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DESIGNING HUMAN-CENTERED ENVIRONMENTS FOR HEALTH OUTCOMES IN EDUCATIONAL SETTINGS: A LITERATURE REVIEW

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Abstract

This study explores how human-centered environmental design affects student health, cognitive performance, and overall well-being in educational settings. The research combines evidence from environmental psychology, ergonomics, and user experience design to review how physical and sensory environments affect student and educator health by influencing body functions, mental states, and social interactions. The research used scoping review methods to identify peer-reviewed studies published in Scopus, Web of Science, PubMed, and Google Scholar from 1990 to 2025. A total of 100 studies were included following screening and quality assessment. The research findings show that spaces that combine natural elements with adjustable ergonomic design and accessible areas for all people create better conditions that lead to better attention focus, reduced stress, and improved overall health. The research study reveals essential deficiencies in studies that monitor subjects over time while using multiple sensory inputs in real-world environments. The research shows that educational space design requires multiple fields to work together for creating learning spaces that support student thinking development and protect student health and fairness.

Keywords

Human-Centered Design; Educational Environments; Environmental Psychology; Cognitive Performance; Biophilic Design; Indoor Environmental Quality; Well-Being; Evidence-Based Design

Introduction

Educational settings serve as sites of concentrated cognitive and social activity, making them essential environments for mental and physical well-being (Pulimeno et al., 2020).

Students spend most of their school hours inside buildings, according to Chithra & Nagendra (2018), so poorly designed spaces that fail to provide sufficient lighting, create excessive noise and thermal discomfort, and require students to stay seated can cause students to experience fatigue and stress (Ulrich, 1984; Joye & Dewitte, 2018). Exposure to poor indoor environments can affect attention span and mood (Mirrahimi et al., 2011; Horvat et al., 2025). According to research, Human-centered design (HCD) can help mitigate these problems by creating spaces that follow human needs, emotional requirements, and health guidelines (Sanders & Stappers, 2014; Blackwell et al., 2017). The review explores literature from relevant domains to determine how components of educational space design affect students' physical health, mental well-being, and social interaction. The research draws on healthcare, education, and occupational design to present universal methods that help designers build better learning environments. The research establishes a link between environmental psychology and educational design to meet human needs for learning environments. The following research questions guided the study.

Research Questions:

- What environmental factors have been linked to health and well-being outcomes in educational settings?
- How can human-centered and evidence-based design principles be applied within schools and universities?
- What methods and metrics have been used to assess the health impacts of design in these contexts?

Theoretical Background

Designing environments that promote health, cognitive functioning, and well-being requires theoretical grounding that captures both the experiential dimension of users and the psychological mechanisms through which environments influence human behavior (Gifford, 2014). Two major theoretical traditions underpin this review: Human-Centered Design (HCD), Stress Recovery Theory (SRT), and Attention Restoration Theory (ART). These theories establish a multidimensional perspective on how educational settings can be intentionally crafted to enhance physical, mental, and social outcomes. This orientation also reflects the integrative structure of the broader literature to guide educational design strategies.

Human-Centered Design and Participatory Co-Design

Human-Centered Design (HCD) serves as a core method for developing educational settings that meet user needs and preferences. The HCD design approach is based on user-centered research, which requires designers to show empathy and engage in multiple problem-solving cycles with their users throughout the design journey (Bate & Robert, 2007). Students, teachers, and administrators should actively participate in HCD, as outlined by Sanders & Stappers (2008), to contribute their knowledge to the development of physical spaces, technological systems, sensory environments, and operational systems. The authors further highlighted that users' tacit knowledge and everyday routines are essential sources of design insight. By involving participants directly in envisioning and prototyping design interventions, co-design supports environments that authentically reflect cultural context, learning styles, neurodiversity, and emotional needs (Blackwell et al., 2017).

The co-design framework helps address situations that require special care by creating spaces that promote both comfort and effective communication (Sanders & Stappers, 2014). The same principles that value these aspects in everyday life also need to be applied to educational settings because students face changing mental work demands, sensory issues, social challenges, and emotional control needs throughout their school day. Co-design frameworks that use evidence-based and experience-driven approaches require researchers to combine scientific findings with personal experiences, resulting in solutions that unite scientific evidence with practical knowledge (Morley et al., 2024). This study establishes its dual focus, aligning with the research objectives to create educational spaces that combine natural elements with ergonomic technological design and sensory-based approaches.

