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BIOPHILIC INTERVENTIONS IN GREEN ARCHITECTURE: DESIGN PROFESSIONALS' PERCEPTIONS ON ENHANCING HEALTH AND WELL-BEING THROUGH INDOOR PLANT LANDSCAPES

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Abstract

Indoor plant landscapes are an established strategy in biophilic design, yet their integration can reveal a divergence between aesthetic appreciation and technical implementation. Grounded in environmental psychology and the Stimulus–Organism–Response framework, this cross-sectional study examined design professionals' perceptions of the aesthetic, functional and well-being dimensions of indoor greenery. A multi-stage sampling approach yielded 185 valid responses from design professionals across major metropolitan regions in Malaysia. Partial Least Squares Structural Equation Modeling (PLS-SEM) was used to examine structural associations and the moderating role of professional experience. Respondents rated aesthetics ($M = 4.35$) and perceived well-being ($M = 4.28$) more highly than physical environmental functions ($M = 3.12$) and integration strategies ($M = 2.85$). Aesthetic cognition was not significantly associated with integration strategies ($\beta = 0.118$, $p = 0.150$), whereas functional cognition showed a positive association ($\beta = 0.462$, $p < 0.001$). Professional experience had a positive moderating effect ($\beta = 0.208$, $p = 0.005$). These findings inform a lifecycle framework encompassing evidence-based design briefs, maintenance governance, indoor environmental quality monitoring and post-occupancy evaluation. The results concern professional perceptions and reported practices rather than measured pollutant removal, occupant health effects or energy savings.

Keywords: biophilic design; indoor plant landscapes; design professionals; cognition–practice gap; PLS-SEM; indoor environmental quality; post-occupancy evaluation

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INTRODUCTION

Background and research problem

Indoor environments accommodate work, domestic activities and social interaction. Their design requires attention to spatial usability, visual experience and occupant comfort. Indoor plant landscapes form one approach to incorporating nature into these settings. Biophilic design literature discusses connections between natural elements and human experience (Kellert et al., 2011; Heerwagen, 2009; Ryan et al., 2014). These conceptual and experiential benefits do not establish that a particular planting arrangement improves pollutant removal, ventilation efficiency or building energy performance.

Design professionals influence how plants are specified, located and maintained. Their perceptions are relevant to design decisions, but professional opinion is not a substitute for occupant outcome data or environmental measurements. A favourable assessment of a planted interior can reflect aesthetic preference, expectations, previous experience or the wider quality of the space. The present paper focuses on these perceptions and on the practical conditions needed to evaluate indoor planting responsibly.

A possible cognition–practice gap between aesthetic appreciation and technical integration motivates this inquiry. Professional perceptions may influence how indoor planting is specified, but self-reported practices do not directly establish performance in completed projects. This study therefore examines differences in reported evaluations and associations with integration strategies while distinguishing professional perceptions from measured environmental outcomes.

Research objectives and scope

RO1 was to assess design professionals' perceptions of the aesthetic, functional and well-being dimensions of indoor plant landscapes. RO2 was to examine the associations of aesthetic and functional cognition with integration strategies, the association of functional cognition with perceived well-being, and the moderating role of professional experience in the relationship between functional cognition and integration strategies. Spatial layout, lighting and material selection provide the design context for these relationships.

LITERATURE REVIEW

This review brings together environmental psychology, human-centred design and the literature on indoor plant landscapes. It considers how spatial layout, lighting and material selection relate to the integration of plants into indoor environments, while distinguishing potential and perceived benefits from measured performance.

Theoretical Foundation: Environmental Psychology and the S-O-R Model

Environmental psychology examines relationships between physical environments and human behaviour, cognition and emotion. It provides a basis for considering how design features are experienced by occupants and how designers anticipate these experiences. For indoor plant landscapes, relevant questions include visual appreciation, perceived connection to nature, comfort and satisfaction.

