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Designing Thriving School Ecosystems: The Synergy of Biophilic Design, Wellbeing Science, and Systems Science

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Abstract: This article presents a novel approach that integrates biophilic design, wellbeing science, and systems science into a holistic strategy designated as the Biophilic Wellbeing Systems Approach (BWSA). This transdisciplinary approach aims to enhance student wellbeing in educational settings by fostering a deep connection with nature, supported by positive psychology and systems thinking. The research explores how these combined disciplines can shape educational environments that improve learning outcomes and promote human thriving. The study advocates for a transformative redesign of school environments, emphasising the interdependence of individual and planetary health, drawing on Indigenous wisdom and contemporary scientific knowledge. This foundational strategy holds significant potential to fundamentally change how schools are designed and operated. By fostering environments that deeply integrate wellbeing principles, this approach not only influences the physical buildings but also extends to the entire school ecosystem. It works synergistically to promote educational excellence and holistic wellbeing, ensuring that all elements of the school environment contribute to the overall development and health of students and staff.

Keywords: biophilic design; systems thinking; wellbeing science; education; positive psychology; environmental design; educational architecture; sustainability; Eudaimonic education; indigenous wisdom

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1. Introduction

The importance of wellbeing in educational settings has increasingly been recognised over the last few decades, leading to an increase in research, funding, programs, and initiatives aimed at enhancing students' mental and physical health [1]. Despite these efforts, the role of environmental design in promoting wellbeing has often been overlooked. School environments play a significant role in influencing students' mental health and wellbeing [2,3], and while there is a robust and growing body of evidence supporting the benefits of well-designed, nature-connected educational spaces [4,5], many schools persist in designing buildings that fail to incorporate elements and strategies that deliver these benefits.

Australian students receive a total of 11,000 h of instruction in a classroom throughout primary and high school, the highest in the OECD. Furthermore, they spend around 74 percent more time in the classroom than their Finnish counterparts but achieve significantly lower scores in international assessments compared to students in similar countries [6]. This discrepancy indicates that increased classroom time does not necessarily equate to academic success, suggesting the need for a more comprehensive approach that considers the overall wellbeing of students to enhance educational outcomes.

Wellbeing is a multidimensional construct with different meanings across ages, cultures, and population groups [7]. The most widely cited academic definition of wellbeing describes it as a measure of how people feel and function on a personal and social level and how they evaluate their lives as a whole [7]. Concepts like meaning, values, personal growth, and happiness are often used to describe wellbeing. While wellbeing is widely

recognised as critically important, strategies to enhance human and planetary health often lack an interdisciplinary approach. In education systems, efforts are often compartmentalised, with wellbeing siloed into specific programs, subjects, or frameworks. Additionally, wellbeing is frequently overlooked as an architectural imperative, missing opportunities to design spaces that actively promote students' mental and physical health. Traditional focuses on cost-efficiency, utilitarian functionality, and conventional building norms prioritise immediate practical concerns over the long-term health benefits of well-designed spaces.

Long-established theories such as the Attention Restoration Theory [8] and Stress Reduction Theory [9] underscore the psychological benefits of exposure to nature, including improved cognitive function and reduced stress levels. These foundational theories have been reinforced by more recent research demonstrating similar benefits [10,11]. The concept of Biophilia, initially articulated by Wilson [12] and further developed by Kellert [13], posits an innate human affinity for nature that can be harnessed to enhance learning environments. Contemporary studies continue to support this idea, showing that integrating natural elements into educational settings can lead to significant improvements in student wellbeing and academic performance [14,15]. These theories and findings provide a robust foundation for understanding the positive impacts of biophilic design on wellbeing in educational contexts.

The issue of designing for wellbeing in educational settings has become increasingly critical in light of recent statistics. The latest Mission Australia Youth Survey [16], which collected responses from 19,501 participants, revealed that 30% of respondents identified mental health as a significant issue in Australia today, with 32% expressing that they were personally 'extremely' or 'very concerned' about mental health. Environmental issues topped the list of concerns for the second consecutive year at 40%. Globally, mental health challenges among young people are notably high, with one in seven individuals aged 10–19 years experiencing a mental disorder, accounting for 13% of the global disease burden in this age group [17]. In Australia, mental ill-health affects nearly half of all adults over their lifetimes, with suicide being the leading cause of death among Australians aged 15 to 49 years in 2019 [18]. These statistics underscore the urgent need for innovative approaches that integrate wellbeing into educational environments.

Concurrently, the loss of natural habitats, biodiversity, and the impacts of climate change pose serious risks to both human and planetary health. These challenges highlight the urgent need for sustainable practices across all sectors, including education and construction. Biophilic design, an 'approach that emphasises the necessity of maintaining, enhancing and restoring the beneficial experience of nature in the built environment' [13], offers a promising solution. By integrating biophilic design into schools, there is an opportunity not only to enhance student and staff wellbeing but also to promote environmental stewardship, contributing to a healthier planet.

2. Research Method and Contribution

This article contends that a systems thinking approach is essential for recognising the profound impact of the built environment on wellbeing in order to foster thriving educational ecosystems. It introduces the Biophilic Wellbeing Systems Approach (BWSA), a novel synthesis of biophilic design, wellbeing science, and systems science applied to educational settings. Applying a grounded theory methodology, the research adopts an exploratory approach to generate insights that inform a new theoretical approach [19]. Starting with a broad interdisciplinary lens rather than a specific research problem, the study allows the theory to emerge inductively from the research, incorporating multiple perspectives and emphasising the interactions and interconnectedness across various fields.

Data collection involved an exploratory review of the literature across the disciplines of biophilic design, wellbeing science, and systems science, as they relate to education and school environments, to identify intersections, overlaps, and potential synergies. This was complemented by in-depth interviews with architects and school leaders, along with analyses of buildings at pioneering case-study schools in Australia and Indonesia. Through

the qualitative analysis of the collected data and synthesis of knowledge from these different fields, the study aims to develop a novel, transdisciplinary framework. This approach transcends traditional disciplinary boundaries by integrating insights and perspectives from these diverse fields, demonstrating how this integration can enhance educational environments and student wellbeing.

