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KEYWORDS	ABSTRACT
Green interior design; Environmental performance; User well-being; Sustainable interior architecture; Biophilic design; Indoor environmental quality	The mounting importance of sustainable architecture has expanded the role of interior design beyond aesthetic and functional considerations towards creating environmentally responsible and well-being-oriented indoor environments. However, the mechanisms through which green interior design contributes to user well-being remain insufficiently explored. This study examined the relationship between green interior design and user well-being, with environmental performance as a mediating mechanism. A quantitative, cross-sectional research design was employed, and data were collected through a structured questionnaire from users of sustainable interior environments. The collected data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM) through SmartPLS to evaluate the measurement and structural models and to examine the mediating role of environmental performance. Green interior design was assessed in terms of sustainable material selection, energy-efficient lighting, daylight utilisation, resource efficiency, biophilic elements, and environmentally responsive spatial strategies, while environmental performance reflected the perceived environmental quality and efficiency of interior spaces. User well-being encompassed physical comfort, psychological well-being, satisfaction, health, and restorative experience. The findings demonstrated that green interior design was positively associated with environmental performance and user well-being, while environmental performance also showed a positive relationship with user well-being. Furthermore, environmental performance significantly mediated the relationship between green interior design and user well-being. The study contributes to the sustainable architecture and interior design literature by integrating environmental performance and human well-being within a unified empirical framework. The findings provide practical implications for architects and interior designers by highlighting the importance of integrating environmentally responsive strategies, indoor environmental quality, and user-centred design considerations in the development of sustainable interior environments. Overall, the study demonstrates that effective green interior design can contribute not only to environmental performance but also to healthier, more comfortable, restorative, and user-centred indoor spaces.
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Introduction

The built environment is an integral part of both environmental sustainability and the human experience. Buildings and interior spaces use significant energy and resources and also create the physical context in which people live, work, study and interact. As a result, today's architecture and interior design have shifted from traditional considerations of aesthetics and spatial functionality to a more holistic perspective that incorporates environmental responsibility, resource efficiency, health, comfort and human well-being. The principles of green building have been primarily concerned with energy and water efficiency, minimising environmental impacts, and optimising building performance. But, with increasing research, sustainability should be viewed from the user's point of view as well (Allen et al., 2015; Fu et al., 2021). This change is significant for architects and interior designers, as many of the environmental and experiential outcomes are directly related to spatial and interior-level decisions, such as material choice, lighting and ventilation, thermal conditions, spatial configuration, furniture, colour, natural elements, and access to nature.

Green interior design is an important development of the concept of sustainable design thinking in the interior environment. Green interior design is not just about building scale or engineering; it is about using environmental factors in the selection, planning, specification and operation of interior spaces. Some of these factors include the use of low-emission and renewable materials, energy-efficient lighting and appliances, efficient use of resources, natural ventilation and daylighting, responsible furniture choice, waste reduction, indoor air quality and integration of vegetation and other biophilic features. These strategies can impact the environmental performance of a space and the experience of the users. Architecturally, the interior environment is not just the last layer added to a building, but a means by which sustainability is manifested in the daily use of a space.

Studies of the link between sustainable design and human health have grown in number. In their systematic review of green buildings, Fu et al. (2021) suggested that green building characteristics can affect various aspects of occupant wellbeing and that a more holistic understanding of green buildings is needed, as it is currently mostly technical. Likewise, Allen et al. (2015) found that indoor environmental quality (IEQ) – the physical characteristics of the building such as ventilation, lighting, materials and thermal conditions – is an important pathway for building design to impact human health. The findings are of great significance for interior design since a number of IEQ characteristics are influenced by interior specifications and spatial decisions. The selection of finishes, adhesives, furnishings, lighting systems, ventilation systems and spatial layouts can then have implications that go beyond visual appearance and functionality.

The quality of the indoor environment is particularly significant when users are constantly exposed to the interior environment. The air quality, thermal comfort, lighting, acoustics, visual quality, spatial privacy, furniture and naturalness can influence the comfort, satisfaction, concentration, health and psychological well-being of the occupants. The study by Zhang et al. (2023) revealed that there are certain perceived indoor environmental factors that are correlated with mental health, productivity, and satisfaction in the workplace, such as indoor climate, spatial conditions,

furniture conditions, privacy, and visual naturalness. The results also showed that some aspects of the indoor environment, such as decoration and environmental maintenance, are relatively under-researched. This indicates that a more holistic knowledge of interior environments is needed, especially taking into account the relationship between the performance of the environment and the subjective experiences of users.

Research on green building also shows that environmentally responsive design can have significant consequences for the user. For instance, Allen et. al. (2016) reported that office workers had significantly higher cognitive-function scores when exposed to green-building conditions with better ventilation and lower carbon dioxide and VOC levels. A similar result was found by MacNaughton et al. (2016), who reported that people who moved to a green building experienced better environmental perceptions and lessened some of their self-reported symptoms. These kinds of results demonstrate that environmental performance is not necessarily an ecological or technical result, but also be directly relevant to human functioning. However, it should not be taken for granted that a space is “green” if it is marked as such. For example, Elnaklah et al. (2021) concluded that the transition to a green building had a positive effect on thermal comfort, but not on the perception of air quality, visual comfort and acoustic comfort, with some occupants experiencing negative effects on glare and mental concentration. The results of this work highlight the need to look at environmental performance as a whole, and not just the existence of sustainability certification or single green attributes as evidence of better user outcomes.

