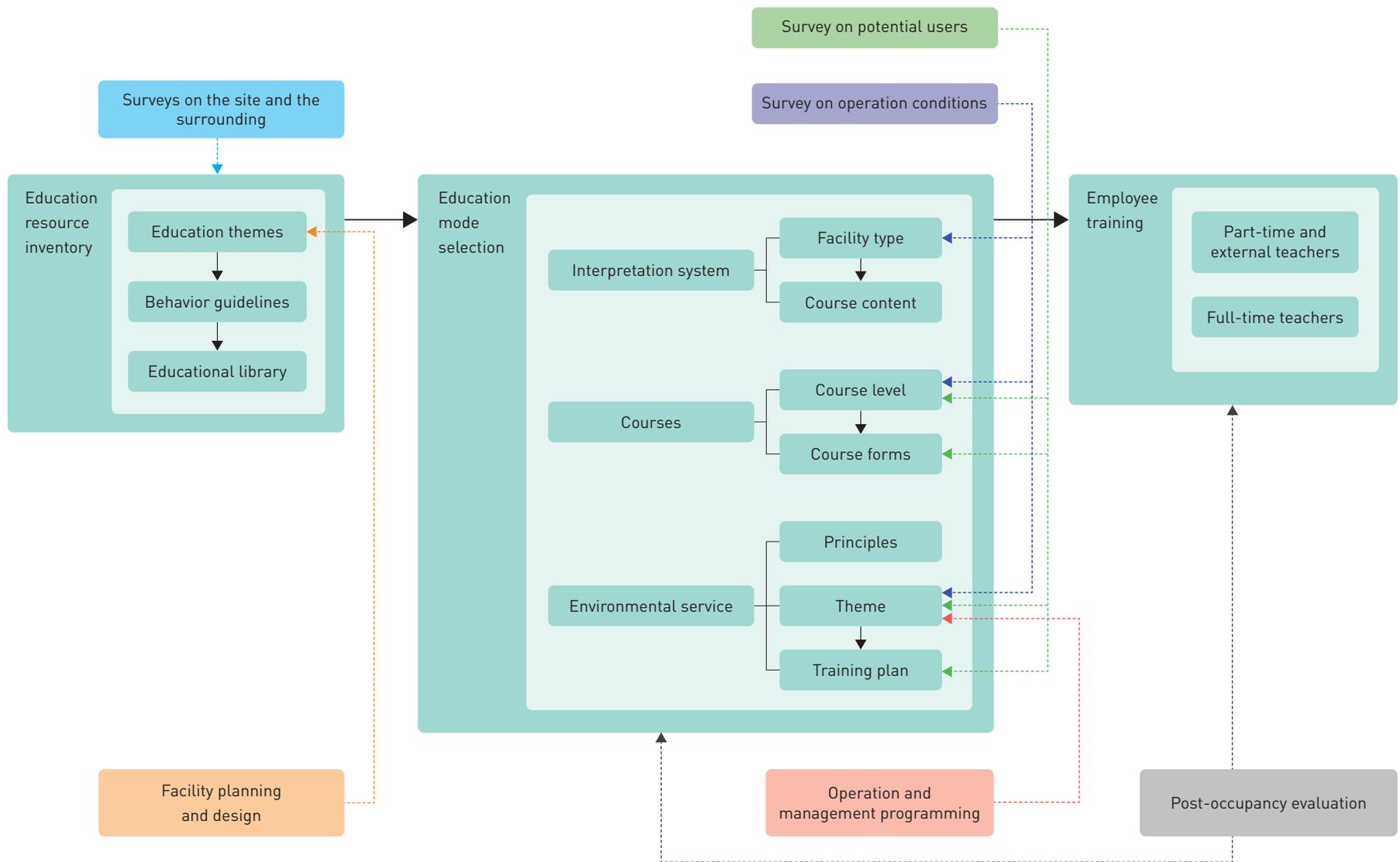
(2) Educational mode selection

Educational mode selection should cover interpretation systems, courses, and environmental service.

1) Interpretation system planning includes the selection of facility type and the compilation of interpretation materials. The selection of facility type depends on the initial funding, operation and maintenance costs, and the human resources needed for information updates, where the latter two are particularly important. The interpretation systems in large educational venues such as museums and exhibition halls depend heavily on well scheduled follow-up management and information updates. It is not suggested to introduce interpretation systems if there is not enough budget or manual labor is insufficient, because shoddy or vacant exhibiting venues would be adverse to users' trust to the sites and the effect of PEB intervention. For smaller venues, the interpretation contents can be the information about the site, which should be plain and easy to understand, and better close to users' daily life, or presented in timeline forms—other similar or allied sites are not suitable for such displays, because it might make users confused about the contents and their corresponding venues.

Venues and contents are mutually influential. Diverse visualization and interaction forms should be adopted for varied types of information. For example, panels or electronic screens are suitable for quick browsing, and games or videos for presenting morphological information and site features. Interactive hand gears and question-answering devices could be adopted to attract children. In addition, different design teams should coordinate

② Spillover here refers to engaging in one PEB would increase the probability that the person will engage in similar behaviors (Source: Ref. [42]).



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6. Framework of environmental education programming

closely so as to ensure the consistency of display contents and forms.