The discussion critiques traditional educational structures, arguing that they often fail to meet the developmental needs of contemporary learners. Applying an architectural lens and incorporating principles of positive psychology and Eudaimonic Education® (a registered trademark of Project Thrive Australia Pty Ltd., Highton, Australia), this approach proposes a transformative method to create school environments that foster educational achievement and genuine thriving.

This study delves into the integration of biophilic design, wellbeing science, and systems science, recognising that wellbeing emerges not simply from direct teaching but is also cultivated—‘caught’, ‘taught’, and ‘sought’ [20]—through the thoughtful design of environments, learning experiences, and cultural contexts. These elements foster wellbeing by enabling a reconnection with nature, incorporating both ancient knowledge and modern science to sustain human and planetary health.

The article also explores the alignment of Indigenous wisdom and systems thinking, examining how these ways of knowing can contribute to creating holistic learning environments. Case studies were selected from public, independent, and private schools to illustrate the practical implementation and benefits of these concepts. The discussion culminates with practical applications and recommendations for future research and implementation, emphasising the significant potential of the BWSA in educational settings.

By establishing a foundation for future research and practical applications, this study proposes an innovative strategy for educational settings. It makes an original contribution by being the first to propose and explore this transdisciplinary approach, offering a unique perspective that bridges multiple fields to enhance student wellbeing and learning outcomes in a highly integrated manner.

3. Biophilic Design, Indigenous Wisdom, and Systems Thinking

The evolution of human society is deeply intertwined with nature, a relationship embedded in the concept of biophilia, which denotes an innate human affinity with the natural world. This bond is crucial for both our psychological and physiological wellbeing and has been a cornerstone of human evolution [21]. This connection is not just a contemporary observation but is rooted in ancient wisdom, where life and environment were understood as holistic and indivisible.

Indigenous societies worldwide have historically exemplified a seamless integration with nature, often reflected in their sustainable practices, spiritual beliefs, and land management techniques that emphasise coexistence with the natural environment. Central to many Indigenous worldviews is the belief in the interconnectedness of all life, vividly illustrated through rich narratives and cultural practices. The Creation stories of Aboriginal Australians are one such example that highlight a symbiotic relationship with the environment that is deeply embedded in their social structures, rituals, and daily practices [22].

Indigenous cultures have long embraced what is now recognised through a Western lens as systems thinking [23]. A large body of work within systems science explicitly acknowledges and addresses the complexity of the real world, including interrelationships of its elements, multiple perspectives, temporality (i.e., changes over time) and the challenges this creates in replicating results, shifting patterns of behaviour, unintended consequences, and recognition that parts cannot be studied in isolation from the whole [24]. Systems science does not view environmental elements in isolation but as parts of a comprehensive system that affects and supports all aspects of life. Such perspectives harmonise with biophilic design principles that aim to create environments supportive of life.

Integrating Indigenous knowledge and perspectives into modern educational frameworks provides a powerful means to enhance holistic learning experiences and, conse-

quently, overall wellbeing. This integration aligns educational practices with systems thinking, which acknowledges and leverages the complex interactions between nature, cultural heritage, and environmental stewardship. A fundamental principle of biophilic design is the emphasis on place-based relationships [25] (p. 12) [26] which enables educational environments to reflect the geographical, historical, ecological, and cultural identities of their settings. Such an approach not only enriches the learning experience but also fosters a deep, enduring connection to the local context, thereby cultivating a sense of identity and belonging among students.

In this light, integrating Indigenous knowledge and biophilic design principles in education is more than a stylistic or cultural inclusion; it signifies a fundamental rethinking of how learning environments can function as interconnected ecosystems that honour and reflect the timeless human connection to nature. This approach offers a meaningful way to create nurturing, sustainable spaces that are deeply rooted in their local contexts and responsive to the environmental challenges of our time.

4. Biophilic Design and Systems Thinking in Educational Environments

Biophilic design and systems thinking hold the potential to profoundly transform school environments by deepening the connections between learning spaces and the broader contexts of the natural world, societal dynamics, and educational frameworks. Viewing educational environments through this holistic lens acknowledges the complex interplay among various elements and recognises humans as integral components of a broader ecosystem. In harmony with Indigenous wisdom, it appreciates the interconnectedness inherent in nature and society. More than just enhancing aesthetic appeal, incorporating natural elements into educational settings creates dynamic, living ‘learning laboratories’ where direct engagement with nature can cultivate a deeper understanding of ecological principles and instil a strong sense of environmental responsibility in students.

Embracing systems thinking enables students to see beyond isolated facts, aiding their understanding of the complexity and interdependence of natural systems. This insight is particularly crucial in today’s volatile, uncertain, complex, and ambiguous (VUCA) world. It equips learners with the skills to identify the root causes of issues, anticipate future challenges, and formulate effective strategies [27]. Such a perspective fosters an appreciation of how various elements within an ecosystem interact, highlighting the need for comprehensive solutions that respect and address these complex relationships.

5. Positive Psychology and Wellbeing Science

Significantly contributing to our global understanding of wellbeing has been the rapidly growing field of Positive Psychology (PP), often referred to as wellbeing science. PP studies the conditions that contribute to the optimal functioning of people, groups and institutions, and aims to improve quality of life [28]. However, as noted by researchers and practitioners like Kern et al. [24] in 2019, the hype regarding the field’s potential has at times led to exaggerated claims, over-inflated expectations, disillusionment, dismissal, and unintentional harms. It has also been observed that PP interventions and programs sometimes overlook the complex and dynamic realities and varied contexts in which people reside [24]. To address these issues, Systems Informed Positive Psychology (SIPP) was proposed as an evolution of PP. This approach explicitly incorporates principles and concepts from the systems sciences into positive psychology theory, methodologies, practices, and discourse, to optimise human social systems and the individuals within them [24]. This perspective acknowledges that human wellbeing depends on more than just the individual and programs. The SIPP approach aims to optimise human social systems and the individuals within them, facilitating system co-evolution and the envisioning of positive, unimagined futures [24].