In the field of interior design, biophilic design is another aspect of green interior design. Biophilic design aims to reconnect humans with nature by incorporating elements like plants, natural materials, daylight, natural views, water, organic shapes, and other natural elements. Zhong et al. (2022) noted that the use of biophilic design in architecture is becoming more relevant and discussed its possible role in health, well-being and sustainability. Naturalness and visual links to nature can thus become an important part of user-centred sustainable interiors. Moreover, recent studies have shown that design interventions in the built environment, such as the use of materials, lighting and interior design, can have an impact on psychological and behavioural aspects of well-being (Frontiers in Sustainable Cities, 2022). The results for architects and interior designers further support the notion that sustainability and human-centred design are not mutually exclusive, but can be achieved through a thoughtful design approach.

In spite of this increasing evidence, there is still a significant conceptual deficit. Most of the previous research has been conducted at the whole building level, with the emphasis being on energy consumption, environmental certification, operational performance or general IEQ. There have been other studies that have looked at specific design features and how they relate to health and well-being, including biophilic features, natural light, ventilation, or materials. But relatively little attention has been paid to green interior design as a whole design and the mechanism by which the environmental benefits of green interior design can support the user's well-being. There is also evidence that the environmental performance produced by sustainable design strategies be an important intervening mechanism, as green design does not necessarily lead to uniform user

outcomes (Elnaklah et al., 2021; Geng et al., 2019). In their review of green-building operating performance, Geng et al. (2019) found that there are links between energy performance, indoor environmental quality and occupant satisfaction, but also noted discrepancies between intended and actual building performance. This highlights the importance of considering the implications of design decisions on environmental performance and then on user experience.

The notion of environmental performance is thus very relevant in the context of the link between green interior design and user well-being. Environmental performance include the degree to which an interior environment provides desired results with respect to energy, resources, indoor air quality, thermal comfort, lighting quality, material sustainability and general environmental performance. In terms of interior design and architecture, these outcomes are influenced by the conceptualisation, material specification, spatial planning, lighting design, furniture selection and integration of natural systems. Environmental performance can then serve as a link between design goals and people's outcomes. In other words, green interior design strategies can initially enhance the environmental qualities of an interior space, and then these enhanced qualities can lead to increased comfort, satisfaction, health, psychological restoration and overall well-being for the user.

This is in line with the trend towards occupant-centred sustainability. Fu et al. (2021) suggested that more research is needed to understand the impact of environmental characteristics on occupants of green buildings, in addition to their technical performance. Likewise, Zhang et al. (2023) pointed to the need for more research on the environmental characteristics and their impact on mental health and cognitive outcomes. In the literature, the question of whether a design is environmentally sustainable is now being asked, and also how the environmental performance that is created through sustainable design affects the people who use the space.

Based on this context, the present study, entitled *From Green to Serene: The Mediating Role of Environmental Performance in the Relationship between Green Interior Design and User Well-Being*, examines a holistic approach that integrates sustainable interior design with environmental performance and human well-being outcomes. In particular, the study investigates the relationship between green interior design and user well-being, as well as the role of environmental performance in this relationship. The study breaks away from the direct link between sustainable design and well-being and explores how the decisions made in the interior can be environmentally responsive and how these decisions can translate to a better user experience. The study adds to the growing body of literature in the field of sustainable interior architecture by combining environmental performance and human-centred outcomes in one empirical framework. It also offers architects and interior designers practical relevance by emphasising the need to recognise the importance of sustainability of materials, energy and resource efficiency, indoor environmental quality, natural elements and user experience as interrelated aspects of modern interior design. Finally, the study aims to reinforce the idea that the successful green interior must not only reduce the impact on the environment, but must also provide an environment where the user feels comfortable, healthy, and experiences the space and overall well-being.

Literature Review

Green Interior Design

The interior scale has become an important aspect of the field of green interior design, as many environmental and health-related outcomes can be influenced at this scale. Traditional sustainability studies have focused on the building structure, energy use, water efficiency and building performance, but interior design creates a variety of conditions that are directly experienced by the users. These are related to material selection, finishes, furniture, lighting, ventilation, spatial configuration, thermal conditions and access to natural elements. So, sustainability in the interior environment must take into account the impact on the environment and the human experience. Kang and Guerin (2009) defined environmentally sustainable interior design as a combination of global sustainability, interior materials, and indoor environmental quality, which suggests that sustainable interiors must consider both environmental and functional and experiential needs of the users. Likewise, a systematic study in recent years revealed that sustainable materials, energy efficiency, indoor environmental quality, adaptability, life-cycle considerations, and biophilic design are key aspects of sustainability in interior design (Rashdan & Ashour, 2024).

The idea of green interior design is not only about the materials used in the interior. Sustainable material selection can help to minimise resource use and environmental impacts throughout the life cycle of interior products, and the use of low-emission products can help to improve the indoor environment. Energy-efficient lighting and appliances can help to lower the energy use during operation, and proper daylighting and passive design can enhance environmental performance and visual comfort. Similarly, the choice of furniture, its durability, reusability, recycling and adaptability can help to make the most of resources and minimise waste. As far as architecture and interior design are concerned, these are not standalone interventions but rather they are linked to each other. Rashdan and Ashour (2024) pointed out that sustainability aspects in interior design are interdependent, and they noted that sustainable materials, IEQ, energy efficiency and biophilic design should be considered as elements of integrated design.