2) Course design needs to formulate course themes, levels, and forms. Course themes should be consistent with the educational topics and help attendants find out their interests, thereby boosting the effect of PEB intervention. Course level depends on the types of intervention objects and more on the competence of teachers. Also, course levels should fit objects' knowledge levels (rather than age), including entry, elementary, intermediate, and advanced levels, as well as training sessions for professionals. In terms of course forms, there are interactive instructions (which can combine with handcrafting, on-site experiencing, and exploratory and experimental activities), class-based

teaching, research projects, and professional lectures. Interactive instructions are suitable for entry- or elementary-level courses, and the other forms can be adopted by higher-level courses.

And 3) environmental service should have clear objectives, and contribute to the long-term benefits for the site's ecology and environment quality. Helping collect garbage on holidays, correcting site users' improper behaviors, and providing guide services can make up the manpower shortage of site management and maintenance. Such activities should offer opportunities to participants to increase awareness of societal and environmental responsibilities. It is also encouraged to boost the societal influence towards a broader public as much as possible, with all activity goals achieved. Roughly, activity themes can range from

sanitation maintenance, on-site building, user management to environmental surveys. For the activities that require certain knowledge or skills (e.g. planting, pest control, and wildlife survey), training is necessary to ensure the educational effect.

(3) Collaboration and training of teachers

The evaluation and enhancement of teachers' knowledge and competence are key to PEB intervention effect. However, most site operators lack the approaches to teaching evaluation or value teachers' expertise over teaching skills. In fact, environmental education requires inter-disciplinary knowledge and sensitivity to participants' emotional feedback, which both should be improved by trainings on teaching methods in forms of expert lectures, demonstrative classes, internal seminars, etc.—teachers need to learn as much knowledge as possible, no matter what educational backgrounds they have. For external teachers, site operators should develop explicit teaching standards, and evaluate their teaching competence based on feedback on trial classes to make adjustments on teaching accordingly.

4.3 Development of Design Briefs

Determining specific design tasks helps designers combine particular PEB intervention goals with basic functions of the site (catering, toilets, sheltering, barrier-free accessibility, touring, etc.), and offers a base for discussion with clients on operation proposals. The design briefs should be developed according to potential user investigation and PEB intervention planning, to estimate the site's capacity for participants with different purposes, as well as the area of venues and the number of supporting facilities for each intervention form, and finally be combined with all environmental, function, and facility requirements.

4.4 Facility Planning and Design

Although the facility planning and design is the most familiar work to designers with specific design briefs, a few of aspects should be paid more attention. First, for the sites aiming at PEB intervention, interpretation paths/trails should be set up as the key and the clues to organizing circulation. In this way those who do not visit the site purposely for PEB intervention would be more likely to engage in the intervention facilities or venues. Second, narrative landscapes and entertaining intervention facilities should be employed to invite users, via information visualization and interactive design while avoiding being puerile. Third, attention should be paid to details of design. For example, insect observation venue should be pesticide-free and cannot

be completely wild, while keeping away poisonous insects; since after-rain hours are the best time for insect observation, it is suggested to use rigid pavement on paths/trails; vegetated retaining walls of one-meter height is ideal for close observation. Another example, toilets, water supply facilities, waiting area, and storage spaces of teaching aids should be properly arranged in the teaching area. Lastly, venues/facilities should be accessible to all-age users, and it is advised to provide opportunities of environmental services for the disabled as much as possible.

4.5 Maintenance and Management Programming

Basically, maintenance and management programming covers five aspects. 1) Making user management regulations compatible with operators' executive competence, and all regulations should come into effect. Honorary rewards (such as event tickets and activity participation opportunities) are recommended so as to foster users' positive relationships with the nature. 2) Vegetation planting and maintenance should aim to improve the ecosystem health rather than merely for ornamental purposes. 3) Over-cleaning should be avoided to keep some fallen leaves and snow when there is no safety hazards, and vegetation wastes can be reused as composts if possible. 4) On-site monitoring and user management should be both emphasized to prevent and alleviate environmental problems. And 5) interpretation and campaign information should be updated timely, and contents and forms of courses and activities should be optimized continuously.

4.6 Post-Occupancy Evaluation and Adjustment

Post-occupancy evaluation on the effect of PEB intervention should be conducted after the site comes into service for a period of time (Table 3). The evaluation can be made by designers, operators, or other third parties, in forms of user questionnaire, scale, and interview, as well as behavior observation and monitoring records, for varied evaluation aspects. Adjustments are then made based on the evaluation results.

5 Conclusions and Prospects

This article provides suggestions on planning and design of environmental education sites from the perspective of PEB intervention. However, it sees limitations: 1) the PEB intervention strategies in this article are based on the findings of western researchers, which have not been widely applied in China; 2) given the significant variety among environmental education sites, the planning and design framework proposed in this article should be

Table 3: Post-occupancy evaluation of environmental education sites

Aspects	Items
PEB intervention environments	Ecological quality of the site Impact of the maintenance approaches on the ecological quality of the site Use frequency and dynamic level of activity venues
PEB intervention facilities	Facility maintenance conditions Use frequency and dynamic level of facilities Information update frequency
PEB intervention activities	Effect of environmental protection campaigns: frequency, number of participants, and feedback Effect of environmental education courses: number of participants, curriculum, syllabus, teaching process, assignments, participants' feedback and behaviors on the class, and observers' response Effect of environmental service activities: number of participants, activity organization, activity achievements, participants' feedback, and observers' response

NOTES

1. Dynamic level refers to the gathering, observation, and exchange by other users around during the activities.
2. PEB intervention facilities include interpretation system, venues for environmental service activities and campaigns, fixed display facilities, signs, commitment display facilities, behavior feedback facilities, facilities with persuasive technology, and other indirect implant facilities on the site.

altered according to the actual conditions of the sites in practice; and 3) the framework is developed for multi-profession teams, which might limit its application and promotion.

