MC 2025
PEOPLE & BUILDINGS
Proceedings of 14th Masters Conference:
London, 15th September 2025
Network for Comfort & Energy Use in Buildings
http://www.nceub.org.uk

Post Occupancy Evaluation and Role of Biophilic Design in Enhancing Workplace Environments: A Comparative Study of Office Building in the UK and Indonesia

Muhammad Hero Umar Renaldi[1] and Anna Mavrogianni[2]

[1] MSc Health, Wellbeing and Sustainable Buildings, University College London, UK, muhammad.renaldi.24@ucl.ac.uk;

[2] Bartlett School of Environment and Energy Resources, Institute of Environmental Design Engineering, University College London, UK, a.mavrogianni@ucl.ac.uk

Abstract: Physical workplace design plays a vital role in supporting wellbeing, comfort, and productivity, with office workers spending around 40% of their waking hours at work, largely indoors. Biophilic design has been shown to enhance psychological wellbeing and performance by reconnecting occupants with nature, yet no framework currently offers a method for evaluating biophilic features during occupancy to validate user satisfaction. This dissertation addressed this gap by assessing the relationship between biophilic features and perceived productivity in office settings, using post-occupancy evaluation (POE) through questionnaires and interviews. Data were collected from three offices in London, one in Bogor, and three in Jakarta, all incorporating biophilic elements. Findings indicate that perceived productivity was more strongly associated with the quality and integration of features than their presence alone. Despite contextual differences, productivity levels were broadly comparable across the case studies in the two countries. Quality, maintenance, and sustained exposure emerged as key determinants of positive outcomes.

Keywords: Post Occupancy Evaluation, Biophilic Design, Perceived Productivity, Office Settings. Case Study

1 Introduction

Since the COVID-19 pandemic, research on healthy workplace design has expanded significantly alongside growing awareness of health and wellbeing concerns (Lei *et al.*, 2022; Elantary, 2024). This underscores the importance of high-quality workplace environments—including adequate lighting, thermal comfort, ergonomic workstations, and spatial convenience—in supporting productivity, enhancing performance, and motivating office workers (Srivastava *et al.*, 2024; Öztürk *et al.*, 2025). Increasingly, studies have examined the effects of incorporating natural elements into office settings on worker health and wellbeing (Yildirim *et al.*, 2023). However, rapid urbanisation and the rise in time spent indoors have limited interaction with nature (Kellert, 2018), contributing to stress and anxiety (Chang *et al.*, 2024). In response, architects and designers have sought to reintroduce natural elements through biophilic design strategies (Ryan *et al.*, 2014; Huizi *et al.*, 2024).

Two widely adopted frameworks—Browning *et al.* (2014) and Kellert (2018)—guide the application of biophilic design in the built environment. Both are deliberately broad and flexible, enabling adaptation across sectors and scales, and leaving designers with freedom to interpret them into specific design features. Yet this lack of prescriptive architectural guidance has created uncertainty in practice (Patel *et al.*, 2022). Post-occupancy evaluation (POE) offers a systematic tool for assessing building performance through user feedback, covering both technical aspects, such as energy use and occupant outcomes, such as satisfaction with the indoor environment (Li *et al.*, 2018; Dam-Krogh *et al.*, 2024). However, no existing biophilic design framework incorporates a POE-based method for validating user comfort or satisfaction (Tabassum and Park, 2024).

Current evaluation tools for biophilic design in office buildings—particularly in relation to perceived productivity—remain underdeveloped, and no comparative case studies have

yet addressed differences across contrasting climatic contexts. This study addresses that gap by assessing the impact of biophilic features on perceived productivity through POE in two regions, the UK and Indonesia, which differ in both climate and workplace culture.

2 Methodology

This study employed a mixed-methods design, combining quantitative data from office workers through a questionnaire survey with qualitative insights from interviews with building facility managers, complemented by technical document review. Findings from these sources were analysed and integrated to support interpretation.