The Stimulus–Organism–Response (S-O-R) model provides a conceptual framework for organising these relationships. Stimulus refers to environmental attributes, including spatial layout, light, material texture and planting. Organism refers to internal appraisal, such as emotional responses and perceived comfort. Response refers to subsequent experiences or behaviours, such as satisfaction and approach or avoidance. These distinctions help explain the proposed relationships without implying that all stages were measured in the present survey.

Biophilic design literature considers how contact with natural elements can inform experiences of built environments (Kellert et al., 2011; Heerwagen, 2009). Turki et al. (2023) discuss greening in healthcare spaces, providing a setting-specific context for this discussion. Introducing indoor plants may create opportunities for visual engagement and perceived connection to nature, but responses can differ with users, settings and the quality of implementation. In this study, S-O-R supports the conceptual discussion of professional perceptions; it is not presented as a statistically validated sequence from plant exposure through comfort to occupant satisfaction.

Human-Centered and User-Centric Design Principles

Human-Centered Design (HCD) places users' needs, activities and experiences at the centre of the design process. In interior environments, this requires attention to aesthetic preferences alongside behavioural patterns, accessibility and everyday use. Indoor planting should therefore be considered in relation to how people occupy and move through a space, rather than through visual composition alone.

Unity of Function and Form

Aesthetic composition and practical use are complementary design considerations. For indoor plant landscapes, this means coordinating plant size, arrangement and visibility with furniture, circulation and maintenance access. A visually attractive planting scheme may be unsuitable if it obstructs sightlines or movement. Conversely, planting can be considered as part of spatial zoning or the provision of visual interest, provided that its intended function is evaluated in the context of users' needs.

Fusion of Sustainability and Health

Sustainability adds questions about resources and operation to the consideration of user experience. Lee et al. (2013) examine practitioners' motivations for specifying sustainable materials, while Alfuraty (2020) discusses sustainable material selection in interior design. These concerns are relevant to planting specifications: irrigation, containers, growing media, replacement plants and supplementary lighting all have operational implications. Indoor plants may contribute to a design intention centred on nature and well-being, but their presence alone does not establish a net carbon benefit, improved air quality or lower energy consumption.

Interaction of Key Design Elements and Biophilic Interventions

Indoor plant landscapes form part of a wider interior design system. Spatial layout, lighting and material selection influence where plants can be accommodated, how they are experienced and whether they can be maintained. These elements are considered here as design conditions, rather than as verified predictors in the professional survey.

Spatial Layout

Spatial layout includes zoning, circulation and furniture placement. Plant arrangements can be designed to mark boundaries, frame views or create a degree of visual separation. Their suitability depends on mature plant size, visibility, accessible routes and the activities taking place nearby. The idea of a biophilic partition is therefore useful as a design strategy, but a visual boundary should not automatically be described as effective acoustic insulation or evidence of improved physical comfort.

Lighting Design

Lighting design needs to consider both the visual experience of occupants and the growing conditions of plants. Daylight availability, shading and the distribution of supplementary light affect where planting is feasible. Leaf forms and changing light patterns may contribute to the visual experience associated with biophilic design (Ryan et al., 2014). However, plant lighting requirements and human lighting needs should be assessed separately. Neither relaxation nor energy savings can be inferred solely from the inclusion of plants or grow lights.

Material Selection

Material selection concerns appearance, tactile qualities, durability, maintenance and potential emissions. Alfuraty (2020) provides a basis for considering sustainable materials in interior design. Plant foliage, containers and surrounding finishes can be composed with materials such as wood and stone to support a

coherent visual setting. Such combinations may be relevant to perceived naturalness and aesthetic preference, but do not establish improved environmental quality without an appropriate assessment. Container drainage and compatibility with adjacent surfaces also require attention during specification.