The principles of HCD align with the design approaches represented by Universal Design and Universal Design for Learning (Capp, 2017). According to Burgstahler & Cory (2010) and Capp (2017), these frameworks highlight learning spaces that require adaptability, are easily identifiable, and are fully accessible to students with diverse learning needs. The authors demonstrate how environmental factors either minimize current social inequalities or make them worse by affecting personal freedom and shaping how people see things and their emotional state. Research conducted in educational facilities demonstrates that human-centered and inclusive design approaches foster greater student involvement and a sense of community by implementing strategies that adapt to environmental conditions and cultural traditions (Bassaw et al., 2025a).

Environmental Psychology: Stress Recovery Theory and Attention Restoration Theory

The study positions Environmental Psychology as its second fundamental theoretical framework, investigating how environmental factors influence the physical and sensory environments, shaping emotional, cognitive, and physiological processes. The two established theories, Stress Recovery Theory (SRT) and Attention Restoration Theory (ART), are most significant. The Stress Recovery Theory holds that spending time in nature leads to rapid physical recovery from stress by lowering blood pressure, relaxing muscle tension, and reducing cortisol levels (Ulrich, 1984; Ulrich et al., 1991). The response draws on evolutionary psychology because humans are born with an innate capacity to form connections with natural environments and the patterns they exhibit. Research indicates that SRT should be used in educational environments because students who experience natural window views, vegetation, daylight, and biophilic elements tend to have lower anxiety levels and improved psychological and affective states (Li & Sullivan, 2016; Lindemann-Matthies et al., 2021).

Attention Restoration Theory provides additional support for SRT by focusing on mental renewal processes rather than physical recovery mechanisms. The ART model demonstrates that nature exposure allows people to experience soft fascination, which prompts them to notice natural elements while their directed attention abilities rest (Kaplan, 1995). Research studies have shown that spending time in nature enhances working memory, improves task performance, and extends attention span (Berman et al., 2008; Ohly et al., 2016). The combination of natural light, outdoor views, and nature-rich microenvironments in educational spaces helps students learn better while reducing mental exhaustion and improving their mood (Porras Álvarez, 2020; Zhang et al., 2024).

Both theories map directly onto empirical evidence synthesized in this review. The study by Figueiro & Rea (2010) shows that daylight exposure regulates the body's clock and maintains alertness. Shield & Dockrell (2003) studied how sound, thermal, and air quality affect cognitive performance (Wargocki et al., 2020; Mendell & Heath, 2005) and revealed the mechanisms by which environmental variables affect psychological and cognitive outcomes. Environmental psychology helps researchers understand how students process sensory information, which influences their cognitive functions and emotional responses in educational environments.

Integrating HCD With Environmental Psychology

The HCD design framework enables organizations to build spaces through collaborative participation and empathetic methods, while environmental psychology identifies which environmental factors impact human health, behavioral responses, and mental processes. The three theories show that educational spaces operate as complex active systems that produce learning results through the combination of students' direct experiences with their automatic biological responses. The review supports its main claim through this integrated theoretical framework, which shows that learning spaces that focus on people and use evidence-based design with natural elements, ergonomic support, technological awareness, and sensory stimulation will create optimal conditions for student and educator health.