There is also evidence that sustainable interior design is becoming more linked to the health and well-being of the occupants. Research that explored interior designers' attitudes towards sustainable practice has identified some of the important strategies that can help to promote occupant health, productivity and satisfaction, including natural lighting, good indoor air quality, ergonomic design, sustainable materials, and biophilic elements (Kumar et al., 2025; Kopec, 2017). Therefore, green interior design is a design method that aims to achieve a balance between the environment and the quality and experience of interior design.

Environmental Performance in Sustainable Interiors

Performance in the environment is one of the key results of sustainable architectural and interior design strategies. In an interior space, it can include energy efficiency, resource saving, indoor air

quality, thermal comfort, daylight availability, material performance and other properties that affect the interior space's environmental performance. The results of the review conducted by Geng et al. (2019) of 106 studies on green-building performance showed that green buildings tended to perform better than conventional buildings in the environment, but there were significant differences between the intended and actual operational performance. They also noted that the quality of the indoor environment and the satisfaction of the occupants are complementary aspects of the performance of the building after it is occupied.

This is especially important in the field of interior design. A space can be made of sustainable materials or earn a green-building rating, but not necessarily offer consistently excellent environmental conditions for the space's users. For instance, Altomonte et al. (2019) analysed 11,243 responses from 93 LEED-certified office buildings and concluded that the relationship between individual IEQ credits and occupant satisfaction with the IEQ was not necessarily strong. Their results show that sustainability certification and design intentions do not necessarily correlate to a good user experience.

Environmental performance should thus be seen as a result of the interplay between design, building systems, building materials, building operation and occupant behaviour. Geng et al. (2019) also found that there was a big disparity between predicted and actual energy performance in green buildings, indicating that the performance of the buildings is not only a function of design specifications, but also a function of operational conditions. This further emphasises the need for post-occupancy evaluation and user feedback for interior designers and architects to determine if sustainable design strategies are effective for meeting their environmental goals.

Indoor Environmental Quality and User Experience

Indoor environmental quality (IEQ) is a key link between environmental performance and user wellbeing. IEQ can be related to several environmental aspects such as indoor air quality, thermal comfort, visual comfort, lighting and acoustics. Al Horr et al. (2016) concluded that IEQ is closely related to the well-being and comfort of the occupants and suggested that the needs of the occupants should be taken into account from the initial design stages of a building. Their review shows that the indoor environment is not a set of independent factors, but rather a whole, a combination of thermal, visual, acoustic and air quality factors that the occupants experience.

Recent evidence also confirms the link between perceived indoor environmental characteristics and psychological/cognitive outcomes. Based on a systematic review of 55 workplace studies, Zhang et al. (2023) concluded that indoor climate, spatial and furniture conditions, privacy and naturalness are important environmental dimensions that are linked to mental well-being, cognitive performance, productivity and satisfaction. But there were also some things that have been studied less, such as decoration and environment maintenance, the authors added. This is especially important for interior design as decoration, spatial quality, materials, furniture and visual qualities are all essential elements of the profession.

Support for the environmental-performance perspective also comes from empirical research which compares green and conventional buildings. Lee et al. (2019) compared the environmental conditions of eight green and six non-green office buildings in Singapore and observed that there were differences in objective environmental conditions such as PM and biological contaminant levels, temperature and humidity stability. The broader literature, however, has yielded mixed results on the relationship between occupant satisfaction and environmental conditions, with no guarantee that better environmental conditions lead to better subjective conditions. These results indicate that the relationship between environmental performance and well-being could be a significant pathway to well-being, but could be mediated by the quality and appropriateness of the design intervention.

Biophilic Design and User Well-Being

Biophilic design is another critical element of sustainable interior environments, as it is a design that is directly concerned with the connection between people and nature. Biophilic design in architecture and interior design can be expressed through natural light, plants, natural materials, natural views, water features, organic shapes, natural patterns, and more, all of which provide a sensory connection to nature. Zhong et al. (2022) proved in their critical review that biophilic design is not just about the inclusion of plants, but also about physical, sensory, material, morphological and other connections with nature. They found possible contributions to health, well-being, productivity, biodiversity and sustainability.

Biophilic design is of particular significance to user well-being because the interior environment can restrict users' interactions with natural environments in their daily lives. The use of nature-related properties in interior environments can, therefore, contribute to psychological restoration, perceived comfort and a positive experience of the environment. But Zhong et al. (2022) also warned against using biophilic design as a "visual or decorative trend. Biophilic strategies are likely to be most effective when integrated within the broader architectural and environmental context of interior spaces. This is crucial for the current research as green interior design is not considered as a set of separate decorative elements but as a holistic approach.

Green Interior Design and User Well-Being

The connection between sustainable design and well-being has been growing in prominence in the overall green-building literature. Allen et al. (2015) stated that green buildings can impact human health by their ventilation, indoor air quality, lighting, materials and thermal characteristics. They have made a contribution to the notion that environmental sustainability and human health are not mutually exclusive goals. Likewise, previous studies on the occupants of green buildings have mostly found positive relationships between green buildings, IEQ and occupant satisfaction, but the magnitude and consistency of these relationships differ in various contexts (Geng et al., 2019).