***Specific Benefits of Indoor Plant Landscapes: An Evidence-Based Perspective
Air Quality and Perceived Environmental Benefits***

The literature on indoor planting includes health, discomfort and environmental-performance questions, which should not be treated as equivalent outcomes. Fjeld (2000) addresses health and discomfort among workers and school children; such outcomes should not be equated with quantified removal of VOCs or particulate matter. Air-purification claims require evidence relevant to the pollutant, planting system and operating conditions. The present questionnaire asks about beliefs concerning indoor air quality and perceived physical improvements. These questions concern perceptions rather than measurements of pollutant removal, ventilation performance or energy savings. Cummings and Waring (2020) analysed reported VOC-removal efficiencies and showed why results from small sealed chambers should not be directly translated into substantial air-cleaning benefits from ordinary potted plants in ventilated buildings. Their findings reinforce the distinction between an experimental removal mechanism and a meaningful contribution under occupied-building conditions.

Psychological Restoration

Heerwagen (2009) discusses biophilia, health and well-being, providing a conceptual basis for considering restorative experiences associated with nature. Psychological restoration remains an important rationale for biophilic design and for investigating perceived comfort, mood and connection to nature. However, professionals' reports of noticed changes cannot establish a clinical benefit or isolate plants as the cause. The distinction between a theoretical explanation, a perceived experience and a measured outcome is maintained throughout this paper. Bringslimark et al. (2009) found that the experimental literature suggested potential psychological benefits, while highlighting variation in study designs and outcomes. Han and Ruan (2019) likewise reviewed self-reported perceptions across diverse exposure conditions. Together, these reviews support investigating perceived benefits without assuming that every planting arrangement produces the same restorative response.

Design Patterns

Ryan et al. (2014) discuss biophilic design patterns as nature-based parameters relevant to health and well-being in the built environment. These patterns provide a vocabulary for considering natural elements and design experiences. Here,

design patterns serve as conceptual guidance rather than as validated questionnaire items or proof of a particular environmental effect.

Together, these perspectives support examining how professionals understand and integrate indoor planting. Budget, maintenance, spatial constraints and the interpretation of available evidence are relevant topics for inquiry, rather than barriers already demonstrated by this survey. The following methodology therefore focuses on professional perceptions and the available instrument, while the later recommendations address how design intentions could be assessed through maintenance records, environmental measurements and post-occupancy evaluation.

RESEARCH METHODOLOGY

Study design and scope

A cross-sectional questionnaire survey examined design professionals' perceptions and reported integration practices. The study evaluated aesthetic cognition (AC), functional cognition (FC), perceived well-being (PW) and integration strategies (IS), with professional experience as a moderator. The S-O-R framework provided conceptual context; the analysis did not test mediation through psychological or physical comfort.

Participants and sampling strategy

The target population comprised certified practitioners and active researchers across architecture, interior design, landscape architecture and green building consultancy. A multi-stage non-probability sampling strategy combining purposive and snowball approaches was executed between March and June 2025 across major urban design hubs in Malaysia, primarily Greater Kuala Lumpur/Klang Valley and Penang. The initial professional group was recruited through institutional directories, including the Malaysian Institute of Architects (PAM), the Institute of Landscape Architects Malaysia (ILAM) and Green Building Index (GBI) facilitator networks. This group subsequently disseminated the survey link across affiliated corporate design offices and private practices.

A total of 230 questionnaire invitations were issued online. Submissions with completion times under three minutes or duplicate IP addresses were excluded. The final sample comprised 185 usable responses, corresponding to a usable-response proportion of 80.4% of invitations. A post-hoc power analysis indicated power above 0.80 for detecting medium effects at $\alpha = 0.05$. The non-probability recruitment strategy nevertheless limits population generalisation.

Questionnaire content and item sources

The questionnaire recorded gender, age, educational level and years of professional experience. The four constructs were assessed using three items each, as shown in Table 1. Responses used five-point scales, anchored from 1 (strongly disagree/rarely) to 5 (strongly agree/always), according to whether a question concerned an evaluation or practice. Perceived well-being refers to designers' assessments of occupant experiences rather than directly measured clinical or physiological outcomes.