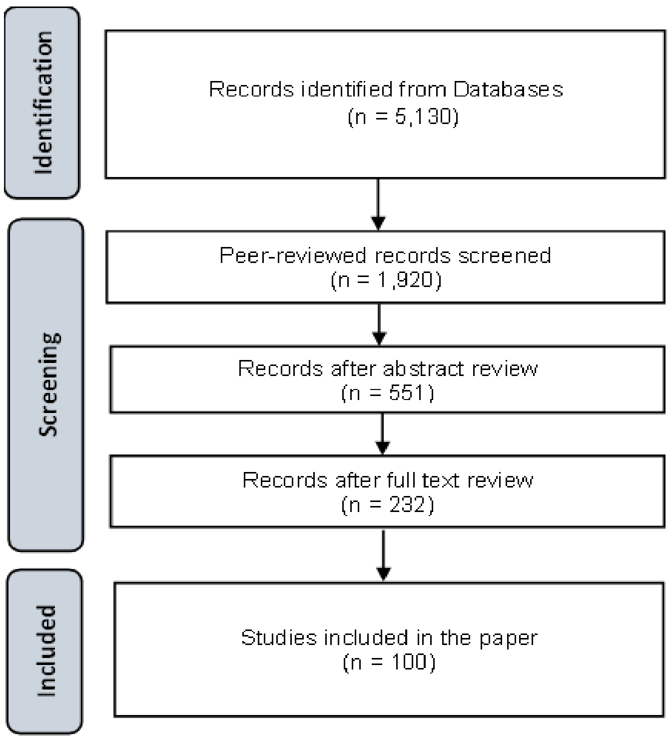
Methodology

A literature review was conducted to capture the breadth of empirical and theoretical work on the relationships between educational design and health outcomes. Adopting the methodology from Khatiwada et al. (2025), this review also followed a five-stage approach, inspired by PRISMA guidelines, to enhance the clarity and transparency of the study analysis.

Databases searched included Scopus, Web of Science, PubMed, and Google Scholar. Search terms combined design-related and health-related keywords: *("school" OR "classroom" OR "campus") AND ("design" OR "architecture" OR "environment") AND ("health" OR "well-being" OR "stress" OR "cognition")*. Searches were limited to English-language peer-reviewed studies from 1990 to 2025. The search produced 5,130 results in the first stage.

After removal of non-peer-reviewed materials, duplicates, and grey literature, 1,920 peer-reviewed studies remained. Abstracts were screened based on inclusion criteria: (1) focus on environmental design in educational or learning contexts, (2) examination of links between design features and physiological, psychological, cognitive, or social outcomes, and (3) empirical or theoretical contributions relevant to human-centered design, environmental psychology, or evidence-based design in education, relevant to the educational or learning environment. This process resulted in 551 studies for full-text review. From these, 232 studies were identified as highly relevant and methodologically sound. The final of 100 articles was included.

Figure 1: Flow Chart illustrating key steps in the literature review and analysis



Note. This PRISMA-style diagram has been provided to enhance the clarity and transparency of the study analysis. The current study did not involve a systematic literature review.

Literature Review

Design Dimensions in Educational Settings

Lighting

Lighting has become a key determinant of the design of schools, with influences directly on circadian rhythm, visual comfort, alertness, and cognitive performance. Research often associates daylight exposure with higher academic achievement and improved wellbeing (Mirrahimi et al., 2013; Heschong, 2002). The more daylight there is in educational settings, the higher the children demonstrated up to 20% faster progress in math and reading performance than those with limited daylight (Heschong, 2002). Additionally, daylight enhances melatonin regulation and synchronizes biological clocks, leading to improved quality sleep, alertness, and memory consolidation (Figueiro & Rea, 2010; Chellappa et al., 2011; Gaggioni et al., 2014).

On the other hand, lighting conditions characterized by glare, non-uniform luminance, and high contrast ratio have been shown to exacerbate visual fatigue, occurrence of headaches, and cognitive workload for students (Boyce, 2014). Recent research suggests that dynamic lighting systems, which vary color temperature and luminance over the course of a day, can simulate natural circadian rhythms and improve arousal and mood for both students and teachers (de Kort et al., 2019). The strategic positioning, orientation, and glazing of windows are critical, not only for lighting but also for facilitating restorative views of the surrounding environment (Dianat et al., 2025a; Bassaw et al., 2025a). For example, the presence of windows offering scenery of green natural environments was shown to have a positive relationship between student attentional performance and the rate of cognitive fatigue relief for students (Li & Sullivan, 2016). Moreover, primary school children in classes with more extensive natural window views reported decreased stress and increased attentiveness (Lindemann-Matthies et al., 2021). University students in learning halls with natural window views also revealed improvements in mood, more pronounced brain-wave indices of alertness, and increased task performance for learning-related cognitive tasks (Zhang et al., 2024).

Acoustics

Acoustic performance is, therefore, an important factor in concentration, stress response, and the efficiency of communication in the educational setting. High noise levels in the classroom have been linked to poor reading comprehension skills (Shield & Dockrell, 2003), while greater cortisol production is found in children with greater noise in the environment (Evans et al., 1995). Continuous noise affects verbal memory, leading to mental exhaustion, frustration, and disengagement (Klatte et al., 2013).