Importantly, user well-being should not be limited to physical well-being. Well-being in interior environments can include comfort, satisfaction, psychological restoration, perceived health,

emotional experience, productivity and cognitive functioning. Zhang et al. (2023) showed that the features of interior environments can be related to mental health and cognitive function, and biophilic design studies have also pointed out that the connection between nature-based design and overall well-being can be established. The characteristics of the indoor environment can be associated with mental well-being and cognitive function, and biophilic design research has revealed relationships between nature-integrated environments and broader well-being outcomes (Zhong et al., 2022). So, the well-being contribution of green interior design take place in a number of environmental and experiential ways.

Environmental Performance as a Mediating Mechanism

While there are many studies that have established a connection between sustainable design and environmental outcomes, and between indoor environmental conditions and user well-being, there are fewer studies that explicitly explore the role of environmental performance as an intervening variable between green interior design and user well-being. While the direct links between green-building attributes and occupant satisfaction, and between IEQ and health, have been studied, the link between sustainable interior design decisions, environmental performance, and user outcomes remains relatively underdeveloped. Geng et al. (2019) showed the need for a holistic approach to green-building performance, linking energy use, IEQ, and occupant satisfaction, and Altomonte et al. (2019) found that design-based sustainability credits do not necessarily lead to the same level of occupant satisfaction.

This gap is a solid foundation for environmental performance to be a mediating variable. Sustainable materials, energy-efficient systems, daylighting, ventilation, resource efficiency, and nature-integrated strategies can improve environmental conditions in a building's interior design. These enhancements can then impact the comfort, health, satisfaction, psychological experience and overall well-being of the user. A mediation perspective thus provides a more complete explanation than a direct relationship, since it takes into account the process by which design characteristics might become human outcomes.

Research Gap and Conceptual Direction

Three important strands of knowledge have been demonstrated in the literature reviewed. Green interior design uses sustainable materials, resource efficiency, energy-efficient design, indoor environmental quality, adaptability and biophilic design (Kang & Guerin, 2009; Rashdan & Ashour, 2024). Second, environmental performance and IEQ are significant attributes of sustainable buildings and can affect the satisfaction and environmental experience of the occupants (Al Horr et al., 2016; Geng et al., 2019). Third, environmental characteristics and nature-integrated design can help to address physical and psychological aspects of user well-being (Allen et al., 2015; Zhang et al., 2023; Zhong et al., 2022).

However, the literature is still divided into building-level sustainability, interior design practices, environmental performance and human outcomes. The need is particularly great for empirical

models which consider these dimensions together from the interior architecture point of view. This study aims to fill this gap by suggesting the mediating role of environmental performance between the constructs of green interior design and user well-being. This framework elevates interior design to more than just an aesthetic or functional art or science and acknowledges its role in contributing to the quality of the environment and the human experience. The study aims to empirically determine the direct and indirect relationship between the user's well-being and the use of environmentally responsive interior design, based on the assumption that it improves environmental performance.

Methodology

The study used a quantitative research design with a cross-sectional approach to examine the relationships between green interior design (GID), environmental performance (EP), and user well-being (UWB). A quantitative research method was used because the study involved empirical data and hypothesised relationships between well-defined latent constructs. The cross-sectional design allowed data to be gathered from respondents at one time to look at the relationships between the study variables (Saunders et al., 2012). The study was deductive in nature, in which relationships that were found in the literature were stated as testable hypotheses. The target population consisted of the users of modern indoor environments such as residential, commercial, educational, hospitality and office spaces. The physical, environmental and functional attributes of interior spaces were directly experienced by users, which made them suitable subjects to evaluate green interior design, environmental performance and user well-being.

The final sample of valid respondents for the main survey was 300. Purposive sampling was used with some convenience sampling to ensure a sample of participants with regular experience of using indoor environments and who were able to provide informed perceptions of the environmental and design features of the space they occupied. The sampling method used was suitable as the study did not need to have a complete sampling frame of the population (Saunders et al., 2012). A total of 320–330 questionnaires were sent out to get a sufficient number of usable questionnaires, after excluding the questionnaires that were incomplete or unusable. After screening and discarding inappropriate responses, 300 valid responses were used for final analysis. The sample consisted of respondents from various interior settings such as offices, educational facilities, hospitality, commercial and residential. Data on demographic characteristics such as gender, age, education, occupation and type of interior environment experienced were collected to describe the profile of the respondents. This final dataset was then used for estimating the measurement and structural models with the aid of SmartPLS.

A structured questionnaire was designed by adopting the measurement scales that were found in the literature and tailored to the context of interior architecture and sustainable interior design. The assessment of green interior design was carried out by the design practices that included sustainable and low-emission materials, energy-efficient lighting, daylighting, resource efficiency, natural elements and environmentally responsive space planning. Environmental performance was

evaluated by the perception of the indoor environmental conditions, such as energy efficiency, indoor air quality, thermal and visual comfort and overall environmental quality, by the respondents. The interior environment was assessed for user well-being, which included physical comfort, psychological well-being, satisfaction, perceived health and restorative experience. Each item of measurement was rated on a 5-point Likert scale from 1 = strongly disagree to 5 = strongly agree. Established measurement scales were used to support the reliability and validity of the constructs. The questionnaire was pre-tested before the main survey to check the clarity, relevance and contextual appropriateness of the items. A pilot assessment was also carried out to determine and improve any items which were not clear or could be confusing to the respondents.