At the same time, this article proposes several directions for future research and practice on the planning and design of environmental education sites.

1) Such projects generally cover a wide scope, among which PEB intervention planning and site operation are especially challenging for landscape designers. It is worth exploring how to build a design team with competent and comprehensive expertise, and how to improve design competence beyond the boundary of Landscape Architecture.

2) To guarantee the realization of expected effects after project implementation, developing precise design briefs is critical. As the increase of refined planning and design practices, designers need to be capable to come up with rational design briefs in the view of project operation.

3) No research has suggested that the PEB intervention effect in the wild (e.g. national parks, natural reserves) is better than that in artificial environments (e.g. community gardens, campuses), and designers are encouraged to pay attention to

environmental education sites in built contexts.

And 4) long-term project evaluation mechanism should be put in place to enhance the empirical research on PEB intervention, thereby improving the competence of the design profession in a systematic way.

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基于环境友好行为干预视角的环境教育类场所规划设计思考

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摘要

人类的环境友好行为 (pro-environmental behavior, PEB) 可推动可持续发展, 而PEB干预策略是PEB实施效果的重要保障。当前景观规划设计关注点在于环境教育而非PEB干预, 对干预行为本身少有策划, 且缺少包含运营与场地维护视角的环境教育类场所的完整规划设计框架。本文基于对相关基础理论的文献综述, 总结适用于景观规划设计的PEB干预策略, 结合规划设计的方法和流程及笔者开展环境教育的观察所得, 提出针对环境教育类场所的规划设计框架: 前期调研 - PEB干预策划 - 制定设计任务书 - 场地设施规划设计 - 维护管理策划 - 使用后评估 - 调整。该框架可以为景观规划师及设计师提供一定指导, 以优化项目的PEB干预效果, 同时也可以帮助场地运营者和研究者拓宽对于此类项目的思考维度。

关键词

景观设计学;
环境教育类场所;
环境友好行为干预策略;
规划设计框架;
保护心理学

文章亮点

- 将保护心理学的行为干预研究成果应用于景观规划设计
- 将环境友好行为干预作为制定设计任务书的基础
- 提出全周期的环境教育类场所规划设计框架

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1 可持续性与环境友好行为

在全球气候变化、资源枯竭、生物多样性丧失等背景下, 可持续发展已成为各国的战略选择^{[1][2]}。人类的环境友好行为 (pro-environmental behavior, PEB) 可推动可持续发展^[3], 此类行为的培养方式包括植绿护绿、保护生物多样性、减少碳足迹、资源循环利用等, 常依托社区花园^[4]、环境教育基地^[5]、自然保护区^[6]、专类园^[7]、国家公园^[8]等各类场所而开展。自2013年首批中小学生环境教育社会实践基地设立以来^[9], 近些年中国此类场所的营建发展迅速, 截至2021年底, 仅北京就已有“园林绿化科普基地”“首都生态文明宣传教育基地”“首都园艺驿站”等环境教育类场所近200个^{[10]-[13]}, 涵盖社区花园、专类园、校园、自然保护区、研学基地^①、居住区等多种类型。

PEB干预策略是PEB实施效果的重要保障。过去的几十年中, 心理学家通过理论机制研究和实证研究试图解释与环境友好行为相关的认知、

情感、社会因素^[14], 探索激发PEB的方法, 已形成多种PEB干预策略^[15], 被广泛应用于能源^{[16][17]}、生态保护^[18]、公共交通^{[19][20]}、酒店管理^{[21][22]}、公共管理^[23]、社区治理^{[24]-[26]}、工业设计^[27]等领域。

PEB干预策略在景观规划设计领域中的研究与应用也取得了一些成果: 物理环境类研究包括场地的景观叙事性设计^{[28][29]}、环境教育建筑设计^[30]、生态教育可视化^[31]、教育设施设计^{[32]-[35]}; 非物理环境类研究包括环境教育经验介绍^{[36]-[38]}、环境教育活动策划^[39]、公众参与活动组织^[40]。然而, 当前研究与应用尚存在以下不足: 1) 规划设计关注点往往在于环境教育而非PEB干预, 且环境教育策划后置于规划设计; 2) 缺乏对PEB干预行为本身策划, PEB干预策略的运用较为单一; 3) 缺少包含场所运

① 已有文献中存在将一般公园中的教育区作为研学基地的情况。本文中, 研学基地指专门面向 (由学校组织或社会机构组织的) 学员团体、以提供环境教育课程和活动服务为主的环境教育类场所。

营与维护视角的完整规划设计框架。

综上, PEB干预策略和景观规划设计之间尚存在研究空白。因此, 本文试图回应以下三个问题: 1) 环境教育类场所中可使用的PEB干预策略有哪些? 2) PEB干预策略如何融入景观规划设计? 3) 环境教育类场所的规划设计框架具体应包含哪些内容?