SIPP has been effectively integrated into educational contexts, most recently through practical work focused on Systems and Eudaimonic Education (SEE) [29] which involves creating conditions that support meaning, purpose, authenticity, and personal growth

through environmental, cultural, and learning design, grounded in wellbeing science. This approach emphasises the importance of designing educational environments that not only support academic achievement but also enhance overall wellbeing. The success of these holistic design principles in promoting comprehensive wellbeing has led to the development of the ‘wholebeing’ framework, specifically tailored for educational settings.

Jarden and Downie [30] define ‘wholebeing’ as an emergent phenomenon resulting from high levels of wellbeing, low levels of illbeing, and the presence of resilience. This framework enables individuals to express their true selves and lead a sustainable, fulfilling life characterised by authenticity, value-driven actions, and a focus on both self and others, optimising their performance in a learning environment. They further suggest that higher levels of wholebeing correlate with better physical health, and vice versa.

The Wholebeing Model (Figure 1) incorporates a systems thinking approach and is supported by factors that enhance personal growth and performance. It emphasises the individual’s relationships with others, their environment, and the resources available to them, including time, finances, and energy. The model considers the interconnected relationships across different systemic levels—Me, We, and Us—illustrating how individuals, groups, and larger communities thrive together.

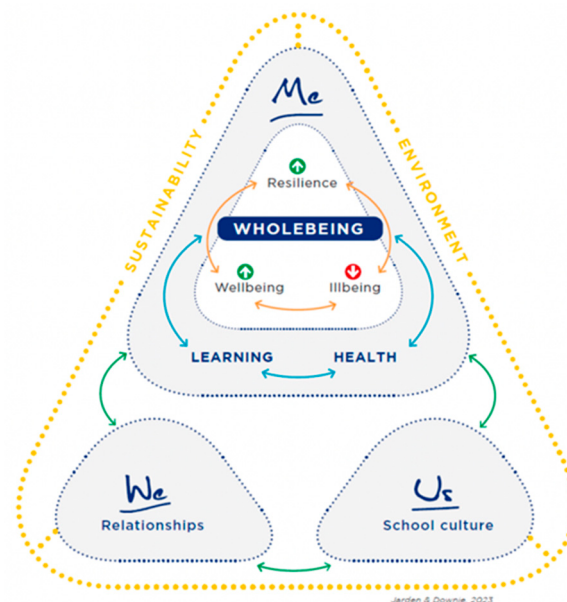


Figure 1. The Wholebeing Model. Source: [30].

The Wholebeing Model assists systems leaders in comprehending the broad, interconnected system, which is crucial for developing a shared understanding of complex challenges [31] while recognising possibilities and opportunities. Jarden and Downie [30] argue that this is because it fosters reflection, directs resource utilisation, facilitates generative conversations, and shifts the focus from merely reacting to problems related to illbeing towards co-creating joint responsibility for a better future incorporating all relevant factors. The environment encompasses the entire model, encapsulating its relationships with all other core components while underscoring the environment’s critical role in enhancing wellbeing, reducing mental ill-health, and cultivating adaptability and resilience. This comprehensive influence illustrates the necessity and significance of the built environment in educational settings.

By applying biophilic design principles to enhance the environmental element of the Wholebeing Model, a new, holistic approach to the design of school environments is introduced. While synergies have been identified between biophilic design principles and systems science, as well as between wellbeing science/positive psychology and systems science [24,25], the integration of all three disciplines—biophilic design, systems science,

and positive psychology—has not yet been explored. The BWSA incorporates each of these elements in the educational and architectural design of schools to create environments that promote nature connection, support learning, and bolster wellbeing.

6. Biophilic Design in Schools

In the realm of educational architecture, the paucity of biophilic elements within typical school environments warrants further attention and improvement. Many educational settings are characterised by enclosed spaces that lack adequate natural light, fresh air, and views of the outdoors, leading to a disconnection from the natural environment [32]. This issue is particularly critical given the substantial amount of time students spend within these environments. Additionally, empirical studies indicate that static and uninspired school environments, often characterised by monochromatic lighting, white walls, and confined layouts, can negatively impact students' cognitive function [33,34]. Such detachment severs the essential connection with nature and adversely affects key aspects of students' psychological and physiological health.

Engagement with nature, whether through direct contact or simulated elements, taps into our deep-seated evolutionary instincts and is crucial for designing educational spaces that fulfill our innate needs for safety, exploration, and harmonious coexistence with our environment. This connection to nature is especially vital for children, as it provides essential sensory experiences that are instrumental in their physical and mental development [35].

For instance, buildings that harness the sun's movement to create dynamic light and shadow patterns can foster a connection to the natural rhythm of days and seasons, aligning with our internal biorhythms to produce restorative effects [36]. This alignment offers a counterbalance to the fast pace of contemporary life, while also enriching learning experiences. Natural elements such as water and plants can also play a significant role [26]. Water features like small ponds or fountains, and the integration of plant life in school settings, have a calming effect, reducing stress and anxiety. The sound and sight of water, combined with the visual appeal of greenery, can lower blood pressure and enhance concentration, making these elements not just aesthetically pleasing but also conducive to students' overall health and wellbeing. Incorporating varied natural features also enriches the sensory experience, further fostering a connection with nature and enhancing the educational environment.