Acoustically designed learning environments are usually created using materials that are absorbent in nature, such as acoustic panels on ceilings, carpets, and upholstered furniture to minimize reverberation time and improve the intelligibility of speech. Research studies conducted in elementary school classrooms have found the average reverberation time to be about 0.4 seconds, and often below 0.6 seconds during learning tasks (Sato & Bradley, 2008). Moreover, research studies conducted within the context of remote health settings have found that well-designed acoustic environments can counter stress and facilitate trust building between carers and patients (Pati et al., 2026).

Quiet acoustic zones and good control over soundscapes in classrooms have been associated with improved wellbeing of teachers and the enhanced ability of students to pay attention and engage. Spatial zoning by partitioning, ceiling baffles, and varied surface materials promote active learning by preventing sound interference (Astolfi & Pellerey, 2008). Background soundscapes, such as soft, natural, or instrumental sounds, are said to sharpen attention and enhance creativity. In contrast, mechanical noises and urban noises would detract from this goal of psychological approach.

Indoor Air Quality (IAQ) and Thermal Comfort

Indoor air quality and thermal comfort are critical to maintaining physiological and cognitive processes. The adverse effects of poor IAQ on the human body, depending on high CO_2 levels, pollutants in the air, or insufficient levels of ventilation, have been related to headaches, sleepiness, and decision impairment (Wargocki & Wyon, 2013; Mendell & Heath, 2005). This can significantly enhance test performance, up to 14% while rising the ventilation rate by 10 L/s, according to Wargocki & Wyon (2013).

Attention and even fatigue also relate to thermal comfort. Temperatures above 26°C and below 20°C in a classroom result in a reduced performance of working memory and problem-solving skills. Cross-ventilation, optimal ceiling height, and operable windows, which act as sustainable designs, assist in enhancing comfort and advancing more comprehensive sustainable designs of buildings. Better IAQ also enhances public health through reduced absenteeism related to pulmonary problems and allergies.

Spatial Layout and Furniture Design

Spatial arrangement is what basically affects posture, mobility, collaboration, and inclusion. Flexible and adaptive designs aid a variety of teaching styles, from solitary studying to collaborative learning, thus addressing both teaching and ergonomic principles (Peng et al., 2022, Tobia et al., 2022). Activity-promoting designs ensure reduced sedentary behavior and musculoskeletal disorders. For example, using Cumulative Load Theory, Bassaw et al. (2025b) argued that excessive static posture increases the possibility of developing back pain, especially among office workers using AI technology in automated offices.

Ergonomic interventions including adjustable desks, dynamic seating, and multi-height workstations can facilitate variability in posture and muscle activity. (Hedge, 2016, Lee & Lee, 2024). Classrooms with active furniture, including standing desks, have reported decreases in sitting time and have been associated with behavior changes, although academic performance has yet to be determined (Guirado et al., 2021). Spatial design greatly determines the social behavior within. A classroom that is open yet zoned can facilitate collaboration between peers, while clearly defined circulation paths avoid disruptions (Cleveland & Fisher, 2014). For neurodiverse and physically disabled users alike, principles of universal access entailing inclusive design include providing enough clearances, contrasting visual cues, tactile markers, and wayfinding clues (Selanon et al., 2025).

Color and Aesthetics

Color psychology has a significant effect on emotional control and learning outcomes. Warm colors including orange and yellow are linked to better sociability and more enthusiastic behavior, while cool colors like blue and green induce feelings of relaxation, concentration, and control (Küller et al. 2009; Elliot 2015). Studies have found that color preferences are different in age and cultural identity, therefore there is the need to adapt to context and school settings accordingly (Al-Rasheed 2022). Equitable color composition that prevents both over-coloring and monotony will reduce anxiety and enhance wayfinding (Dalke et al. 2006). in addition, aesthetic integrity, material authenticity, and the use of natural materials are supportive of feelings of belonging and pride, which will, thereby, stimulate place attachment and place-directed motivation (Qiu et al. 2025).