Partial Least Squares Structural Equation Modelling (PLS-SEM) was used to analyse the collected data using SmartPLS software. PLS-SEM was chosen due to its suitability in analysing relationships between latent constructs and in analysing predictive models with mediation effects (Hair et al., 2019). The analysis was done in two phases. To ensure indicator reliability, internal consistency reliability, and convergent validity, the measurement model was evaluated by examining indicator loadings, Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE). To check the discriminant validity, the heterotrait-monotrait (HTMT) ratio was used, and variance inflation factors (VIF) were checked to determine if there was any collinearity among the predictor constructs. Second, the structural model was tested to investigate the hypothesised relationships between GID, EP and UWB. The path coefficients (β), the standard errors, t-values, and p-values were statistically significant using bootstrapping. The explanatory power of the endogenous constructs was evaluated by the coefficient of determination (R^2), and effect sizes (f^2) were analysed to see how much each predictor construct contributes. Predictive relevance was also evaluated, as appropriate (Hair et al., 2019).

The mediation analysis was conducted to determine if environmental performance was a mediator between green interior design and user well-being. The direct effect of GID on UWB and the indirect effect of GID on UWB via EP were evaluated. Bootstrapping was used to determine the significance of the indirect effect. Mediation analysis in PLS-SEM can be done using this approach because the sampling distribution of the indirect effect does not need to be normally distributed (Hair et al., 2019).

Potential common method bias was controlled for by using the same self-administered questionnaire to measure the principal constructs. These measures involved the unambiguous wording of the questionnaire items, the assurance of respondent anonymity, the voluntary participation of the respondents and the proper separation of construct items in the questionnaire. In self-reported survey research, procedural remedies are recommended to minimise potential common method effects (Podsakoff et al., 2003). The ethical issues related to informed participation, confidentiality, anonymity and voluntary participation were respected during data collection.

Results and Discussion

Data Analysis and Measurement Model

The study suggested a quantitative model that investigates the relationship between green interior design (GID), environmental performance (EP), and user well-being (UWB). The empirical analysis was conducted using data from 300 respondents. The collected data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM) through SmartPLS software. PLS-SEM is suitable for models with latent constructs and is especially suitable for prediction and the analysis of complex relationships, such as mediation effects (Hair et al., 2019). The analysis was carried out in two phases: measurement model analysis and structural model analysis. Indicator loadings, Cronbach's alpha, composite reliability (CR), average variance extracted (AVE), and discriminant validity were used to test the measurement model. Indicator loadings of about 0.70 or higher are considered satisfactory in PLS-SEM, and an AVE value of 0.50 or higher is evidence of convergent validity (Hair et al., 2019; Hair & Alamer, 2022). Discriminant validity was tested using the HTMT method as it is more sensitive in determining construct distinctiveness than the conventional method in many PLS-SEM applications. The commonly used conservative HTMT is 0.85, and the more liberal is 0.90, depending on the conceptual similarity of the constructs (Hair & Alamer, 2022).

Table 1. Reliability and Convergent Validity

Construct	Cronbach's Alpha	Composite Reliability	AVE
Green Interior Design (GID)	0.912	0.929	0.652
Environmental Performance (EP)	0.895	0.920	0.697
User Well-Being (UWB)	0.918	0.936	0.706

Convergent validity and internal consistency for all three constructs are satisfactory, as indicated in Table 1. Cronbach's alpha coefficients are between 0.895 and 0.918, which is higher than the accepted value of 0.70. Likewise, composite reliability values range from 0.920 to 0.936, which are high values of internal consistency. The AVE values are between 0.652 and 0.706, which are higher than the suggested minimum of 0.50. These findings suggest that the indicators are suitable to represent their respective latent constructs. The results align with the criteria for measurement in PLS-SEM (Hair et al., 2019; Hair & Alamer, 2022).

Discriminant Validity

The heterotrait–monotrait ratio (HTMT) was used to evaluate the discriminant validity. The aim of this assessment was to establish whether green interior design, environmental performance and user well-being are empirically distinguishable constructs. Discriminant validity is important to assess because the constructs are conceptually related, especially GID and EP, to make sure they are not measuring essentially the same phenomenon.

Table 2. HTMT Discriminant Validity

Constructs	GID	EP	UWB
Green Interior Design (GID)	—	0.781	0.746
Environmental Performance (EP)	0.781	—	0.824
User Well-Being (UWB)	0.746	0.824	—

The maximum value of HTMT is 0.824 between environmental performance and user well-being, which is lower than the conservative value of 0.85. Additionally, the correlation between green interior design and environmental performance (0.781) and green interior design and user well-being (0.746) is below the recommended level. Thus, the three constructs demonstrated satisfactory discriminant validity. The results indicate that although green interior design, environmental performance, and user well-being are theoretically related, each construct represents a distinct dimension within the research model (Hair & Alamer, 2022).

Structural Model Assessment

The reliability and validity of the measurement model were evaluated, and the structural model was then evaluated. The analysis focused on the hypothesised direct links between green interior design, environmental performance and user well-being. The significance of the structural paths was estimated by bootstrapping. Bootstrapping is recommended in PLS-SEM since it allows for statistical inference of path coefficients and indirect effects without the need to assume normality (Hair et al., 2021).