In situations where direct access to natural elements is limited, simulating natural features within educational environments can still offer significant benefits [37]. By incorporating elements that mimic the aesthetics and ambience of nature, such as natural shapes, colours, sounds, and materials, schools can partially compensate for the absence of direct natural exposure. Tapping into our innate preference for natural environments, the inclusion of such elements can provide psychological and physiological benefits typically associated with direct contact with nature.

7. A Paradigm Shift in Educational Architecture, Pedagogy, and Wellbeing Design

The principles of biophilic design are not just theoretical; they are being actively implemented around the world, signalling a paradigm shift in educational architecture and pedagogy. This shift encompasses changes in teaching practices, curriculum design, approaches to wellbeing, and the physical spaces designed for learning. As schools embrace these concepts, they not only change their physical structures but also the very nature of how education is delivered and experienced. The tangible impact of this holistic approach is illustrated in the following three case studies, which detail the practical implementation and beneficial outcomes in diverse educational settings and sectors (public, private, and independent) in Australia and Indonesia.

8. Green School, Bali

The Green School in Bali, Indonesia, conceptualised by John and Cynthia Hardy, serves as an exemplar of biophilic educational architecture. It adeptly integrates the natural environment in a manner that is both innovative and reflective of Indigenous vernacular traditions. The school prioritises ecological building materials and techniques, while concurrently promoting the wellbeing of its students by focusing on social and emotional learning, supported by systems thinking tools within its curriculum.

Central to the architectural ethos of the Green School is the innovative use of bamboo, a material chosen for its sustainability, rapid growth rate, strength, and adaptability. The extreme bend in the school's bamboo structures serves as a visual representation of the fundamental wellbeing principle and life skill of 'adaptability' which has been shown to be a greater predictor of satisfaction with life, self-esteem, school participation, and a sense of meaning and purpose than resilience [38]. In its use throughout the school, bamboo has been transformed from a traditional material for temporary structures to the primary component of permanent, robust, and elegant structures across the campus. These include the Heart of the School, the Millennium Bridge that connects the east and west sides of the campus, and the school's latest architectural addition, The Arc. Each of these structures showcases bamboo's versatility in creating vast, open communal spaces designed to foster learning and social interaction.

In the Heart of the School, towering bamboo columns support multi-level spaces, blending sophisticated engineering with local craftsmanship (Figure 2). Even the bamboo flooring, constructed using bamboo pins without synthetic adhesives or finishes, reflects the school's dedication to environmental integrity and creating a healthy learning environment for children. The building is deliberately positioned to create a strong sense of connection and belonging. The notion of connection is further highlighted in the architectural expression by the structure's three interconnected spiralling nautilus forms. These fluid, organic forms break away from traditional, rectilinear education spaces, to create a physical environment that inspires creativity [39] and dynamic learning experiences. Classrooms, designed as open-air pavilions on rice fields, also maximise connectivity and immersion in nature, and each learning space is consistently furnished with bamboo, sustaining the biophilic theme.

The Arc, built in 2021, demonstrates an advanced application of biophilic shapes, forms, and patterns (Figure 3). Designed by the architecture studio Ibuku, led by Elora Hardy, and working in collaboration with carpentry specialist Jörg Stamm and Atelier One structural engineers, the building features bamboo arches spanning 19 m, interconnected by anticlastic gridshells. These gridshells derive strength from curving in opposite directions, enhancing the building's structural integrity. The architecture exemplifies the concept of biomimicry, emulating a mammal's ribcage stabilised by tensile membranes that function like tendons and muscles, efficiently distributing structural forces. Serving dual purposes as a wellness space and a gymnasium, The Arc enhances the campus facilities with a design that deeply integrates biological concepts in both form and function.

In its extensive use of bamboo, the school's architecture embodies flexibility, strength, and lightness—qualities that mirror human adaptability and wellbeing, as well as resonate with the Balinese philosophy of Tri Hita Karana. This philosophy promotes a symbiotic relationship between people, nature, and the spiritual world, principles that the Balinese consider essential for human thriving, and which are seamlessly integrated into the school's core educational values. By embodying these ideals, the architectural design reinforces the school's commitment to a holistic and interconnected learning approach.

The Green School's pioneering approach has gained considerable acclaim, leading to the planning and establishment of three additional international campuses and its acquisition by the educational conglomerate Education in Motion (EiM). Through its innovative practices, the Green School serves as an illustration of how architecture can respect and enhance the relationship between the built environment and the natural world while also influencing wellbeing and educational outcomes. As a revolutionary shift in

educational design, the Green School in Bali has inspired educators around the world (Figure 4) and directly influenced educational projects in other regions, including the following case study from Australia.



Figure 2. Towering bamboo columns supporting multi-level spaces of the Heart of the School. Photo: Fiona Gray.



Figure 3. The rib-like structure of The Arc, designed by Ibuku (2021). Photo: Fiona Gray.



Figure 4. School principals participating in a principals redesigning education immersion program led by Project Thrive (2019). Photo: Andrea Downie.

9. Lisieux Catholic Primary School, Australia

Lisieux Catholic Primary School in Torquay, Australia, represents a progressive model in educational innovation, blending systems thinking and biophilic design with a deep respect for cultural heritage. Under the leadership of founding principal, Dr. Susan Ryan, the school was established with a clear vision. This vision was further shaped by a collaboration with the second author (Downie), the director of Project Thrive—a consulting firm that specialises in education redesign, wellbeing, and systems leadership. A pivotal experience in this collaboration was an educational redesign immersion in Bali that included a visit to the Green School [40]. The school has dedicated itself to boosting wellbeing by merging Positive Psychology with thoughtful environmental design that supports connection with nature and committed respect for Indigenous cultural practices. The school's design establishes a tangible connection to nature and place, fostering a learning environment conducive to educational outcomes while promoting a deeper understanding of, and respect for, the natural world and Aboriginal culture. It achieves this by merging natural elements, place-based cultural contexts, and sustainable practices.