Biophilic and Natural Elements

Biophilic design, based on the profound affinity of humans towards nature, constitutes an elementary design approach towards improving well-being experiences within an educational environment (Gray & Downie, 2024). The application of vegetation, material, and bio-inspired patterns has shown an ability to reduce the level of anxiety, heighten the attention restoration experience, and facilitate creative cognition (Ulrich, 1984; Kaplan, 1995; Berman et al., 2008 Dianat et al., 2025b). Both direct and indirect variables, including the experience of plants in an indoor setting, living walls, and outdoor classrooms, and those inspired by nature like material, may improve well-being experiences (Kellert et al., 2015). Moreover, related to additional health aspects, the inclusion of natural elements, like plants and natural materials, can improve indoor humidity control and acoustic absorption (Jiang et al., 2024; Salunkhe et al., 2023).

There is also cumulative proof of the interconnection of various factors of the physical environment: lighting affects circadian health, acoustics impact stress regulation, air quality impacts cognition, and biophilia impacts attention. Taken together, these factors of design frame a human-centric approach to education that recognizes the classroom environment itself as a dynamic partner in physical health, cognitive functioning, and social well-being, and not simply as scenery for learning (Pati et al., 2026; Bassaw et al., 2025a).

Health and Well-Being Outcomes

Physiological Outcomes

Physiological outcomes relate to measurable changes in bodily systems, such as cardiovascular, respiratory, endocrine, and immune function, arising from environmental exposure (Andersen et al., 202). In educational settings, the physical characteristics of buildings can significantly influence occupants' physiological well-being (Wen et al., 2024; Salih et al., 2024 & Pulimeno et al., 2020). Factors like air quality and thermal comfort are directly linked to stress physiology and overall physical health (Wargocki et al., 2020).

There is extensive research on physical activity, which is among the best-studied physiological phenomena. Active design buildings, which include walkable designs, open staircases, and outdoor learning areas, promote physical activity while minimizing time spent sitting (Sallis et al., 2016). Physical activity at higher levels helps children reduce their obesity risk, improve cardiovascular health, and learn to control their metabolism (Men et al., 2025). The construction of accessible playgrounds and well-designed school courtyards allows children to engage in spontaneous physical activities, which support their physical development (Dyment & Bell, 2008).

Indoor air quality can negatively affect multiple health outcomes, including respiratory symptoms and reduced blood oxygen levels when carbon dioxide concentrations rise, ventilation fails, or volatile organic compounds enter the space (Mendell & Heath, 2005). The implementation of improved ventilation systems,together with environmentally friendly building materials, helps reduce the number of asthma cases and respiratory health problems (Fisk et al., 2013). Building designs that use natural ventilation, along with biophilic elements such as vegetation and operable windows, to manage humidity and air circulation, can enhance pollutant removal (Zhong et al., 2022).

The body maintains its temperature through hormonal and autonomic responses that regulate comfort levels across various thermal environments. The human body develops two negative responses to thermal discomfort, including decreased concentration and increased fatigue (Kim et al., 2022). Lighting and circadian exposure patterns affect both our ability to stay alert and the quality of our sleep (Nagare et al., 2021; Jalali et al., 2024). The implementation of dynamic circadian lighting systems in educational facilities leads to better sleep outcomes and improved daytime alertness, resulting in superior physical recovery and academic performance (Li et al., 2024).

Research using salivary cortisol and heart rate variability biomarkers shows that people can manage their chronic stress when they spend time in supportive spatial environments, including peaceful areas with natural light and attractive design (Burnard & Kutnar, 2020).

Psychological Outcomes

People develop psychological effects through their emotional responses, stress levels, mood, and self-reported health status, which respond to their surroundings and current location (Shin et al., 2021). Student psychological state directly affects their motivation levels and their ability to attend school and maintain focus on their learning activities (Kassab et al.,2024). The field of environmental psychology shows that spaces that receive proper design create conditions that promote relaxation, self-determination, and social connection (Gifford, 2014).

The Attention Restoration Theory (ART) explains that people can restore their exhausted attentional resources by spending time in restorative environments that include natural elements and complex visual patterns (Ohly et al., 2016). The Stress Recovery Theory (SRT) supports the idea that nature views elicit positive emotions, which help people recover from stress through parasympathetic responses (Ulrich et al., 1991; Dianat et al., 2025a). The research conducted by Li & Sullivan (2016) shows that educational buildings that include gardens, green walls, and natural lighting systems help students decrease their anxiety symptoms and mental fatigue.