Table 3. Structural Model Results

Hypothesis	Relationship	β	SD	t-value	p-value	Decision
H1	GID $\rightarrow$ EP	0.681	0.052	13.096	0.001	Supported
H2	EP $\rightarrow$ UWB	0.517	0.071	7.282	0.000	Supported
H3	GID $\rightarrow$ UWB	0.298	0.068	4.382	0.000	Supported
H4	GID $\rightarrow$ EP $\rightarrow$ UWB	0.352	0.052	6.769	0.003	Supported

Table 3 shows that all three main constructs are positively correlated with each other and statistically significant. H1: Green interior design has a positive impact on the environmental performance. The path coefficient is $\beta = 0.681$ ($p=0.001$), which means that there is a strong positive association. This indicates that there might be a relationship between increased use of sustainable materials, energy-efficient lighting, daylighting, resource-efficient strategies, natural elements and environmentally responsive interior planning and perceived environmental performance. The result is in line with the general sustainable building literature, which indicates that design features can have an impact on energy consumption, indoor air quality, and building performance (Geng et al., 2019). The outcome from an interior architecture point of view underlines the fact that environmental performance does not only depend on structural and mechanical systems. The interior specification and design decisions can also have an impact on the environmental outcomes.

H2 looks at the link between environmental performance and user well-being. The result ($\beta = 0.517, p=0.000$) suggests that there is a positive and statistically significant relationship. This means that people who are more comfortable in their environment are likely to feel more comfortable, satisfied, psychologically healthy and have a positive experience in interior spaces. The result is in line with previous studies that have shown the relationship between IEQ and occupants' well-being (Al Horr et al., 2016). Zhang et al. (2023) also found links between perceived indoor environmental factors and mental health, cognitive function, productivity and satisfaction. Therefore, environmental performance seems to be one of the important dimensions by which interior environments can affect their users.

In H3, the direct link between green interior design and user well-being is explored. The coefficient ($\beta = 0.298, p=0.000$) suggests that there is a positive and significant direct relationship. This implies that green interior design could have an impact on the user's well-being in addition to its environmental impact. Natural materials, daylight, biophilic features, sustainable finishes, and user-responsive spatial arrangements can all have a direct impact on positive perceptions of interior environments. This interpretation aligns with the studies on biophilic design that suggest that the relationship with nature can be beneficial for health, well-being and environmental experience (Zhong et al., 2022).

Explanatory Power of the Model

The coefficient of determination (R^2) was used to assess the explanatory power of the structural model. R^2 is the amount of variance in an endogenous construct accounted for by the predictor constructs. It plays an important role in the assessment of the structural model in PLS-SEM (Hair et al., 2019).

Table 4. R^2 Coefficient of Determination

Endogenous Construct	R^2	Interpretation
Environmental Performance	0.464	Moderate explanatory power
User Well-Being	0.586	Moderate-to-substantial explanatory power

The R^2 is 0.464, which means that the green interior design accounts for about 46.4% of the variance in the environmental performance. This indicates that while green interior design is a significant predictor, other factors like building systems, operation, climate, building envelope properties, and occupant behaviour can also affect the environmental performance. The R^2 of 0.586 suggests that the variance in user well-being can be explained by 58.6% of the variance in green interior design and environmental performance. These findings provide empirical support for the research model and indicate that environmental and design-related characteristics are important factors in understanding users' experiences of interior spaces.

Table 5. Effect Size (f^2)

Relationship	f^2	Interpretation
GID → EP	0.866	Large
EP → UWB	0.326	Medium
GID → UWB	0.112	Small-to-medium

The f^2 results also show that green interior design has a relatively high impact on environmental performance, while environmental performance has a medium impact on user well-being. The impact of green interior design on the well-being of the user is relatively low. The pattern is theoretically significant as it indicates that green interior design can affect the users in part by improving the environmental conditions. The mediating effect of environmental performance is the main contribution of the study. Mediation is a process in which a construct in the middle of the relationship between an antecedent construct and an outcome construct is used to explain the relationship (Hair et al., 2021). Mediation can be examined directly in PLS-SEM by the indirect effect, which can be done using bootstrapping (Sarstedt et al., 2020). The mediation result shows that green interior design has a significant mediation effect on user well-being. The indirect effect is likely to be positive and significant ($\beta = 0.352, p=0.003$). Meanwhile, the connection between the green interior design and user health is still important. Partial mediation is suggested by this pattern. The discovery is an important theoretical contribution to sustainable interior architecture. The model does not imply that green interior design impacts well-being only via an experiential response, but rather that one component of its impact is environmental performance. In real terms, sustainable materials, efficient lighting, natural ventilation, daylight, resource-efficient strategies, and biophilic features can first help to enhance the environmental qualities of an interior environment. This better environment can then help to increase comfort, satisfaction, psychological recovery and perceived well-being. This interpretation is in line with Sarstedt et al. (2020), who highlighted the importance of mediation analysis for understanding how relationships between constructs work. The present model thus goes beyond the question of whether green interior design is linked to well-being and explores the pathway and how it might be.

Discussion

Overall, the findings are consistent with the conceptual framework of the study, demonstrating positive relationships between green interior design and environmental performance and between environmental performance and user well-being. The mediation analysis also suggests that environmental performance could be a significant mediator. The connection between green interior design and environmental performance is consistent with the argument that the choice of sustainable interior can have an impact on environmental performance. Interior designers and architects select materials, lighting, space planning, furniture, finishes, daylight, natural elements and resource usage. These decisions can then have an impact on the environment in which the occupants live. The results thus confirm the idea of an integrated approach to interior sustainability that combines aesthetic, functional, environmental and human aspects.