Table 1. Measurement constructs, operational items and sources

Construct	Operational items	Sources
Aesthetic Cognition (AC)	AC1: Indoor plants markedly enhance visual spatial layering and aesthetic interest. AC2: Plant foliage and forms harmonize effectively with architectural finishes (wood, stone). AC3: Incorporating greenery elevates perceived indoor spatial luxury and environmental quality.	Kellert et al. (2011); Ryan et al. (2014)
Functional Cognition (FC)	FC1: Indoor plants actively regulate ambient indoor microclimates and relative humidity. FC2: Dense vegetation layouts function as noticeable acoustic buffers against ambient noise. FC3: Indoor planting systems contribute to mitigating perceived airborne particulates and stale air.	Fjeld (2000); Alfuraty (2020)
Perceived Well-being (PW)	PW1: Exposure to planted interiors significantly mitigates occupant mental fatigue. PW2: Indoor greenery fosters an emotional sense of connection to nature (biophilia). PW3: Biophilic plantscapes noticeably improve reported spatial satisfaction and stress relief.	Heerwagen (2009)
Integration Strategies (IS)	IS1: Plant layouts are systematically coordinated with HVAC airflow and circulation in early design. IS2: Dedicated supplementary horticultural lighting is engineered to support plant biology. IS3: Technical criteria (drainage, automated irrigation, maintenance access) are formalized into project specifications.	Turki et al. (2023); Lee et al. (2013)

Items were adapted with reference to the biophilic design literature. Aesthetic cognition drew on Kellert et al. (2011) and Ryan et al. (2014); functional cognition on Fjeld (2000) and Alfuraty (2020); perceived well-being on Heerwagen (2009); and integration strategies on Turki et al. (2023) and Lee et al. (2013). The functional items elicited respondents' beliefs about environmental benefits; their wording should not be interpreted as independent evidence that plants deliver these effects.

The analysis focused on the four constructs in Table 1. Selection criteria were not treated as an additional numerical construct, and no mean or standard deviation is reported for that topic.

Data collection procedures

The survey was administered online during the March–June 2025 fieldwork period. The questionnaire introduction explained the research purpose and included assurances of privacy and research-only use of responses. Completion-time and duplicate-IP checks were applied before retaining the final analytic sample.

Data analysis strategy

Quantitative data were processed using SPSS 26.0 for descriptive statistics and SmartPLS 4 for structural equation modeling, following the reporting considerations of Hair et al. (2019). The measurement model was assessed for internal consistency using Cronbach's alpha and composite reliability, convergent validity using average variance extracted (AVE), and discriminant validity using the heterotrait–monotrait ratio (HTMT). Reference values of 0.70 for alpha and composite reliability, 0.50 for AVE and 0.85 for HTMT guided interpretation. The use of HTMT follows Henseler et al. (2015), who proposed this criterion to improve the detection of discriminant-validity problems in variance-based structural equation models.

Structural paths and the moderating role of professional experience were evaluated using non-parametric bootstrapping with 5,000 resamples. The analysis reported path coefficients, standard errors, t-values, p-values and f^2 effect sizes. Model assessment also included variance inflation factors (VIF), R^2 , the standardized root mean square residual (SRMR) and Q^2_{predict} . The bootstrap resample count is distinct from the respondent sample size of 185.

H1 specified a positive association between aesthetic cognition and integration strategies; H2 specified a positive association between functional cognition and integration strategies; and H3 specified a positive association between functional cognition and perceived well-being. H4 proposed that professional experience positively moderated the association between functional cognition and integration strategies. These relationships were examined as cross-sectional associations rather than causal effects.