本文基于对相关基础理论的文献综述, 总结适用于景观规划设计的PEB干预策略, 结合规划设计的方法和流程及笔者开展环境教育的观察所得, 提出针对环境教育类场所的规划设计框架。该框架可以为景观规划师及设计师提供一定指导, 以优化项目的PEB干预效果, 同时也可以帮助场地运营者和研究者拓宽对于此类项目的思考维度。

2 基础理论与基本概念

2.1 基本概念

PEB是保护心理学中的一个概念, 是指个体最大程度减少对自然和人工环境的负面影响^[41]。与之语义相近的术语包括“对环境负责任的行为”(environmentally responsible behavior)、“可持续发展行为”(sustainable behavior)、“保护行为”(conservation behavior)等。

促进PEB的发生在保护心理学领域被称为“PEB干预”^[42]。本文所研究的环境教育类场所是指将PEB干预策略主动融入其规划、设计、建设、运营管理等过程, 能够培养和激发人们产生PEB的公共绿地。本文所探讨的PEB包括个体在环境教育类场所内部发生的行为, 也包括个体由于PEB干预在场所外发生的行为。

在研究领域, 存在“环境教育”与“自然教育”(natural education)内涵部分重叠的情况; 但在实践领域, 自然教育侧重于“自然”环境下人的感知、感觉、情感培养, 以及自然缺失症的治疗等, 而环境教育侧重于可持续发展的生活模式和经济模式, 对自然生态和人工环境同样关注, 且更关注行为的改变。尽管本文讨论的PEB干预策略适用范围并不局限于环境教育, 但笔者选择“环境教育类场所”这一业内约定俗成的术语来概括本文的研究对象, 其中“场所”一词可突出PEB干预与人和环境紧密相关这一特性。鉴于各类公共绿地均有或轻或重的PEB干预效果, 那些没有明确PEB干预设计目标的景观绿地不纳入本文的讨论范围。

2.2 PEB干预策略

在众多PEB干预策略中, 选用具有理论基础的策略是理解和激发PEB的重要基础, 且有助于评估方法的有效建立^[15]。笔者根据文献的权威性和其所总结成果的全面性, 以2012年出版的《牛津环境与保护心理学手册》^[43]和2019年再版的英国心理学会编制的《环境心理学介绍》^[44]为PEB干预策略选择的基础。

PEB干预策略可分为个体(person)和情境(context)两大类^[42], 表1中所示9种策略较适合于环境教育类场所^{[15][42][45]-[47]}。心理学研究表明, 强调内驱力与行为联结的个体类干预更适用于生物中心主义者, 因为这类策略将各种生命和自然视为最重要的价值; 而情境类干预聚焦于PEB给个体带来的物质获益、便利、良好人际关系或社会荣誉, 更适用于利己主义者和利他主义者^[42]。因此, 为实现PEB干预效果最大化, 环境教育类场所的规划设计需要综合运用多种策略, 作用于不同人群。

3 PEB干预策略融入环境教育类场所规划设计

环境教育类场所的规划设计需将上述PEB干预策略细化为各种干预形式, 再落实于干预载体, 即具体的设计需求。其中涉及的阶段包括: 前期调研、PEB干预策划、制定设计任务书、场地设施规划设计, 以及运营管理策划(表2)。

当前, 很多项目往往仅在场址规划设计完成后考虑举办一些教育课程和活动的可能性, 缺乏明确的PEB干预目标, PEB干预行为和形式的选择也通常取决于实际操作时组织人员的临场决策, 可能每次都不尽相同。因此, 在制定设计任务书之前, 需要实施科学而系统的、运用了多种PEB干预策略的PEB干预策划。同时, 相关规划设计实践往往忽视了软性植入其他功能(第6项)、展示使用者的资源消耗和环境影响(第10项); 塑造良好生态环境(第11项)、展示公众PEB干预成果(第12项)也没有引起足够的重视; 而使用劝导技术(第13项)则是PEB干预的一大发展方向。

软性植入其他功能面向的是场所内大多数的使用者。实际上, 除研学基地存在较高比例的以接受教育为到访目的的使用者外, 其他环境教育场所的大部分使用者并不以接受教育或改变行为为到访目的。因此, PEB干预策划需高度重视能够与一般使用者服务需求结合的软性植入PEB干预设计, 通过潜移默化的信息传达影响使用者。例如, 环境教育类场所中游客餐厅的提升设计将熊猫进化史融入餐厅桌布和餐垫的产品设计之中(图1)。为引导游客放弃投喂动物的行为, 可在游乐设施的优化设计中通过设置互动设施模拟喂养动物, 这样既满足游客的好奇心, 也可向公众普及动物饮食知识(图2); 设施可同时销售相关环保制品(如由动物粪便制成的纸巾), 收入可用于野生动物保护及教育项目, 设施的交互界面会介绍资金的去向。在游客休息区中为儿童设计的寻找动物足迹的游戏空间, 配有奖励贴纸打印机器, 贴纸上印有介绍小动物的科普知识和保护常识(图3)。

“展示使用者的资源消耗和环境影响”可有效提升PEB干预效果。普通人对于个体行为所造成的能源消耗和环境影响等问题并不敏感, 需要借助量化、可视化或可以切身感受的设施进行反馈。独立的反馈设施或加入反馈功能的设施可以让使用者更清楚行为后果, 并及时作出调