Beginning in 2018, the school's construction has progressed in stages. The second stage of the development, designed by Minx Architecture (Figure 5), introduced a deliberate emphasis on enhancing connection with nature. This design phase incorporated a colour palette inspired by local natural elements such as Waratah, Spotted Gum, Banksia, and seaspray (J. Briese, personal communication, 18 April 2024). The school's principal has observed the positive impact this has had on the learning environment, observing that the

calming colours enhance concentration and stimulate creative and innovative thinking (S. Ryan, personal communication, 21 April 2024).



Figure 5. Lisieux Catholic Primary School (2022), Torquay, Australia. Photo: Rhiannon Slatter.

Biophilic and cultural integration extends through the naming of the teaching spaces after native species—Acacia, Waratah, Spotted Eucalypt, Golden Wattle, Grevillea, Scent-bark, and Silver Banksia—embedding local flora into the learning environment. Botanical motifs represented on decals of glazed internal partitions add another layer of natural imagery, strengthening the connection to the school’s local context.

The school’s engagement with Aboriginal culture is multifaceted, woven into both the curriculum and the physical environment. The celebration of Stage Two’s opening with a traditional smoking ceremony, an ancient Aboriginal practice that involves smouldering native plants to produce smoke believed to hold cleansing properties and the ability to ward off bad spirits, underscores this deep respect (Figure 6). The school also collaborates with local Aboriginal Elders on special projects, such as the creation of a possum skin cloak by Aunty Lisa Couzens. This cloak, rich with stories of belonging, place, and the sacred and spiritual aspects of Aboriginal culture, is worn by Aboriginal students during assemblies, graduation ceremonies, and other significant events. Indigenous knowledge is further embedded in the student’s learning through a unique Beach Discovery Program, where they engage with local beaches to learn about sustainability, environmental care, and marine life. This program offers an authentic, hands-on learning experience about connection to Country, cultural heritage sites, traditional ecological knowledge, respect, and reconciliation.

Nature is woven into the school’s fabric through the naming of its four house teams after native birds: Bundjil, Kunuwarra, Gherang, and Parrwang. In collaboration with Aboriginal artist-in-residence Norm Jurrwaa Stanley, students helped design a playground mural that visually represents these birds, enhancing the visual landscape of the school

and enhancing students' engagement with local fauna and Aboriginal heritage. Cultural connections are further emphasised in the school's upstairs breakout space, named the Wayapperi Hub, meaning "meeting space". This area serves multiple purposes and fosters interaction, enhancing the communal feel of the school environment.



Figure 6. Cultural education programs facilitator, Norm Jurrawaa Stanley, playing the didgeridoo at the opening ceremony of the stage two building at Lisieux Catholic Primary School. Photo: Susan Ryan.

The school has strategically incorporated design features to ensure natural light floods the communal spaces and is borrowed into the classrooms through generous skylights above a central double-height atrium. In many schools, deep floor plans often result in substantial distances from the building's exterior walls to its interior core, typically due to large classrooms connected by hallways or other interior spaces. This layout can make it challenging to bring daylight into central areas. However, access to daylight supports the

body's natural circadian rhythm, which regulates cycles of alertness and sleepiness, and has been shown to enhance mood, increase alertness, and improve overall productivity and learning outcomes in educational settings [41]. By integrating natural light, the school creates a healthier and more engaging environment for students and staff.

Biophilic design at Lisieux also emphasises the integration of outdoor and natural spaces. Classrooms with access to outdoor areas, many featuring breakout balconies or direct access to outdoor spaces, support an immersive outdoor educational approach. This is exemplified by dedicated areas like the Outdoor Discovery space and the Ubuntu Garden, which facilitate direct contact with nature and hands-on learning experiences integrated into the curriculum.

Through these design choices, Lisieux illustrates a systems-based approach to education that prioritises sustainability, cultural integration, and a meaningful connection to the natural world, demonstrating how educational environments can function as ecosystems of learning and respect for heritage and nature.

10. Wollert Primary School, Australia

Wollert Primary School in Victoria, Australia, is a government school designed as a Supported Inclusion Hub, tailored to enhance learning outcomes for students with diverse abilities and needs. The architectural partnership of Thomson Adsett and Law Architects has brought to life a design that emphasises inclusion and accessibility, with specialised facilities like sensory areas, accessible play spaces, and classrooms designed with acoustic, visual, and tactile elements to support all students (Figure 7).



Figure 7. Wollert Primary School, Wollert, Victoria (2022). Photo: Dianna Snape.

A key biophilic principle integrated into the school's design is the concept of prospect and refuge, which balances spaces for expansive observation with areas that provide a sense of protection. Features such as large windows and bleacher seating offer prospect, while

elements like dark colours and deep bay windows with seating nooks offer safe, cocooning spaces that embody the notion of refuge (Figure 8). Informed by research from the Turner Institute for Brain and Mental Health at Monash University, the use of dark green walls in certain classrooms was specifically chosen to evoke this sense of refuge, offering a calming, enclosed space that helps mitigate sensory overload. This strategic use of colour aims to create a more comforting and protective atmosphere for those with heightened sensitivities.



Figure 8. Bay window, bleacher seating, and dark carpets in Wollert Primary School learning space (2022). Photo: Dianna Snape.

Working closely with educational planner Lisa Horton, the school was organised into 'learning neighbourhoods', each comprising four classrooms designed to support a range of educational experiences and pedagogical approaches (S. Brincat, personal communication, 2 February 2024). These neighbourhoods are crafted for both collaborative and individual learning, emphasising flexibility and inclusion. Each classroom is uniquely tailored to support different teaching methods and learning preferences. At the heart of each neighbourhood is a central area where classrooms converge, with distinct segments that support varied sensory and learning experiences. This setup facilitates both group activities and quieter areas for focused work, allowing teachers to organise students in environments that best suit their educational needs, enhancing the overall learning experience by aligning the physical space with the pedagogical approach.