2.1 Data Collection

Data were collected across seven case study offices in the UK (n=3) and Indonesia (n=4). All buildings were in city-centre areas, incorporated biophilic features, and had been occupied for at least one year, making them suitable for post-occupancy evaluation (RIBA, 2017). Several also held green building certifications, indicating a focus on occupant health and wellbeing. General information on case study offices is provided in Table 1.

Table 1. Office Building Information for Case Study

Office	Location	Workplace Dimension	Business Scope	Number of Employees	Office Illustration
I1	Bogor, Indonesia	1st – 2nd floor	Construction	Approx. 26	
I2	Jakarta, Indonesia	4th floor	Government	Approx. 60	
I3	Jakarta, Indonesia	1st floor	NGO	Approx. 10	
I4	Jakarta, Indonesia	1st – 4th floor	Property	Approx. 700	
UK1	London, UK	GF	NGO	Approx. 10	
UK2	London, UK	5th – 8th floor	Consultancy	Approx. 700	
UK3	London, UK	1st – 5th floor	Consultancy	Approx. 700	

N*ote: I – Indonesian Offices; UK – United Kingdom Offices*

The questionnaire, "Role of Biophilic Design in Enhancing Workplace Environment", consisted of 31 items divided into three subscales: biophilic design (BD, 17 items), perceived productivity (PP, 7 items), and personal information (PI, 7 items). The BD subscale evaluated the presence and quality of features using a five-point Likert scale aligned with the 12 attributes of the Biophilic Design Framework for Office Buildings (Tabassum and Park, 2024). The PP subscale, adapted from Brennan *et al.* (2002), measured self-reported productivity using seven statements rated on a five-point Likert scale. The PI subscale captured demographic and employment-related variables, used as independent factors in the analysis (Lei *et al.*, 2022). Reliability testing demonstrated acceptable internal consistency (Cronbach's $\alpha > 0.7$), with $\alpha = 0.85$ for BD and $\alpha = 0.81$ for PP.

Interviews were conducted with facility managers or office managers recommended by HR, focusing on biophilic design intent, implemented features, and evaluation practices. Seven core questions were posed, grouped into three themes: design intent during development, implementation of biophilic elements, and perceived outcomes. Interviews were held online (WhatsApp/email) in Indonesia and in person in the UK.

Participation in both questionnaires and interviews were voluntary and anonymous, with no sensitive personal information disclosed. Ethical approval was granted by the UCL Research Ethics Committee. Response rates ranged from 60–77% across most offices, although three large offices achieved only ~4% as distribution relied on open channels such as QR codes, paper forms in shared spaces, or general email circulation. In such cases, rates were estimated by dividing the number of completed surveys by the approximate total number of employees.

2.2 Data Analysis

Quantitative analysis was conducted in two stages: univariate and bivariate (Kajamaa, *et al.*, 2020). Univariate analysis described sample characteristics, office attendance, and evaluations of biophilic features and productivity using descriptive statistics (mean, median, SD) presented in tables and diagrams (Bertani *et al.*, 2018). Bivariate analysis explored associations between variables using Pearson's correlation and t-tests. Correlations were examined between biophilic feature quality, office attendance, and productivity, with coefficients >0.6 indicating strong relationships and significance confirmed at $p<0.05$ (Sheard, 2018). Additional tests assessed which specific features were most strongly associated with productivity and whether differences existed across demographic subgroups or between UK and Indonesian offices. All statistical tests were performed using Excel 16.94 with the Analysis ToolPak and Xrealstats add-ins (Microsoft, no date).

3 Findings

3.1 Descriptive Results

The sample was balanced by gender (46% male, 50% female, 4% prefer not to say), with most participants aged 25–34 and holding at least a bachelor's degree. UK respondents typically had 1–3 years of working in current offices, while Indonesians reported more than six years. Office attendance also varied: over 90% of Indonesian employees worked five days per week compared with two to three days for most UK workers. Weekly hours were generally 31–40 in the UK and 41–50 in Indonesia.