表 1: 适用于环境教育类场所的 PEB 干预策略

类型	内涵	干预策略
个体类	试图通过改变个体认知、意识、情感和态度等进行 PEB 干预, 强调改变个体的内驱力 (来源: 参考文献 [42])	干预目标设定: 设定可实现的 PEB 干预目标 (来源: 参考文献 [15])
		环境教育: 通过课程、活动、展示等形式普及相关知识、探究环境问题、提供解决问题的指导 (来源: 参考文献 [42][45])
		环保宣传: 以号召为主, 宣传内容较为泛泛, 受众数量大 (来源: 参考文献 [42])
		环保提示: 针对某些特定行为提出具体而直接的指导或警告 (来源: 参考文献 [15])
		签署环保承诺: 组织引导公众以书面的形式保证实施某类 PEB, 或不实施某项对环境具有负面影响的行为 (来源: 参考文献 [15])
		提供行为反馈: 为公众呈现其行为的后果, 如水、电、燃气的消耗量, 碳足迹的数量, 环境影响等 (来源: 参考文献 [15])
情境类	通过改变个体周围的社会环境或物理环境进行 PEB 干预 (来源: 参考文献 [42])	建立环境友好的社会规范: 社会规范是个体认为的社会组织或文化认同的信念、态度、行为, 是一种个体对社会的主观认知; 可通过创造活动、环境、氛围等使个体认为 PEB 是社会大众所期望的行为; 使用劝说型科技亦可代替人发挥社会规范的作用 (来源: 参考文献 [42][46])
		改变和调整行为后果: 通过使用正激励、负激励影响行为发生, 通过强化增加行为发生, 通过惩罚降低行为发生 (来源: 参考文献 [47])
		辅助行为发生: 提高行为发生的可能性和便利性, 或降低行为发生的障碍 (来源: 参考文献 [42])

注

劝导技术可利用智能系统提供“社交反馈”, 例如用模拟人脸的机器人提供消耗能源数量的反馈, 可以说出“你的能源消耗量太可怕了”这样人类的语言, 或当用量过多时闪烁红灯。

整, 亦可促进公众对PEB的关注。例如, 北京温榆河·未来智谷公园利用互动设施记录游客低碳马拉松、虚拟骑行等行为的碳积分, 公众可直观感受到自身行为对碳排放的影响。^[48]

塑造良好生态环境并非新的理念, 但以往规划设计更多关注于生态环境保护及促进使用者身心健康。从PEB干预的角度而言, 良好的生态环境是干预对象对场所建立信任的基础, 信任又是对象接受干预信息的基础。例如, 对于树木较多的场地, 大量使用化学杀虫剂会破坏规划的生态效果, 干预对象也会因此对园区形象产生负面环境态度, 进而影响PEB干预效果。因此场地设施规划设计后需制定环保的维护方法。

设计师需要为展示公众PEB干预成果提供更多且合理的场地和设施。通过组织有益于场地生态环境保护的环境服务, 展示公众参与此类活动的过程或成果。以笔者在北京双秀公园开展的某次“碳足迹小研

究”主题教育活动为例, 活动组织小朋友们在园内张贴自己设计的科普海报。通常, 公园的广场是人流最为密集的场所, 适合活动开展; 但广场也是人流集散空间, 一般缺乏集中展示宣传海报的设施——即便有宣传设施, 也会被置于入口或边缘, 这是一种陈旧且被动的宣传模式, 忽视了宣传物与人之间的互动 (图4) 与宣传活动的机动性。类似的设计问题在很大程度上是由于设计师缺少PEB干预的实践经验, 对环境教育类场所的具体使用需求认识尚有不足。因此, 设计团队需要在PEB干预策划阶段对公众参与各类PEB干预活动的过程、形式、成果有所预判, 以优化行为展示效果, 塑造环境友好的场所氛围。

受限于成本及市场需求, 目前劝导技术在环境教育类场所中的应用尚不广泛。随着科技与景观设计的融合发展, 劝导技术有望被引入更多的环境教育类场所。劝说型科技可在一定程度上替代人对场地使用者的