Attention to acoustics and tactility was a paramount consideration in the design, with the use of acoustic panelling and varied wall textures and materials such as brick and timber that also provide a tactile quality that aids navigation for vision-impaired students while also enhancing the sensory and wayfinding experience for all students.

The landscape design by Outlines Landscape Architecture is an integral element of the school's biophilic strategy. It replaces the conventional concrete apron that typically surrounds school buildings with rich indigenous plantings that blur the indoor–outdoor boundary, enhancing visual permeability. To further incorporate natural elements, the design team collaborated with a local ecologist to integrate invertebrates into the outdoor setting. Various deceased insects were sourced and encapsulated in resin within rocks, enriching the educational qualities of the landscape and fostering a connection with the local ecosystem. Historical elements are also interwoven into the landscape, with remnants of the site's recent agricultural past, such as old fences, serving as historical markers that deepen the school's connection to its local context.

Community feedback influenced the school's development, shaping it into a space that serves as an extension of home and a community hub, especially crucial in an area where new suburbs feature housing stock with limited connection to nature and a car-centric urban layout. The design preserves areas of cultural significance and prioritises accessible natural spaces and outdoor learning environments, enhancing educational outcomes and fostering a deeper sense of environmental awareness (S. Brincat, personal communication, 2 February 2024).

Overall, the school presents a notable shift in educational architecture by deliberately accommodating the diverse sensory and cognitive needs of all students through the application of biophilic principles to enhance their wellbeing. This approach not only fosters an inclusive and adaptable educational experience but also supports the development of a dynamic and responsive learning community.

11. A Battle for Relevance

Schools around the world are recognising the need for a more relevant education system and within that, more relevant learning spaces [42]. Recent pedagogical shifts reflect a growing emphasis on experiential and authentic learning [43]. This highlights a need to reconsider the design of learning environments to enable the conditions that support this type of educational philosophy. Biophilic design intersected with wellbeing and systems science can forge dynamic and engaging learning environments that ignite curiosity and promote exploration for experiential and authentic learning to emerge. Such environments allow for direct and continuous interaction with nature, playing a crucial role in the holistic development of students. At a pivotal moment in wellbeing science, it is understood that the learning environments we create can positively impact the mental health, wellbeing, and outcomes of the individuals that reside within them [44]. Integrating biophilic design into educational environments is an important strategy for nurturing connections with the natural world. This approach enhances the emotional and psychological development of students, equipping future generations to be deeply attuned to environmental sustainability

and concerns. It holds the potential to develop well-rounded individuals who possess a profound connection to and understanding of themselves, others, and their environment.

12. Future Research and Implementation Opportunities

This novel approach presents multiple opportunities for future research and practical application in schools. Longitudinal studies are essential to track the long-term impacts of the BWSA on student wellbeing and educational outcomes. Such studies will provide robust empirical evidence over extended periods to validate the effectiveness of the BWSA in diverse school environments. Conducting additional case studies in varied geographical and socio-economic contexts will further understanding of the adaptability and effectiveness of the BWSA across different educational settings. This will help identify best practices and potential challenges, ensuring that the approach can be tailored to meet the needs of different communities.

Developing and implementing quantitative measures that encompass psychological, emotional, social, and academic performance dimensions will be crucial in providing a comprehensive understanding of how the BWSA impacts overall student wellbeing. Future studies could also include ethnographic surveys to observe user responses and behavioural patterns. This will help increase understanding of how specific design elements impact student wellbeing, the extent of these impacts, the ways in which students interact with the designed environment, as well as identify areas for improvement.

Integrating Indigenous knowledge, with a focus on how Indigenous perspectives can enrich biophilic design principles and contribute to holistic and culturally responsive educational environments, is another promising area for research. Documenting these integrations will provide valuable insights into creating inclusive and diverse learning spaces.

The holistic nature of the BWSA also necessitates the development of comprehensive policy guidelines and implementation frameworks for educational authorities and school administrators. These guidelines should be developed by interdisciplinary teams of researchers, educators, architects, and policymakers, to provide practical steps and considerations for incorporating nature-connected elements in school environments. This collaborative approach aligns with the overarching ethos of the BWSA and will ensure the strategies are well-rounded and feasible for implementation.

Supporting the implementation of the BWSA can also be achieved through professional development programs for educators, architects, and school leaders. These programs should focus on increasing awareness and understanding of the BWSA, emphasising the benefits of biophilic design, wellbeing science, and systems thinking. Training should provide practical guidance on effectively applying these principles in educational settings, ensuring that all stakeholders are equipped to foster environments that enhance student wellbeing and learning outcomes. By addressing these areas, future research and practical applications can build on the foundational insights provided by this study, leading to more effective and holistic educational environments that support the wellbeing and development of students.

13. Conclusions

This article explored the dynamic synergy between biophilic design, wellbeing science, and systems science as vital elements in fostering holistic wellbeing within educational settings. This interdisciplinary approach investigates how the integration of nature and its complex processes supports and enhances the learning experience by aligning with the principles of Eudaimonic Education[®]. This approach is about creating environments that improve educational outcomes while simultaneously supporting wellbeing and preparing young people for future challenges.

Throughout the discussion, the article addresses the critical need for a shift away from traditional school designs that often neglect the well-documented benefits of connection to nature. Despite significant investment in wellbeing programs, many young people still struggle, emphasising the need for a comprehensive, integrated approach that sees

educational spaces as ecosystems where wellbeing is cultivated through thoughtful design and an understanding of the interconnectedness of all life.

Indigenous knowledge systems, with their deep-rooted understanding of these connections, alongside the principles of biophilic design, provide a rich source of inspiration. These systems illustrate that learning environments can and should reflect and respect the natural world, fostering spaces that are not just places of learning but also sources of wellbeing. The significant impact of a harmonious relationship with the natural world on psychological and physiological wellbeing underscores the importance of this approach.