ANALYSIS AND DISCUSSION

Demographic profile of respondents

Table 2 summarises the demographic characteristics of the 185 respondents. The sample comprised 102 men and 83 women. The largest reported age category was 30–40 years (36.8%); 48.1% held a master's degree, and 51.9% were in the 5–15

years of experience category. The distribution provides variation in professional tenure but does not establish population representativeness.

Table 2. Demographic profile of respondents

Variable	Category	n	%
Gender	Male	102	55.1
	Female	83	44.9
Age	Less than 30 years	45	24.3
	30–40 years	68	36.8
	40–50 years	52	28.1
	50 years and more	20	10.8
Educational Level	Diploma / Bachelor's	74	40
	Master's Degree	89	48.1
	Ph.D. / Professional	22	11.9
Years of Experience	Less than 5 years	38	20.5
	5–15 years	96	51.9
	15 years and more	51	27.6
Total		185	100

Descriptive Statistics of Reported Perceptions

Aesthetic cognition had a mean rating of 4.35 (SD = 0.62), and perceived well-being had a mean of 4.28 (SD = 0.68). Functional cognition was rated at 3.12 (SD = 0.85), while integration strategies had a mean of 2.85 (SD = 0.91). These descriptive differences suggest stronger endorsement of aesthetic and well-being topics than of functional and technical integration topics. They are not presented as a statistically tested difference between means.

The cognition–practice gap provides an interpretive description of this pattern. It should not be equated with a measured shortfall in building performance or evidence that individual professionals lack competence. Selection criteria were not assigned a numerical score.

Measurement model assessment

Table 3 presents indicator-loading ranges and reliability and convergent-validity statistics. Cronbach's alpha ranged from 0.786 to 0.845, composite reliability from 0.842 to 0.895, and AVE from 0.573 to 0.682. Indicator loadings were reported as significant at $p < 0.001$. Table 3b presents the HTMT ratios, which ranged from 0.292 to 0.641 and were below the 0.85 reference value. Reported inner VIF values ranged from 1.352 to 1.502.

Table 3. Measurement model assessment

Construct	Loading range	Alpha	CR	AVE	Inner VIF
AC	0.762–0.841	0.824	0.881	0.650	1.352
FC	0.735–0.814	0.786	0.842	0.573	1.418
PW	0.791–0.863	0.845	0.895	0.682	1.502
IS	0.754–0.832	0.801	0.858	0.603	—

Note: All indicator loadings were reported as significant at $p < 0.001$. Alpha = Cronbach's alpha; CR = composite reliability; AVE = average variance extracted. Inner VIF values are reproduced as reported.

Table 3b. Discriminant validity assessed using HTMT

Construct	AC	FC	PW
AC	—		
FC	0.435	—	
PW	0.518	0.612	—
IS	0.292	0.641	0.485

4.4 Structural model and moderation

Table 4 presents the structural path estimates. H1 was not supported ($\beta = 0.118$, $p = 0.150$). H2 and H3 were supported, with positive associations of functional cognition with integration strategies ($\beta = 0.462$, $p < 0.001$) and perceived well-being ($\beta = 0.389$, $p < 0.001$). The experience interaction was positive and significant ($\beta = 0.208$, $p = 0.005$), supporting H4. The corresponding f^2 values were 0.016, 0.252, 0.185 and 0.065, respectively.

Table 4. Structural hypotheses tested using 5,000 bootstrap resamples

Hypothesis and path	β	SE	t	p	f^2	Decision
H1: AC $\rightarrow$ IS	0.118	0.082	1.439	0.150	0.016	Not supported
H2: FC $\rightarrow$ IS	0.462	0.085	5.435	< 0.001	0.252	Supported
H3: FC $\rightarrow$ PW	0.389	0.091	4.275	< 0.001	0.185	Supported
H4: Experience $\times$ FC $\rightarrow$ IS	0.208	0.074	2.811	0.005	0.065	Supported

Note: SE = standard error. Respondent N = 185; bootstrap resamples = 5,000.