表 2：PEB 干预策略与景观规划设计的结合

PEB 干预策略	PEB 干预形式	设计需求 (PEB 干预载体)	涉及阶段
环境教育	1. 环境解说系统	教育建筑、展示说明设施	PEB 干预策划、场地设施规划设计
	2. 教育课程	教育建筑 (独立建筑, 或与场地内其他空间结合)	PEB 干预策划、场地设施规划设计
	3. 环境服务活动	独立场地, 或与场地内其他空间结合	PEB 干预策划、场地设施规划设计
环保宣传	4. 宣传活动	能容纳 50 人以上的户外开阔场地及相关设施	场地设施规划设计
	5. 固定展示	室内/室外展示设施	场地设施规划设计
	6. 软性植入其他功能	配合交通、住宿、餐饮、文创、卫生等其他功能	场地设施规划设计
环保提示	7. 张贴牌示	配合场地设施使用 and 使用者管理需求	场地设施规划设计、维护管理策划
签署环保承诺	8. 公众签署活动	能容纳 50 人以上的户外开阔场地及相关设施	场地设施规划设计
	9. 承诺展示	室内/室外展示设施	场地设施规划设计
提供行为反馈	10. 展示使用者的资源消耗和环境影响	具有反馈功能的设施	场地设施规划设计
建立环境友好社会规范	11. 塑造良好生态环境	生态规划和维护管理策划, 营造环境友好氛围	场地设施规划设计、维护管理策划
	12. 展示公众 PEB 干预成果	展示环境服务过程及成果; 环境服务通常包括使用者对场地生态环境做出贡献的无偿服务, 如清理场地垃圾、参与绿化养护、参与场地物种调查与环境调查等	场地设施规划设计
	13. 使用劝导技术	配置具有劝说功能的设施, 劝阻非环保行为	场地设施规划设计
改变和调整行为后果	14. 制定使用者管理条例	规定对危害生态环境行为的惩罚措施	维护管理策划
	15. 制定奖励措施	结合环境服务打卡积分等各种活动, 制定奖励方案	维护管理策划
辅助行为发生	16. 使用环境友好设施	使用绿色建筑, 以及环保节能、低影响设施	场地设施规划设计

注

宣传活动 (第 4 项) 在室内、室外开展均可, 出于受众人群数量最大化的考虑, 建议在户外开展。

管理：该项技术本身创新性不大，但更多需要考虑的是如何在不使干预对象产生反感的前提下进行劝说提示。其不同于简单的广播提示，可以更隐蔽地结合建筑、设施，使用智能系统提供更易被干预对象接受的行为反馈——这也是未来景观设施的一项研发热点。

4 环境教育类场所规划设计框架

环境教育类场所的PEB干预效果高度依赖于项目实施后的运营、维护和使用管理，而中国的此类实践仍在起步阶段，大量项目的甲方无法提出与运营管理能力匹配的设计任务书，是造成项目设想与建成效果脱节的主要原因。因此，此类场所规划设计框架需要充分考虑运营需求，并制定使用后的管理和维护计划。同时，绝大部分项目在运营阶段缺少针对PEB干预效果的测评，且大部分运营方也不了解测评方法，经常以简单的使用者满意度调查（如询问对教育课程、组织活动、解说系统等是否满意）代替科学、系统的评估，造成设计团队无法了解设计漏洞，进而影响此类设计的提升。综上，本研究提出“前期调研—PEB干预策划—制定设计任务书—场地设施规划设计—维护管理策划—使用后评估—调整”的规划设计框架（图5）。

4.1 前期调研

在常规场地及周边空间、社会环境调查的基础上，重点关注潜在干预对象调查和运营调查。干预对象是指场地内所有使用者，其中需重点关注各类活动参与者，他们的数量和需求对场地设计及配套设施供给的影响较大。设计团队需明确干预对象的年龄层、受教育程度、到访目的与途径等特征，同时根据场地类型确定服务范围，并据此选择相应的方法展开使用者调查。可针对场地内使用者及周边人群采用问卷、访谈、行为观察等实地调查的方式，更大范围的调查可参考同类型场地的使用者结构。

设计团队还需要通过调查了解场所的运营计划和人力资源现状，包括运营属性（公益或营利）；运营方对场地组织活动主题及形式的构想；是否有合作的研学机构；是否接待团体活动参与者，以及最大接待量。此外，还需要掌握运营方活动组织人员的数量、教育背景、经验与能力水平，以及内部专职人员、内部兼职人员和外部聘用人员的比例。若运营方无活动组织经验或场地尚无明确运营方（如部分社区花园），设计团队可参考其他同类型场所的运营方案。

4.2 PEB干预策划

4.2.1 PEB干预原则

环境教育类场所的PEB干预策略不仅涵盖个人在场地内的行为，更应包含场地外的行为。PEB的选择应遵照以下原则：首先，选择低障碍

行为，例如，和推进公众从开私家车转变为乘坐公共交通出行相比，推进公共垃圾分类更为易行。第二，选择具有溢出效应^②的行为，如参与植树活动的人可能也会参与生态防治病虫害。第三，根据场所自身特性选择PEB，比如动物园、植物园是具有物种收集和繁育作用的场所，可侧重于生物多样性保护类PEB，而社区花园则可侧重于家庭生活方式类PEB（如推广环保的生活用品、介绍日常生活中可减少碳足迹的小贴士等）。

4.2.2 PEB干预形式选择

根据运营方设施维护和使用管理的能力选择干预形式（表2），并明确相关后续工作。宣传活动、固定展示、张贴小型牌示、签署环保承诺活动及承诺展示等形式对于成本和管理的要求都较低；展示公众PEB干预成果在设计合理的情况下，不需很多额外投入；制定使用者管理条例和奖励措施对运营方有较高要求——前者而言，工作人员如果不能真正监督使用者行为，那么条例就形同虚设，而后者一般与场地内组织的活动相关，需要运营方有较高的精细化管理水平；教育课程和环境服务活动对运营组织能力要求较高，教育课程研发和环境解说系统内容更新对信息更新保障力有较高要求；展示使用者资源消耗和环境影响、使用劝说型科技、使用环境友好设施需要较多资金投入，且对设施维护有一定要求；软性植入其他功能时，需运营方与设施供应方进行充分的沟通协作，且会延长设计周期。