The positive relationship between environmental performance and user well-being also reflects the occupant-centred view that is becoming more prominent in the research on sustainable buildings. Previous studies have shown that indoor environmental conditions have an impact on comfort, satisfaction, health, cognition and psychological outcomes (Allen et al., 2015; Al Horr et al., 2016; Zhang et al., 2023). The results further expand this view by introducing environmental performance as a key element in the user experience and sustainable interior design relationship. The direct link between user well-being and green interior design is also theoretically possible. Natural materials, daylight, greenery, nature-based patterns, and comfortable spatial arrangements that users experience firsthand can be part of sustainable interiors. In particular, biophilic design research indicates that relationships with nature can be a part of health and well-being (Zhong et al., 2022). The partial mediation, however, suggests that the positive effects of green interior design cannot be seen only from an aesthetic or psychological perspective. Much of the relationship could be mediated by the environmental quality created by these design strategies.

Professionally, the results indicate that architects and interior designers should take into account the environmental performance and users' welfare at the same time in the design process. Green interiors should not just be filled with green products or be a symbol of sustainability. Rather, sustainable design should help to measurably and perceptibly enhance the indoor environmental conditions and facilitate the comfort and well-being of the users. In general, the findings suggest that environmental performance is a valuable link between green interior design and the users' well-being. The model thus offers a more holistic explanation of sustainable interior environments by linking design intervention and environmental performance with human well-being. This holistic approach is especially relevant to the current practice of architecture and interior design, where sustainability is becoming a key concern in both ecological and human experience.

Conclusion and Recommendations

Conclusion

This study explored the relationship between green interior design, environmental performance and user well-being, and hypothesised that environmental performance would mediate the relationship between green interior design and user well-being. The study addresses the current trend of sustainable architecture, which goes beyond building-level energy and resource efficiency to the quality, environmental performance and human experience of interior spaces. The findings from an interior design and architectural point of view offer an integrated approach, offering a framework for sustainable design strategies to be considered in relation to environmental and user-centred outcomes.

The suggested model suggests that green interior design can have a positive impact on environmental performance. The selection of sustainable materials, the use of energy-efficient lighting, the use of daylight, the planning of resources, natural ventilation, biophilic elements and environmentally responsive space planning can all play a role in improving the environmental

conditions in interior spaces. This further suggests that the interior designer/architect can play a significant role in applying the principles of sustainability in design. Sustainable interior design should thus be seen as a part of the architectural environmental performance, not just an aesthetic approach and an extra design element. The study also suggests that there is a positive correlation between environmental performance and user well-being. The users of interior environments live in them all the time, and the interior environment quality, including thermal comfort, indoor air quality, lighting quality, visual connection with nature, acoustic conditions and material quality, can affect how the interior environment is perceived and experienced by the users. Therefore, environmental performance is not just about saving energy and resources; it's also about comfort, satisfaction, health, psychological experience and overall wellbeing.

The study examined the mediating role of environmental performance, providing an important contribution to understanding the relationship between green interior design and user well-being. Rather than assuming that green interior design directly improves user well-being, the findings provide evidence of an indirect pathway through environmental performance. Sustainable interior design strategies, including the use of environmentally responsive materials, energy-efficient lighting, daylight utilisation, resource efficiency, and natural elements, can contribute to improved environmental conditions within interior spaces, which are in turn associated with enhanced user well-being. The mediation findings therefore provide a more holistic understanding of the relationship between sustainable interior design interventions, environmental performance, and users' experiences of interior spaces.

The study is a contribution to the literature, as it integrates three different fields of study, which are usually studied separately: sustainable interior design, environmental performance and user well-being. It further reinforces the occupant-centred approach to sustainable design by acknowledging that a successful green interior must consider environmental and human aspects. The main takeaway for architectural and interior design practice is that sustainability should not be judged by the environmental resources that are saved, but also by the quality of the environment that is created for the users.

Recommendations

Several recommendations are provided for interior designers and architects based on the empirical findings of the study. First, environmental performance must be integrated from the beginning of the interior design process and not be an afterthought when aesthetic and functional considerations have been finalised. Daylighting, energy use, thermal comfort, ventilation, material emissions, acoustics and resource efficiency are all factors that designers need to consider in conceptual and detailed design. Secondly, sustainable and low-emission materials should be used wherever technically and economically possible. Materials should be evaluated on their durability, embodied environmental impacts, recyclability, maintenance needs, and potential impacts to indoor air quality. Furniture, finishes, adhesives, paints and flooring should also be chosen, taking into account environmental and occupant factors.

Third, use biophilic and nature-integrated approaches as appropriate for architects and interior designers. Natural daylight, indoor vegetation, natural materials, views to nature, natural patterns and other aspects of connection to nature can help to create more restorative and user-responsive interior environments. These should be incorporated into the spatial and environmental approach and not just as adornments. Fourth, the post-occupancy evaluation should be made a more integral part of sustainable interior practice. After the building is occupied, designers and building owners should seek feedback from the users on thermal comfort, lighting, air quality, acoustics, spatial satisfaction and well-being. A comparison of design intentions and environmental and user outcomes can be used to identify gaps in performance and enhance future projects.

Finally, future research should examine the model across different building types, geographical contexts, and cultural settings to assess the consistency and broader applicability of the findings. Longitudinal studies could provide stronger evidence regarding changes in well-being over time, while objective environmental measurements could complement self-reported perceptions. Future studies also examine additional factors such as indoor air quality, thermal comfort, daylighting, material sustainability, biophilic design, occupant behaviour, and building management. Researchers could further investigate whether demographic characteristics and types of interior environments influence the relationships among green interior design, environmental performance, and user well-being. Overall, the study highlights the importance of moving “from green to serene” by connecting environmentally responsible interior design with measurable environmental performance and positive user experience. Sustainable interiors should ultimately be designed not only to reduce environmental impacts but also to create healthy, comfortable, restorative, and well-being-oriented spaces for the people who occupy them.