The way we feel about ourselves depends on lighting and acoustics, as poor acoustics can cause annoyance and irritation, leading to mental exhaustion (Braat-Eggen et al.). According to Wang et al. (2017), proper lighting conditions improve both physical and mental health. Good lighting conditions promote better emotional states and improve mood (Li et al., 2024). Research shows that classrooms that receive natural daylight create better learning spaces because students and teachers experience reduced depression symptoms and higher satisfaction (Zhang et al., 2024). People who can change their environment through temperature control, lighting adjustments, and space arrangement will achieve higher autonomy levels, resulting in better health outcomes and increased satisfaction (De Dear et al., 2020; Ličina et al., 2018; Van Someren et al., 2018).

Environmental design creates emotional bonds with health through psychological effects, which connect these two elements. Designers who minimize environmental stressors while creating spaces that evoke positive emotions will establish environments that support mental wellness and academic success.

Social and Behavioral Outcomes

According to Rands and Gansemer-Topf (2017), designs that provide clear views, easy access, and flexible spaces foster social interaction and collaboration. The authors argued that designs featuring elements such as open-plan classroom layouts with shared commons and transparent partitions between spaces galvanize students to interact with one another, fostering stronger peer relationships and reducing social isolation. Additionally, Bassaw et al. (2025a) demonstrated that, in schools where learning is both cognitive and social, the design of spaces strongly shapes these dynamics. They stated that physical design influences behavioral health, including levels of physical activity, safe movement, and risk-taking behaviors, and highlighted features such as walkable circulation routes and outdoor learning zones as pivotal in encouraging active behaviors.

Human-Centered Design fosters social cohesion by enabling people to build relationships within their local community (Sadeghi et al., 2022). People choose to stay longer in areas they consider safe and organized, but they leave when they feel threatened or when the environment becomes difficult to navigate (Zeng et al., 2023). Educational buildings that include student-teacher casual interaction spaces, such as lounges, courtyards, and learning pods, allow students and teachers to work together while preserving their natural environment (Salih et al., 2024).

Cognitive Performance Outcomes

The physical environment influences how people perform in attention, memory, learning, and problem-solving (Llorens-Gámez et al., 2022). The leading indicator that shows educational facility design success is cognitive health, according to Barrett et al. (2015). The IEQ elements, which consist of lighting, noise, air quality, and thermal conditions, affect human ability to focus and maintain working memory according to (Liang et al., 2024; Pradhan et al., 2024; Brink et al., 2022). The combination of elevated CO_2 concentrations and inadequate ventilation systems produces environmental conditions that lead to decreased mental processing speed and deteriorated decision quality (Wargocki et al., 2020). The research by Barrett et al. (2013) shows that students perform better on tests when they receive proper lighting and air quality, which leads to better concentration and alertness. The way people perform cognitively and perceive things depends heavily on both lighting conditions and the availability of natural daylight (Li et al., 2024). Research shows that classrooms that receive more natural sunlight produce better student results (Porras Álvarez, 2020). The human body maintains its ability to focus through circadian lighting, which follows its natural biological rhythms (Jalali et al., 2024).

The two essential elements for this project include noise management and acoustic comfort standards. Exposure to high-volume background noise for extended periods causes people to lose their ability to understand speech and to have their reading abilities deteriorate (Ricciardi & Buratti, 2018). Students can better understand speech when classrooms have sound insulation and absorptive materials, which also reduces their cognitive workload (Mealings, 2016).

The connection between environmental quality and cognitive function operates through psychological well-being, which serves as a mediating factor. People experience decreased performance in working memory and executive function when they are stressed and fatigued, but their mental clarity improves in peaceful environments (Brink et al., 2022; Martin et al., 2019). The research by Li & Sullivan (2016), Dianat et al. (2025a), and Ohly et al. (2016) shows that students who view green spaces will improve their abilities to direct their attention and self-regulation. Easy-to-follow directions, organized space, and the presentation of important environmental elements help people navigate and create mental maps.