3.2 Biophilic Design Features

Average ratings for biophilic features were positive in both regions (with Likert scale value above 3.0 out of 5.0), except for nature-inspired interiors in Indonesian offices (2.85). Natural lighting and outdoor green spaces received the highest scores across both countries (UK: 4.24 and 4.15; Indonesia: 4.15 and 4.08). While mean feature quality was almost identical (UK 3.76; Indonesia 3.77), UK workers expressed higher overall satisfaction (mean=3.87) than Indonesian counterparts (mean = 3.60). Correlation analysis showed that higher perceived quality was significantly associated with greater overall satisfaction. Strongest relationships ($r>0.4$, $p<0.05$) were found for thermal comfort, air quality, indoor plants, nature-inspired colours, and natural materials, with colours being most influential ($r = 0.56$, $p<0.05$). Natural lighting showed weaker relationship ($r=0.35$), suggesting potential issues such as glare or shading. Qualitative responses confirmed that satisfaction was often shaped by multiple

interacting features rather than a single element. For example, one UK respondent cited daylight, indoor plants, and colour palette as the most important features combined, while an Indonesian respondent emphasised both daylight and outdoor views. Some participants also mentioned factors outside the 14 features, including ergonomic furniture and workplace safety, reinforcing the idea that biophilic design interacts with broader workplace qualities.

3.3 Perceived Productivity

The perceived productivity (PP) scale demonstrated strong reliability (Cronbach's $\alpha = 0.90$). Mean productivity across all groups was approximately 4.0, indicating generally positive perceptions. Most biophilic features correlated positively and significantly with productivity ($p<0.05$). The strongest predictors were nature-inspired interiors ($r = 0.54$) and overall design satisfaction ($r = 0.44$). Other significant contributors included thermal comfort, air quality, natural lighting, indoor plants, and outdoor green spaces. These findings highlight the dual role of environmental quality and restorative features in supporting workplace performance. Contextual differences emerged in certain features. Water features, natural materials, and colours correlated significantly with productivity in Indonesia but not in the UK. This may reflect the greater symbolic and climatic relevance of such elements in tropical environments, compared with their less prominent role in temperate UK workplaces.

3.4 Biophilic Design Intention

Interviews with six facility managers revealed that biophilic strategies were typically planned from the outset, often tied to sustainability certifications. Motivations centred on wellbeing, productivity, comfort, and sustainability, with some features added post-occupancy, such as preserved green walls. Maintenance was generally manageable, though exposed conditions posed challenges—an Indonesian manager noted rooftop and façade plants suffered under harsh afternoon sun. Costs were widely seen as justified by health and comfort benefits. Evaluation methods ranged from informal feedback to formal POEs, though rarely focused specifically on biophilic design. Reported benefits included wellbeing, comfort, creativity, and collaboration, while productivity was viewed more as an indirect outcome, as one UK manager explained: "*Productivity is a consequence of comfort rather than the main goal*".

4 Discussion and Future Research

4.1 Biophilic Design Features and Perceived Productivity

Findings suggest that perceived productivity depends more on the quality of biophilic features than on their mere presence. Consistent with Shibata *et al.* (2024), biophilic elements aid cognitive restoration and affective states that enhance productivity, though the effect is shaped by wider environmental and organisational conditions (Danielsson and Theorell, 2024). Interviews indicated that productivity was often seen as a by-product of comfort and wellbeing, echoing studies that frame biophilic design as health-focused (Ryan *et al.*, 2014; Huizi *et al.*, 2024). Nature-inspired interiors showed the strongest associations, consistent with evidence that organic forms improve circulation, accessibility, and user experience while lowering stress (Candido *et al.*, 2019). Other features—plants, water, and natural colours—were also positively linked to productivity, aligning with research on their restorative potential for stress reduction and focus (Hähn, *et al.*, 2021; Demirkol and Önaç, 2024). Respondent feedback echoed these outcomes, noting calming effects of plants and colours on concentration, reinforcing the role of biophilic design in supporting productivity (McCunn and Frey, 2020).