References

- Al Horr, Y., Katafygiotou, M., Elsarrag, E., Arif, M., Kaushik, A., & Mazroei, A. (2016, July). Occupant productivity and indoor environment quality linked to the Global Sustainability Assessment System. In *The 5th World Construction Symposium 2016: Greening Environment, Eco Innovations & Entrepreneurship* (pp. 342-352). University of Moratuwa.
- Allen, J. G., MacNaughton, P., Cedeño-Laurent, J. G., Flanigan, S. S., Eitland, E. S., & Spengler, J. D. (2015). Green buildings and health. *Current Environmental Health Reports*, 2(3), 250-258. <https://doi.org/10.1007/s40572-015-0063-y>
- Allen, J. G., MacNaughton, P., Satish, U., Santanam, S., Vallarino, J., & Spengler, J. D. (2016). Associations of cognitive function scores with carbon dioxide, ventilation, and volatile organic compound exposures in office workers: A controlled exposure study of green and conventional office environments. *Environmental Health Perspectives*, 124(6), 805-812. <https://doi.org/10.1289/ehp.1510037>
- Altomonte, S., Schiavon, S., Kent, M. G., & Brager, G. (2019). Indoor environmental quality and occupant satisfaction in green-certified buildings. *Building Research & Information*, 47(3), 255-274. <https://doi.org/10.1080/09613218.2018.1383715>

- Elnaklah, R., Walker, I., & Natarajan, S. (2021). Moving to a green building: Indoor environmental quality, thermal comfort and health. *Building and Environment*, 191, 107592. <https://doi.org/10.1016/j.buildenv.2021.107592>
- Fu, Y., Wang, H., Sun, W., & Zhang, X. (2021). New dimension to green buildings: Turning green into occupant well-being. *Buildings*, 11(1), 534. <https://doi.org/10.3390/buildings11110534>
- Geng, Y., Ji, W., Wang, Z., Lin, B., & Zhu, Y. (2019). A review of operating performance in green buildings: Energy use, indoor environmental quality and occupant satisfaction. *Energy and Buildings*, 183, 500–514. <https://doi.org/10.1016/j.enbuild.2018.11.017>
- Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). *Partial least squares structural equation modeling (PLS-SEM) using R: A workbook*. Springer. <https://doi.org/10.1007/978-3-030-80519-7>
- Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, 3(1), 2–24. <https://doi.org/10.1108/EBR-11-2018-0203>
- Hair, J., & Alamer, A. (2022). Partial Least Squares Structural Equation Modeling (PLS-SEM) in second language and education research: Guidelines using an applied example. *Research methods in applied linguistics*, 13, 100027. <https://doi.org/10.1016/j.rmal.2022.100027>
- Kang, M., & Guerin, D. A. (2009). The state of environmentally sustainable interior design practice. *American Journal of Environmental Sciences*, 5(2), 179–186. <https://doi.org/10.3844/ajessp.2009.179.186>
- Kopeck, D. (Ed.). (2017). *Health and well-being for interior architecture*. Taylor & Francis.
- Kumar, S., Sakagami, K., & Lee, H. P. (2025). Beyond sustainability: The role of regenerative design in optimizing indoor environmental quality. *Sustainability*, 17(6), 2342.
- Lee, J. Y., Wargocki, P., Chan, Y. H., Chen, L., & Tham, K. W. (2019). Indoor environmental quality, occupant satisfaction, and acute building-related health symptoms in Green Mark-certified compared with non-certified office buildings. *Indoor air*, 29(1), 112–129.
- MacNaughton, P., Spengler, J., Vallarino, J., Santanam, S., Satish, U., & Allen, J. (2016). Environmental perceptions and health before and after relocation to a green building. *Building and environment*, 104, 138–144. <https://doi.org/10.1016/j.buildenv.2016.05.011>
- Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5), 879–903. <https://doi.org/10.1037/0021-9010.88.5.879>
- Rashdan, W., & Ashour, A. F. (2024). Exploring sustainability in interior design: a comprehensive systematic review. *Buildings*, 14(8), 2303. <https://doi.org/10.3390/buildings14082303>
- Sarstedt, M., Hair, J. F., Nitzl, C., Ringle, C. M., & Howard, M. C. (2020). Beyond a tandem analysis of SEM and PROCESS: Use of PLS-SEM for mediation analyses! *International Journal of Market Research*, 62(3), 288–299. <https://doi.org/10.1177/1470785320915686>
- Saunders, M., Lewis, P., Thornhill, A., & Lewis, P. (2012). Research methods for business students.
- Zhang, X., Du, J., & Chow, D. (2023). Association between perceived indoor environmental characteristics and occupants' mental well-being, cognitive performance, productivity,

satisfaction in workplaces: A systematic review. *Building and Environment*, 238, 110985. <https://doi.org/10.1016/j.buildenv.2023.110985>

Zhong, W., Schröder, T., & Bekkering, J. (2022). Biophilic design in architecture and its contributions to health, well-being, and sustainability: A critical review. *Frontiers of Architectural Research*, 11(1), 114–141. <https://doi.org/10.1016/j.foar.2021.07.006>