Key case studies at Green School Bali, Lisieux Catholic Primary School and Wollert Primary School demonstrate these concepts in action. These schools have broken new ground by creating learning environments that meaningfully integrate nature, honour Indigenous practices and local contexts, and prioritise ecological and sustainable practices. By also incorporating principles of wellbeing science, these schools support both the physical and psychological health of their students.

Ultimately, a paradigm shift in the conception and realisation of educational environments is needed. This shift involves embracing a holistic view that integrates biophilic design, wellbeing science, and systems thinking, an approach termed the Biophilic Wellbeing Systems Approach (BWSA). This approach represents a step towards fostering a more environmentally conscious, balanced, adaptable, and ‘well’ generation. By broadening the scope of conventional educational models, this approach deepens connection to the environment and enhances awareness of students’ own roles within the natural world. This shift is crucial for developing well-rounded individuals who are equipped to navigate the complexities of a rapidly changing world. By fostering environments that reflect these principles, schools can play a crucial role in promoting sustainable living and wellbeing, preparing students for academic success and a meaningful, authentic, and healthy life, connected to their world and each other.

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References

1. White, M.; Murray, A.; Seligman, M.P. *Evidence-Based Approaches in Positive Education: Implementing a Strategic Framework for Well-Being in Schools*; Springer: Berlin/Heidelberg, Germany, 2015. [\[CrossRef\]](#)
2. Higgins, S.; Hall, E.; Wall, K.; Woolner, P.; McCaughey, C. *The Impact of School Environments: A Literature Review*; The Centre for Learning and Teaching-School Education, Communication and Language Science, University of Newcastle: Callaghan, Australia, 2005.
3. Barrett, P.; Davies, F.; Zhang, Y.; Barrett, L. The impact of classroom design on pupils’ learning: Final results of a holistic, multi-level analysis. *Build. Environ.* **2015**, *89*, 118–133. [\[CrossRef\]](#)
4. Alves, S.; Gulwadi, G.B.; Nilsson, P. An Exploration of How Biophilic Attributes on Campuses Might Support Student Connectedness to Nature, Others, and Self. *Front. Psychol.* **2021**, *12*, 793175. [\[CrossRef\]](#) [\[PubMed\]](#)

5. Mann, J.; Gray, T.; Truong, S.; Sahlberg, P.; Bentsen, P.; Passy, R.; Ho, S.; Ward, K.; Cowper, R. A systematic review protocol to identify the key benefits and efficacy of nature-based learning in outdoor educational settings. *Int. J. Environ. Res. Public Health* **2021**, *18*, 1199. [CrossRef]
6. Singhal, P. Australian Students Spend More Time in Class, Are still Outperformed in Tests. 2018. Available online: <https://www.smh.com.au/education/australian-students-spend-more-time-in-class-are-still-outperformed-in-tests-20180727-p4zu34.html> (accessed on 27 April 2024).
7. Jarden, A.; Roache, A. What Is Wellbeing? *Int. J. Environ. Res. Public Health* **2023**, *20*, 5006. [CrossRef] [PubMed]
8. Kaplan, R.; Kaplan, S. *The Experience of Nature: A Psychological Perspective*; Cambridge University Press: Cambridge, UK, 1989.
9. Ulrich, R.S. View through a window may influence recovery from surgery. *Science* **1984**, *224*, 420–421. [CrossRef] [PubMed]
10. Kweon, B.S.; Ulrich, R.S.; Walker, V.D.; Tassinary, L.G. Anger and stress: The role of landscape posters in an office setting. *Environ. Behav.* **2008**, *40*, 355–381. [CrossRef]
11. Berto, R. The role of nature in coping with psycho-physiological stress: A literature review on restorativeness. *Behav. Sci.* **2014**, *4*, 394–409. [CrossRef]
12. Wilson, E.O. *Biophilia*; Harvard University Press: Cambridge, MA, USA, 1984.
13. Kellert, S.R.; Heerwagen, J.H. Preface. In *Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life*; Wiley: Hoboken, NJ, USA, 2008.
14. Determan, J.; Akers, M.; Albright, T.; Browning, B.; Martin-Dunlop, C.; Archibald, P.; Caruolo, V.; Macht, C. *Impact of Biophilic Learning Spaces on Student Success*; The American Institute of Architects: Washington, DC, USA, 2019. Available online: <https://www.brikbases.org/sites/default/files/The%20Impact%20of%20Biophilic%20Learning%20Spaces%20on%20Student%20Success.pdf> (accessed on 8 July 2024).
15. Peters, T.; D’Penna, K. Biophilic Design for Restorative University Learning Environments: A Critical Review of Literature and Design Recommendations. *Sustainability* **2020**, *12*, 7064. [CrossRef]
16. Mission Australia. Youth Survey. 2023. Available online: <https://www.missionaustralia.com.au/publications/youth-survey> (accessed on 27 April 2024).
17. World Health Organization. Mental Health of Adolescents. 2021. Available online: <https://www.who.int/news-room/fact-sheets/detail/adolescent-mental-health#:~:text=Key%20facts,illness%20and%20disability%20among%20adolescents> (accessed on 27 April 2024).
18. Australian Government Department of Health and Aged Care. Mental Health and Suicide Prevention. 2024. Available online: <https://www.health.gov.au/topics/mental-health-and-suicide-prevention> (accessed on 27 April 2024).
19. Bryant, A. The Grounded Theory Method. In *The Oxford Handbook of Qualitative Research*, 2nd ed.; Leavy, P., Ed.; Oxford Academic: Oxford, UK, 2020; pp. 167–199.
20. Curren, R.; Boniwell, I.; Ryan, R.M.; Oades, L.; Brighouse, H.; Unterhalter, E.; Kristjánsson, K.; de Ruyter, D.; Macleod, C.; Morris, I.; et al. Finding consensus on well-being in education. *Theory Res. Educ.* **2024**, *22*, 117–157. [CrossRef]
21. Barbiero, G.; Berto, R. Biophilia as Evolutionary Adaptation: An Onto-and Phylogenetic Framework for Biophilic Design. *Front. Psychol.* **2021**, *12*, 700709. [CrossRef] [PubMed]
22. Stanner, W.E.H. The Dreaming (1953). In *The Dreaming & Other Essays*; Black Inc. Agenda: Collingwood, VIC, Australia, 2011; pp. 57–72.
23. Goodchild, M. Relational systems thinking: That’s how change is going to come, from our earth mother. *J. Aware.-Based Syst. Chang.* **2021**, *1*, 75–103. [CrossRef]
24. Kern, M.L.; Williams, P.; Spong, C.; Colla, R.; Sharma, K.; Downie, A.; Oades, L.G. Systems informed positive psychology. *J. Posit. Psychol.* **2020**, *15*, 705–715. [CrossRef]
25. Kellert, S.R. *Nature by Design: The Practice of Biophilic Design*; Yale University Press: New Haven, CT, USA, 2018.
26. Browning, W.; Ryan, C.; Clancy, J.; 14 Patterns of Biophilic Design. Terrapin Bright Green. 2014. Available online: <https://www.terrapinbrightgreen.com/report/14-patterns/> (accessed on 10 July 2024).
27. Johansen, B.; Euchner, J. Navigating the VUCA world. *Res.-Technol. Manag.* **2013**, *56*, 10–15. [CrossRef]
28. Seligman, M.E.P.; Csikszentmihalyi, M. Positive psychology: An introduction. *Am. Psychol.* **2000**, *55*, 5–14. [CrossRef]
29. Downie, A.K. Could Redesigning Education End the Mental Health Crisis? A Paradigm Shift Towards a More Relevant System. Medium. 2023. Available online: <https://medium.com/@andrea-downie/could-redesigning-education-end-the-mental-health-crisis-3c099ec869d3> (accessed on 12 March 2023).
30. Jarden, A.; Downie, A.; Finter, K.; Jarden, R. Next level flourishing in education: A case study of ‘wholebeing’. In *Handbook of Positive School Psychology Interventions: Evidence-Based Practice for Promoting Youth Mental Health*; Arslan, G., Yıldırım, M., Eds.; Springer: Berlin/Heidelberg, Germany, 2023.
31. Senge, P.; Hamilton, H.; Kania, J. The dawn of system leadership. *Stanf. Soc. Innov. Rev.* **2015**, *13*, 27–33. [CrossRef]
32. Largo-Wight, E. Cultivating healthy places and communities: Evidence-based nature contact recommendations. *Int. J. Environ. Health Res.* **2011**, *21*, 41–61. [CrossRef] [PubMed]
33. Ming, A.; Jinghua, H.; Yoshihiro, S.; Tetsuo, K. Time-of-day-dependent Effects of Monochromatic Light Exposure on Human Cognitive Function. *J. Physiol. Anthropol.* **2009**, *28*, 217–223. [CrossRef]
34. Grube, K. Detrimental Effects of White Valued Walls in Classrooms. *Educ. Plan.* **2014**, *21*, 69–82.