The reported SRMR was 0.067, below the 0.08 reference value. R^2 was 0.345 for integration strategies and 0.224 for perceived well-being, corresponding to explained variance of 34.5% and 22.4%. The reported Q^2_{predict} was 0.278. Its positive value supports further consideration of predictive relevance but is not,

by itself, a basis for classifying predictive performance as medium or strong. Shmueli et al. (2019) distinguish explanatory assessment from prediction-oriented evaluation and provide guidance for interpreting PLSpredict against appropriate benchmarks.

DISCUSSION

Functional cognition was positively associated with integration strategies, whereas the aesthetic-cognition path was not statistically significant. This pattern suggests that recognising functional considerations is associated with reported technical integration beyond aesthetic appreciation alone. However, a non-significant aesthetic path does not establish that aesthetics is unimportant, and the cross-sectional design does not demonstrate a causal sequence from knowledge to implementation.

The positive interaction between professional experience and functional cognition is consistent with a stronger association between functional cognition and integration strategies at higher values of the coded experience measure. Functional cognition was also associated with perceived well-being. These findings extend the professional perspective on biophilic design discussed by Heerwagen (2009), Kellert et al. (2011) and Ryan et al. (2014), while remaining subject to the limits of self-report and the sampling design. More recently, Abbasoğlu and Kahramanoğlu (2025) examined plant-related perceptions of indoor air quality and subjective well-being in a Northern Cyprus survey. Their results linked favourable assessments of plant characteristics with perceived benefits, providing a relevant comparison for the present perception-based approach while involving a different setting and population.

The distinction between perceptions and performance is particularly important for air quality. A respondent's belief that indoor plants improve air quality is a report about that belief. Without exposure measurements and an appropriate comparison, it cannot quantify VOC removal, particle reduction or ventilation savings. Similarly, a perceived well-being benefit does not establish a clinical effect or identify plants as the sole cause. These limits define the scope of the recommendations below.

IMPLICATIONS FOR DESIGN AND PROFESSIONAL PRACTICE

The following recommendations are design and evaluation proposals informed by the questionnaire topics and conceptual literature. They have not been validated as causal effects by the present survey. Their purpose is to make design intentions, operational responsibilities and evidence requirements explicit.

Evidence-based design guidelines

A project planting brief should identify intended experiential goals, target users and spatial constraints. Designers should document species suitability for available light, mature size, circulation and accessible routes, sightlines, proximity to services and access for maintenance. Plant placement should be coordinated with furniture, cleaning and building operation. For each intended benefit, the brief should specify whether it is an aesthetic objective, an occupant-perception objective or an environmental performance claim, together with an appropriate evaluation method. Aesthetic preference should not be used as a proxy for pollutant removal or energy performance.

Plant growth lighting and occupant visual or circadian lighting objectives should be assessed separately. A grow-light specification does not by itself establish suitability for human lighting needs. Plant installations should complement the intended use and operation of a space. Active planted systems connected to mechanical airflow require specialist assessment, commissioning and operating evidence. No ventilation reduction or energy-saving allowance should be assigned on the basis of this questionnaire; quantified claims require measurements under relevant operating conditions.

Maintenance and operational governance

Design proposals should identify the facilities management team or other party responsible for routine care, inspections, repairs and replacement. A handover plan should record species and locations, irrigation and drainage arrangements, maintenance access, care schedules and the procedure for reporting faults. Routine records should cover leak checks, pruning, pest inspection, cleaning, plant survival and replacement rates. Water use, labour, replacement materials and other operating costs should be recorded over a defined period to assess the continuing resource requirements of the installation. Responsibilities and the maintenance budget should be agreed before installation.

Quantified indoor environmental quality metrics

Evaluation should distinguish subjective responses from physical measurements. Perceived comfort, satisfaction and nature connection can be assessed through clearly worded questions with consistent response anchors. A parallel environmental protocol can record temperature, relative humidity, illuminance and relevant acoustic conditions. Air-quality evaluation can include CO₂ as contextual information about occupancy and ventilation and particulate or pollutant-specific measurements selected for the stated objective. If total volatile organic compounds (TVOC) or individual VOCs are monitored, the method should identify the metric, instrument, calibration, locations, sampling duration and reporting units.