4.2.3 环境教育策划

与其他PEB干预策略相比，环境教育最为复杂，需制定专项策划，包括教育资源梳理、教育模式策划、教育人员合作培训与提升三部分（图6）。环境教育需要秉承寓教于乐、追求质量而非数量的原则。

（1）教育资源梳理

教育资源包括具有正面教育意义和反面警醒意义的信息。首先，需保证资源的全面性，自然环境、人工环境、生产利用、文化艺术，以及规划设计中采用的生态策略、绿色技术等都应囊括在内。其次，通过建立知识点之间的联系形成议题——可以是时间线上的联系、与日常生活或学校教育的联系、自然或人文层面的联系。例如，针对场所内可食用植物的教育资源，可从植物科学、食物链、植物种植、堆肥、农药与杀虫剂的危害、食物制作、饮食文化、植物经济价值等角度收集资料。其后，在使用者个体可操作层面提出明确的PEB行动指导。例如，针对减少食物浪费问题，PEB行动指导除常见的“光盘行动”，还可推荐尽量购买当地蔬菜，减少蔬菜在长途运输中的损失；尽量购买当季蔬菜，减少储存中的损失；做饭时控制蔬菜用量，并充分利用食材；科学储藏不

^② 溢出效应指一种行为会引发类似的行为发生（来源：参考文献[42]）。

同蔬菜，减少腐败浪费；利用剩余蔬菜进行堆肥等。最后，对知识点进行分级分类，建立具有场地特色的教育知识库。

（2）教育模式策划

教育模式策划包括环境解说系统、教育课程、环境服务活动三个方面。

1）环境解说系统策划包括设施类型选择和解说内容策划。初始资金投入、运行维护财务成本、信息更新所需的人力资源是设施类型选择的依据，且后两者尤为关键。博物馆、展览馆等大型教育设施非常依赖于后续管理和信息更新，如无此方面支撑，则不建议设置，否则内容低劣的展览和闲置的大型设施会降低干预对象对场所的信任。小型设施的解说内容通常为科普知识，用以展示和说明场地特点，需浅显易懂，内容可以从科普知识点向贴近使用者日常生活的文化层面拓展，也可以从时间线上进行系统梳理展示，但尽量不要在空间上拓展，避免说明内容和场地的不对应给使用者造成理解混乱。

此外，设施和内容两者互相影响，针对不同类型的信息应采取多样的可视化形式及互动形式——如可快速浏览的信息适用于平面展板或电子屏；更为深入的信息可以用游戏或科普视频的方式展示形态类信息或特征类信息；针对低龄儿童的信息可以使用手动装置，以答题的形式增加互动；此外，还应避免由不同设计方分开设计造成的内容与形式脱节。

2）教育课程策划包括制定课程主题、课程分级和课程形式。根据教育议题划分课程的主题，有助于选课者发现自己的兴趣点，进而提高干预效果。课程分级与干预对象类型和教师教育能力有关，且主要受制于后者。课程分级一般以干预对象知识基础（而非年龄）为考量因素；在教师能力匹配的前提下，课程可分为零基础的入门级、了解基本概念的初级、掌握一定原理的中级、具有一定能力的高级，以及针对专业人员的职业培训。常见的课程形式包括互动式授课（结合手工活动、现场体验、探究活动、实验活动的教学）、课堂式授课、研究小课题，以及专业讲座。入门级和初级课程适合互动式授课，一般中级以上课程可以考虑知识密度较大的后几类。

3）环境服务活动的开设需具有明确意义，避免作秀式的“为活动而活动”：活动需对维护场地生态环境有明显且长期的效果；可通过节假日辅助清理垃圾、劝导游客不文明行为、辅助引导游客等活动弥补场地管理维护的人力不足；可通过提供场地、机会以帮助干预对象建立服务社会 and 环境保护的意识；在保证活动成效的前提下，可扩大环保宣传的影响面。活动主题可分为场地环境卫生维护、场地营建、场地使用者管理、场地生态环境调查四类，其中一些对技能和知识有较高要求的活动（如植物栽培、病虫害防治、野生动物调查等）应为参与者制定相应的培训计划，以保证实施的效果。

（3）教育人员合作、培训与提升

教师知识和能力的评估和提升与PEB干预效果紧密相关，而目前多

数项目运营方缺乏评估教师教学水平的方法，或存在重专业而轻教学能力的现象。实际上，环境教育涉及知识广泛，任何教育和学历背景的人都需大量补充学习，且需具备捕捉学生情绪反馈的能力。因此，对内部人员应制定针对教学方法和知识提升的培训计划，可采用外聘专家讲座、观摩学习公开课、内部研讨会等形式；对合作教师应制定授课标准，并通过在试听课上收集听众反馈的方式评估其教学能力，并根据测评反馈进行科学而系统的优化教学。

4.3 制定设计任务书

设计任务书的制定旨在帮助设计团队平衡PEB干预目标与场所基础功能需求（包括餐饮、如厕、遮风、避雨、遮阳、无障碍通行、游览等方面），并为与甲方协商运营方案提供讨论基础。在对潜在干预对象进行调查和PEB干预策划的基础上，可估算出场地使用者的规模及细分使用群体，并计算出各种PEB干预形式所需场地面积、设施的数量；最后，结合场所环境、功能、设施等方面的基础需求，制定设计任务书。