4.2 Biophilic Design Features and Perceived Productivity

This study highlights contextual differences in how biophilic features relate to productivity in UK and Indonesian offices. Indoor plants were more common in the UK (96%) than in Indonesia (75%), while water features were more prevalent in Indonesia (53%) than in UK (9%). Despite these contrasts, mean productivity scores were similar, suggesting outcomes depend more on feature quality and contextual fit than on presence alone (Yildirim *et al.*, 2023). Productivity associations also varied: in the UK, nature-inspired interiors were most influential, reflecting spatial coherence, while in Indonesia, colours, thermal comfort, and water features played greater roles. This aligns with evidence that coherent design supports legibility (Candido *et al.*, 2019), while sensory cues such as colour and water provide symbolic and physiological relief in tropical settings (Hermawan and Švajlenka, 2022). The prominence of water further reflects its cultural meaning as calming or spiritual (Browning *et al.*, 2014). Longer exposure increased satisfaction in both regions (Hasebe and Harada, 2025) though links to productivity were more complex: in the UK, longer weekly hours reduced productivity, reflecting non-design stressors such as commuting (Halonen *et al.*, 2020). In Indonesia, limited remote work restricted comparisons, though heavy workloads may similarly moderate perceptions.

4.3 Limitations and Future Directions

This study is limited by its office selection, which did not account for cultural or industry differences, and by the non-comparability of features across sites, reducing statistical robustness. Missing data further narrowed the sample, while reliance on self-reported, cross-sectional measures introduced bias and prevented causal inference (Pastore and Andersen, 2019). The tailored questionnaire also excluded health indicators and richer qualitative feedback. Despite these constraints, the findings underscore that biophilic design must be context sensitive, with emphasis on feature quality and maintenance. The POE tool developed here offers practical screening potential, but future research should adopt longitudinal, mixed-method approaches, integrating objective IEQ measures, validated cognitive tests, and psychometric tools to strengthen evidence and capture the complex interactions shaping perceived productivity (Isham *et al.*, 2021).

5 Conclusion

This study finds that productivity gains are shaped less by the presence of biophilic features than by their quality, integration, and maintenance. Nature-inspired interiors, especially organic forms that improve circulation and accessibility, showed the strongest links to productivity, while restorative elements such as plants, water, and colour supported focus and reduced stress. Despite contextual differences—UK offices favouring integrated design and Indonesian offices emphasising sensory features—overall productivity was comparable, underscoring that quality and upkeep matter more than quantity. Longer workplace exposure reinforced satisfaction, though the study is limited by small samples, self-reported data, and a cross-sectional design. Future research should adopt longitudinal methods with objective environmental and performance measures, but these findings confirm POE as a valuable tool for assessing biophilic design's impact on workplace outcomes.

6 References

Bertani, A. et al., 2018. How to describe bivariate data, *Journal of Thoracic Disease*, 10(2), pp. 1133–1137.

Bodin Danielsson, C. and Theorell, T. (2024) 'Office Design's Impact on Psychosocial Work Environment and Emotional Health', International Journal of Environmental Research and Public Health, 21(4), p. 438.