35. Arola, T.; Aulake, M.; Ott, A.; Lindholm, M.; Kouvonen, P.; Virtanen, P.; Paloniemi, R. The impacts of nature connectedness on children's well-being: Systematic literature review. *J. Environ. Psychol.* **2023**, *85*, 101913. [CrossRef]
36. Unnikrishnan, G. *WELL V2: Evidence behind the Light Concept*; International WELL Building Institute: New York, NY, USA, 2021. Available online: <https://f.hubspotusercontent40.net/hubfs/7039796/Evidence%20Box/evidence%20box-%20light%20final.pdf> (accessed on 1 May 2024).
37. Pasca, L.; Carrus, G.; Loureiro, A.; Navarro, Ó.; Panno, A.; Tapia Follen, C.; Aragonés, J. Connectedness and well-being in simulated nature. *Appl. Psychol. Health Well Being* **2022**, *14*, 397–412. [CrossRef] [PubMed]
38. Martin, A.; Nejad, H.; Colmar, S.; Liem, G. Adaptability: How students' responses to uncertainty and novelty predict their academic and non-academic outcomes. *J. Educ. Psychol.* **2013**, *105*, 728–746. [CrossRef]
39. Strachan-Regan, K.; Baumann, O. The impact of room shape on affective states, heartrate, and creative output. *Heliyon* **2024**, *10*, e28340. [CrossRef]
40. Chin, T.-C.; Ricci, E.; Cooper, A.; Downie, A.; Vella-Brodrick, D. Using theory of change for fostering well-being and engagement in learning communities. In *Handbook of Positive Psychology in Schools: Supporting Process and Practice*, 3rd ed.; Allen, K.-A., Furlong, M.J., Vella-Brodrick, D., Suldo, S.M., Eds.; Routledge: Oxfordshire, UK, 2022; pp. 417–436. [CrossRef]
41. Heschong, L. Daylighting and human performance. *ASHRAE J.* **2002**, *44*, 65–67.
42. Haythornthwaite, C. Rethinking learning spaces: Networks, structures, and possibilities for learning in the twenty-first century. *Commun. Res. Pract.* **2015**, *1*, 292–306. [CrossRef]
43. Herrington, J.; Reeves, T.C.; Oliver, R. Authentic Learning Environments. In *Handbook of Research on Educational Communications and Technology*; Spector, J., Merrill, M., Elen, J., Bishop, M., Eds.; Springer: Berlin/Heidelberg, Germany, 2014. [CrossRef]
44. Hughes, H.; Franz, J.; Willis, J. (Eds.) *School Spaces for Student Wellbeing and Learning: Insights from Research and Practice*; Springer: Berlin/Heidelberg, Germany, 2019.

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