These measurements should be accompanied by records of occupancy, ventilation operation, outdoor conditions, cleaning and other potential influences. Sensor placement and sampling times should be documented so that comparisons refer to similar conditions. A single reading near plants does not demonstrate removal efficiency or causation. Energy claims require measured system consumption and an appropriate baseline, including lighting, pumps and fans where present. Plant visibility or density may describe an installation, but should not be treated as a validated proxy for health or air quality.

Post-occupancy evaluation protocol

A post-occupancy evaluation should compare the planting brief with the occupied setting during routine operation. For a prospective installation, the protocol should establish a pre-installation baseline and follow-up observations after installation, using consistent instruments, questions and sampling locations where possible. Follow-up should include normal operation rather than only commissioning conditions. Comparable spaces without the intervention can strengthen the comparison where feasible. Timing, occupancy, ventilation settings, seasonal changes and concurrent modifications should be recorded. Occupant satisfaction and complaints should be reviewed alongside environmental measurements and maintenance records.

This approach allows teams to assess whether a planting scheme remains usable and maintainable and whether anticipated experiential benefits are reported. It also enables revision when shading, access, leaks, replacement burden or user preferences differ from expectations. Any claim of an environmental effect should depend on the actual comparison and uncertainty, rather than on the presence of monitoring equipment.

Professional and cross-disciplinary education

Professional education can connect biophilic design concepts with horticultural requirements, building services, building biology, questionnaire design and evidence appraisal. Case-based teaching should ask learners to distinguish professional perceptions, laboratory findings and occupied-building measurements. Exercises can include a planting brief, an operating-cost estimate, a maintenance handover plan and a post-occupancy evaluation protocol. Joint work among architects, interior designers, horticultural specialists, facilities teams and ventilation engineers can help balance aesthetic goals with plant viability, usability and the evidence required for performance claims.

LIMITATIONS AND FUTURE RESEARCH

The cross-sectional design limits causal interpretation and cannot establish how professional perceptions or practices change over time. Purposive and snowball

recruitment may overrepresent connected professional networks in the surveyed urban regions. Self-reported constructs may also share response tendencies, and designers' assessments of occupant well-being are not equivalent to reports collected directly from occupants.

The study did not measure pollutant removal, acoustic performance, ventilation efficiency or energy savings. Consequently, the functional-cognition results reflect professional beliefs rather than demonstrated environmental effects. The reported positive Q^2 predict value alone does not establish the magnitude of out-of-sample predictive performance; prediction-error comparisons and further external validation would strengthen assessment.

Future research could extend recruitment to additional regions and professional groups, collect direct occupant feedback and examine completed projects longitudinally. Detailed conditional-effect analysis could further characterise the experience interaction. Combining questionnaire responses with maintenance records, environmental monitoring and post-occupancy evaluation would help assess how professional intentions relate to operation and user experience.

CONCLUSION

The study examined design professionals' perceptions of indoor plant landscapes using 185 survey responses. Aesthetics and perceived well-being received higher descriptive ratings than functional cognition and integration strategies. Functional cognition was positively associated with integration strategies and perceived well-being, while the aesthetic-cognition path to integration strategies was not significant. Professional experience showed a positive moderating association with the functional cognition–integration relationship. These results concern perceptions and reported practices rather than causal environmental performance.

The practical contribution is a set of recommendations linking plant specification with maintenance, explicit evaluation criteria, post-occupancy feedback and professional education. Indoor planting should be assessed against stated project goals and operating requirements. Perceived benefits and measured performance should be reported separately, with claims concerning air purification, health outcomes or energy savings supported by appropriate evidence.

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