Human-Centered and Evidence-Based Approaches

Participatory and Co-Design

Participatory and co-design approaches emphasize the engagement of end users in the design process, so that the environment encompasses their needs, wishes, and culture (Bate & Robert, 2007; Sanders & Stappers, 2008; Boyle & Arnedillo-Sanchez, 2022). This paper discusses the role of combining the design process based on end users' needs and the adoption of robust and evidence-grounded approaches to improve the effectiveness and acceptance of the intervention, especially when dealing with complex settings such as educational institutions (Moun et al., 2024). This helps in achieving the goal of both satisfying and functioning effectively because the design process would develop an environment where the users feel ownership and relevance for the environment, especially due to the consideration of highly diverse students enrolled in the institution as well in non-educational libraries and settings (Moun et al., 2024; Sanders & Stappers, 2014; Blackwell et al., 2017). For instance, an example exists at Malawi's Outdoor Learning Environment (OLE) where design considerations were influenced by the incorporation of the community's culture, directly involving students, developing an environment that is highly dynamic and meets the expectations of the users at Malawi schools (Bassaw et al., 2025a). Additionally, this process helps in the design of prototypes so that enhancements are done based on the approach of improving the dynamics of the environment and its interaction when engaging the users, especially when dealing with complex environments such as the health aspect in the institution (Boyle & Arnedillo-Sanchez, 2022; Moun et al., 2024). Yet despite the above importance, this approach of engaging the users in the design process creates barriers when considering the dynamics of the health aspect of students' involvement and the management of the stakeholders' expectations in the institution (Boyle & Arnedillo-Sanchez, 2022; Cahill, 2007).

Universal Design and Inclusion

Universal Design (UD) principles help create spaces accessible and usable by all individuals, regardless of ability, thereby reducing barriers that disproportionately affect students with disabilities (Burgstahler & Cory, 2010). UD transcends mere compliance with accessibility standards by proactively embedding flexibility, simplicity, and perceptibility into design features, promoting equality and participation within educational settings (Boothe et al, 2018).

Such inclusive environments not only improve physical access but also enhance psychological comfort and social integration, which are fundamental to positive health outcomes and academic success (Blackwell et al., 2017; Capp, 2017; Florian, 2015). The educational environment needs furniture that adapts to different learning styles, and materials that help students with various needs (Bate & Robert, 2007; Capp, 2017). The UD framework follows human-centered design principles through its method of including diverse users in design choices. This leads to health-supportive and fair environments (Sanders & Stappers, 2008; Burgstahler & Cory, 2010). Academic research shows that Universal Design principles in educational settings decrease exclusionary practices, which results in an environment that supports both mental and physical health (Boothe et al, 2018; Blackwell et al., 2017)

Evidence-Based Design (EBD)

Evidence-Based Design (EBD) started in healthcare as a practice which applies scientific research to create designs that enhance health results, safety, and user happiness (Ulrich et al, 2008). Educational environments such as schools and colleges can benefit from EBD principles because they help create spaces that improve natural light distribution, acoustic management, indoor air quality, and spatial organization. These affect student learning, stress, and health (Pati et al., 2026; Dianat et al., 2025a). Research shows that exposure to daylight and nature views leads to better attendance rates, improved mood, and concentration, which demonstrates the value of biophilic design elements in schools (Peters & D'Penna et al., 2020). Sound attenuation methods and ergonomic classroom arrangements also help students with sensory sensitivities to control their sensory experiences while reducing interruptions (Khatiwada et al., 2025). The combination of evidence-based design with human-centered methods produces learning spaces which merge scientific precision with user comfort and health-promoting features.

Integration of Participatory and Evidence-Based Approaches

Combining participatory design with evidence-based frameworks bridges the gap between empirical rigor and contextual relevance, creating human-centered environments both scientifically grounded and user-responsive (Almusaed et al, 2023; Adewusi et al, 2022). This integrated modus operandi recognizes that while data and evidence may inform best practice, the unique lived experiences and needs of users must ultimately shape the application of design if optimal health outcomes are to be achieved (Morley et al 2024). Collaborative processes that include stakeholders in data interpretation and the codesign of solutions enhance transparency and foster trust, both of which are important for sustained implementation (Longworth et al, 2024). This is evidenced by numerous case studies where integration results in contextually appropriate interventions more likely to be adopted, their impact thus amplified across a range of educational contexts (Bassaw et al., 2025a; Longworth et al, 2024). Moreover, this blended approach promotes innovation by allowing flexibility within evidence parameters, facilitating adaptation to emerging needs and changing environments.