4.4 场地设施规划设计

在有明确任务书的基础上，场地设施规划设计就转化为设计师最熟悉的工作内容，其中需要特别注意的几点是：首先，以PEB干预为主要功能的场地，应该设置解说路径，且解说路径应作为交通组织的核心线索，因为场地使用者中大部分为无组织的被动干预者，他们的到访目的一般仅仅是游览，不会刻意寻找PEB干预设施和场地。第二，应通过叙事性景观和具有趣味性的干预设施潜移默化地吸引使用者的注意力，但有趣并不等同于幼稚，而是需要通过信息可视化和互动设计激发使用者的兴趣。第三，应关注设计细节。例如，昆虫观察既需要无杀虫剂的环境也不能为纯荒野环境，还需避免被毒虫叮咬；雨后是昆虫活跃时间，为避免路面泥泞给观察带来的不便，一般建议铺设硬质铺装的小路；一米左右高度的断面（可在挡土墙上种植植物）比地面更适合于观察昆虫行动，避免了趴在地面找虫子的尴尬。又如教学空间需考虑设置卫生间、饮水、等候、教具储存等功能空间。第四，设施应尽量便于不同年龄和行为能力的人群使用，并尽量为行为受限人士提供环境服务的可能。

4.5 维护管理策划

维护管理规划包括以下五个方面：第一，使用者管理条例的制定需与运营方执行能力相匹配，不出现形同虚设的条例，奖励措施可通过活动名额或门票等形式落实，优先使用名誉性奖励，培养人与自然的正向关系。第二，绿化养护应以生态良好而非单纯的美化为目标。第三，场地保洁应避免过度清洁，在不引发安全事故的前提下尽量保留自然痕迹，如落叶归根、降雪留存；减少绿化垃圾，使用园林废弃物堆肥。第四，环境问题控制需要场地监测和使用者管理并行。第五，及时更新环

表 3: 环境教育类场所使用后评估内容

评估对象	评估内容
PEB 干预环境	场地生态环境状况 维护方法对场地生态环境的影响 活动场地使用频率和关注度
PEB 干预设施	设施维护状况 设施使用率和关注度 信息更新频率
PEB 干预活动	环保宣传活动效果: 活动频次、活动参与者数量、听众反馈 环境教育课程效果: 招募情况、课程体系、课程教案、教学过程、课程成果或作业、参与者自反馈和课堂行为、旁观者反应 环境服务活动效果: 招募情况、活动组织、活动成果、参与者自反馈、旁观者反应

注

1. 场地关注度是指活动场地在使用时, 其他使用者观看、围观、议论等的情况。
2. PEB 干预设施包括环境解说系统、环境服务场地、宣传活动场地、固定展示设施、小型牌示、承诺展示设施、行为反馈设施、劝导设施, 以及被软性植入的其他设施等。

境解说系统和环保宣传中的时效性信息, 并不断优化教育课程、活动内容和形式。

4.6 使用后评估与调整

场地运营一段时间后, 应对PEB干预效果进行使用后评估(表3), 可由设计师、运营方或第三方实施评估, 针对不同的评估目标, 选择使用者自报告(问卷、量表、访谈)或他方报告(行为观察、监控记录)的测评方法。根据评估结果, 提出调整与优化方案。

5 结语与展望

本文对基于环境友好行为干预视角的环境教育类场所规划设计提出了一些设计思维建议, 但尚存在局限性: 1) 本研究所使用的PEB干预策略基于西方学者的研究成果, 缺少中国本土化的实践检验。2) 不同环境教育类场所存在较大的差异性, 本文所提出的规划设计框架在应用过程中还需结合具体场地的实际情况进行调整。3) 本规划设计框架主要面向多专业背景的设计团队, 因而存在一定应用门槛。

此外, 本文为环境教育类场所规划设计提出未来研究与实践探索的几个方向。

1) 此类规划设计涉及的内容较广, 其中PEB干预策划、场地运营等对景观设计师都具有很大挑战性, 如何组建具有综合能力的设计团队,

需要吸纳哪些专业的人员, 或景观设计如何突破学科边界, 才能有效提升对此类场所的设计能力?

2) 甲方购买的服务是项目的实施效果, 而非方案效果, 而精准的设计任务书是保障实施效果的关键。在规划设计日趋专业化精细化的今天, 设计师应具备对其擅长的设计领域提出具有运营思路的设计任务书的能力, 如何编制科学、合理的设计任务书需要进一步探索。

3) 目前并无研究表明在荒野环境(如国家公园、自然保护区)中的PEB干预效果高于人工环境(如社区花园、学校), 因此在当前中国城市化进程中, 希望更多设计师可以关注城市环境下居民身边的环境教育类场所的设计。

4) 应建立项目长期评估机制, 加强PEB干预项目实证研究, 从而科学而系统地提升行业设计水平。

基金项目

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- 图 1. 环境教育类场所学生设计作业——动物园游客餐厅设计
- 图 2. 环境教育类场所学生设计作业——动物园游客互动机器设计
- 图 3. 环境教育类场所学生设计作业——动物园游客休息区设计
- 图 4. 广场中缺少适合展示宣传海报的设施(摄于 2022 年 1 月)
- 图 5. 环境教育类场所规划设计框架(新建项目从前期调研开始, 改造类项目从使用后评估开始)
- 图 6. 环境教育策划框架