Brennan, A., Chugh, J.S. and Kline, T. (2002) 'Traditional versus Open Office Design: A Longitudinal Field Study', Environment and Behavior, 34(3), pp. 279–299.
Browning, W., Ryan, C. and Clancy, J. (2014) 14 Patterns of Biophilic Design: Improving Health & Well-being in the Built Environment. New York: Terrapin Bright Green LLC, p. 64.
Candido, C. et al. (2019) 'Designing activity-based workspaces: satisfaction, productivity and physical activity', Building Research & Information, 47(3), pp. 275–289.
Chang, C. et al. (2024) 'A lower connection to nature is related to lower mental health benefits from nature contact', Scientific Reports, 14(1), p. 6705.
Dam-Krogh, E.P. et al. (2024) 'Scoping review of post occupancy evaluation of office buildings with focus on indoor environmental quality and productivity', Journal of Building Engineering, 86, p. 108911.
Demirkol, A.K. and Önaç, A.K. (2024) 'Integrating biophilic design elements into office designs', Ain Shams Engineering Journal, 15(10), p. 102962.
Elantary, A. (2024) 'Unleashing the Potential: The Impact of Biophilic Office Design on Enhancing Employee Productivity', Mansoura Engineering Journal, 49(4).
Hähn, N., Essah, E. and Blanusa, T. (2021) 'Biophilic design and office planting: a case study of effects on perceived health, well-being and performance metrics in the workplace', Intelligent Buildings International, 13(4), pp. 241–260.
Halonen, J.I. et al. (2020) 'Commuting time to work and behaviour-related health: a fixed-effect analysis', Occupational and Environmental Medicine, 77(2), pp. 77–83.
Hasebe, T. and Harada, Y. (2025) 'Repeated restoration effects of viewing a WELL-certified biophilic office environment—A pilot study using psychological, physiological, and eye-tracking indicators', Building and Environment, 271, p. 112637.
Hermawan, H. and Švajlenka, J. (2022) 'Building Envelope and the Outdoor Microclimate Variable of Vernacular Houses: Analysis on the Environmental Elements in Tropical Coastal and Mountain Areas of Indonesia', Sustainability, 14(3), p. 1818.
Huizi, D., Sulaiman, R. and Ismail, M.A. (2024) 'Enhancing children's health and well-being through biophilic design in Chinese kindergartens: A systematic literature review', Social Sciences & Humanities Open, 10.
Isham, A., Mair, S. and Jackson, T. (2021) 'Worker wellbeing and productivity in advanced economies: Re-examining the link', Ecological Economics, 184, p. 106989.
Kajamaa, A., Mattick, K. and De La Croix, A. (2020) 'How to do mixed-methods research', The Clinical Teacher, 17(3), pp. 267–271.
Kellert, S.R. (2018) Nature by design: the practice of biophilic design. New Haven London: Yale University Press.
Lei, Q. et al. (2022) 'Post-Occupancy Evaluation of the Biophilic Design in the Workplace for Health and Wellbeing', Buildings, 12(4), p. 417.
Li, P., Froese, T.M. and Brager, G. (2018) 'Post-occupancy evaluation: State-of-the-art analysis and state-of-the-practice review', Building and Environment, 133, pp. 187–202.
McCunn, L. and Frey, C. (2020) 'Impacts of large-scale interior murals on hospital employees: a pharmacy department case study', Journal of Facilities Management, 18(1), pp. 53–70.
Öztürk, S.N. et al. (2025) 'Factros Affecting Workplace and Employee Productivity', Journal of The Institute of Science and Technology, 8(2), pp. 985–999.
Pastore, L. and Andersen, M. (2019) 'Building energy certification versus user satisfaction with the indoor environment: Findings from a multi-site post-occupancy evaluation (POE) in Switzerland', Building and Environment, 150, pp. 60–74.
Patel, A. et al. (2022) 'A critical review of Biophilic design and its design framework', in. Proceedings of the International Conference of Architectural Science Association, pp. 22–31.
RIBA et al. (2017) Building Knowledge: Pathways to Post Occupancy Evaluation. Reading: RIBA Publications.
Ryan, C.O. et al. (2014) 'BIOPHILIC DESIGN PATTERNS: Emerging Nature-Based Parameters for Health and Well-Being in the Built Environment', International Journal of Architectural Research: ArchNet-IJAR, 8(2).
Sheard, J. (2018) 'Quantitative data analysis', Research Methods, pp. 429–452.
Shibata, S. et al. (2024) 'Visual properties and perceived restorativeness in green offices: a photographic evaluation of office environments with various degrees of greening', Frontiers in Psychology, 15.
Srivastava, C. et al. (2024) 'Impact of workplace design on perceived work performance and well-being: Home versus office', Journal of Environmental Psychology, 95, p. 102274.
Tabassum, R.R. and Park, J. (2024) 'Development of a Building Evaluation Framework for Biophilic Design in Architecture', Buildings, 14(10), p. 3254.
Yildirim, M. et al. (2023) 'Investigating restorative effects of biophilic design in workplaces: a systematic review', Intelligent Buildings International, 15(5), pp. 205–247.