Implementation Challenges and Best Practices

Despite its advantages, application of a human-centered and evidence-based design process in educational environments encounters challenges of allocation of resources, interdisciplinary collaboration, and ensuring continued participatory fervor (Fischer et al., 2021). The application of a proper integration procedure involves effective facilitation of a complex setting of diverse stakeholders, ensuring proper channels of communication in a collective quest of predefined goals by academic, designing, health, and user communities (Zamiri & Esmaeili, 2024). Furthermore, maintaining continued enthusiasm in participatory approaches may be hampered by financial and policy constraints (Almusaed et al, 2023). Best approaches in application involve embracing adaptability in design processes through modifications in established design protocols, early inclusion of user insights, continuous evaluation cycles, and specialized training of both designing and academic undertakings in accordance with knowledge of HCD and EBD approaches (Zamiri & Esmaeili, 2024; Fischer et al., 2021). Handling issues of equity and equality in application of approaches is fundamental in ensuring an equitable presence of diverse perspectives in decision-making.

Discussion

The current literature review emphasizes the complex effects of human-centered environmental design on health, cognition, and well-being in educational environments. The literature clearly reveals that the environment is more than just the background, but is the determinant for the outcomes of students and teachers. One of the most important findings that have arisen from these systematic reviews is the important influence of indoor environmental quality factors, including lighting, acoustic conditions, indoor air quality, and thermal conditions, and the influence these have in relation to comfort, health, and performance. Multiple levels of indoor environmental quality are recommended in the classroom.

Biophilic and restorative design components which include daylight exposure, views of nature, and natural materials, have been rapidly shown to reduce stress, improve moods, and contribute to attention restoration, which suits with existing theoretical frameworks. However, existing literature has demonstrated a gap between existing knowledge and research related to studying this real-world multisensory experience of biophilic environments, as most research focuses on virtual exposures through visual simulation and preferences rather than direct behavioral and physiological observations and data gathering in a real-world classroom and campus settings.

Ergonomic flexibility, including adjustable furniture and abilities for varied postures, is associated with reduced musculoskeletal strain and increased engagement, especially for neurodiverse learners. Acoustic comfort, though often has been studied, appears as an essential determinant of learning quality, with extreme noise linked to impaired memory, literacy development, and stress regulation. The literature also emphasizes the importance of equity and inclusion in spatial design. Universal Design and participatory approaches are endorsed to enhance accessibility, support neurodiversity, and foster social belonging. However, there remains a lack of research examining the intersection of environmental design and social connectedness, essentially in higher education environments.

Taken together, these findings support the conceptualization of educational environments as a multisensory environment in which physical, psychological, and social dimensions are highly interrelated. Improvement in any one design variable in isolation may be limited; a holistic approach that is oriented toward systems and informed by environmental psychology, ergonomics, public health, and participatory design offers the greatest promise for enhancing learning, development, and lifelong health.

Future research should be longitudinal, interventionist, and with a special focus on multisensory and social dimensions of design to better explain the underlying mechanisms by which human-centered environments support educational outcomes.

Conclusion

This review shows clear evidence that human-centric environment design has a substantive effect on the physiological health and wellness, psychological well-being, and cognitive functioning of students and educators. The inclusion of natural lighting, restorative views, better acoustic environments, healthy indoor air environments, ergonomic designs, accessible spatial designs, and biophilic designs has been confirmed in their proactive role in improving student outcomes and reducing stress levels. These findings point towards health-enhancing environments that extend beyond education environments.

The review points out important gaps in existing research, such as a need for longitudinal, multisensory, and ecologically valid research investigating the interactions of environmental factors over time. A very important aspect, therefore, is interdisciplinary collaboration between designers, neuroscientists, psychologists, educators, and health professionals to advance knowledge in this domain of research. However, another very important aspect of this new domain of knowledge, therefore, has to do with user involvement and user-centric designs.

Human-centered design should be considered the paradigm for education, one that values empathy, inclusivity, and well-being as same as traditional concerns with achievement. By designing health-promoting principles into the planning, design, and evaluation of learning environments, educators can create settings that support resilience, creativity, equity, and long-term flourishing among all learners.

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