Pendhapa
Vol. 15., No. 2, December 2024, pp. 1-9
ISSN 2086-8138, eISSN 2745-7249
https://jurnal.isi-ska.ac.id/index.php/pendhapa

Green Building Interior Design for Recycle Center Edutourism

Nida Aulia [a,1,*], Nurhayatu Nufut Alimin [a,2]

[a] Sebelas Maret University, Ir. Sutami St. No.36, Surakarta 57126, Indonesia
[1] nidaa.auliaaa@gmail.com* ; [2] nurhayatu@staff.uns.ac.id
* Corresponding Author

Received 25 May 2023; accepted 8 November 2023; published 13 December 2024

ABSTRACT

In Indonesia, food and plastic waste make up the largest proportion of total waste production, and this amount will continue to increase in line with growing human consumption if not properly managed. In Karanganyar Regency, Central Java, household and plastic waste remain dominant, yet waste management is still suboptimal due to limited facilities, inadequate infrastructure, and low public awareness of proper waste handling. Poor waste management threatens the environment and public health by contributing to pollution and disease. Responding to these challenges, this study proposes an interior design plan for a recycle center that integrates educational functions to raise community awareness and promote sustainable waste management practices. The design applies green building principles to reduce environmental impact through efficient use of natural resources, eco-friendly materials, and spatial strategies that support behavioral change. This recycle center is expected to serve as an edutourism facility that combines recycling education with interactive experiences, fostering new habits and a better understanding of waste management within the community.

KEYWORDS

Edutourism
Waste
Recycle
Interior Design
Green Building

1. Introduction

According to the National Waste Management Information System (SIPSN), Indonesia generated approximately 19 million tons of waste in 2022. The composition of this waste is dominated by food waste at 41%, followed by plastic waste at around 18%. Waste can be classified based on its composition (organic and inorganic) and its source (domestic, industrial, agricultural, mining, etc.) (Bobulski & Kubanek, 2019). Alongside technological development and increasing human consumption, the amount of accumulated waste will continue to rise if it is not managed properly. Government Regulation No. 18 of 2008 on Waste Management highlights that the general public still tends to perceive waste merely as useless residue rather than a potential resource to be reused. Consequently, waste handling practices remain limited to end-of-pipe approaches—removing pollutants after they form—rather than minimizing waste generation at its source. This practice contributes significantly to greenhouse gas emissions, especially methane (CH_4) from organic waste decomposition, which exacerbates global warming.

In Karanganyar Regency, Central Java, the problem of household and plastic waste remains unresolved due to inadequate facilities, limited waste transportation, and low public awareness. Many residents still dispose of waste irresponsibly by dumping it into rivers, burning it, or leaving it in temporary collection points with minimal further treatment (Joko, 2023). These habits pose serious environmental and health threats. Addressing this issue requires not only improvements in waste infrastructure but also continuous public education to build awareness and foster behavioral change. One effective strategy is to establish a recycle center that functions as an edutourism facility (Malihah & Setiyorini, 2014). By combining waste management with educational tourism, communities can learn about the importance of waste separation and the 4R principles—reduce, reuse, recycle, and replace—while engaging directly in sustainable practices. This research aims to develop an interior design concept for a recycle center in Karanganyar that applies green building principles. The theoretical foundation

builds upon the idea that interior design can shape user behavior (Jassim et al., 2022) and encourage sustainable habits through spatial planning and material choices (Alimin et al., 2021). The design will integrate cross-ventilation, renewable energy, and the use of eco-friendly materials to minimize the building's environmental impact. It is expected that this recycle center will not only address local waste management challenges but also serve as a means of public education and behavioral transformation. The final design aims to provide an immersive learning environment that inspires communities to adopt more sustainable lifestyles, contributing to environmental preservation and supporting local waste reduction efforts.

2. Method

2.1 Programming and Data Collection

The research began with a programming phase, which focused on formulating the design goals and identifying contextual needs. This process was guided by David K. Ballast's interior design methodology, which emphasizes a comprehensive understanding of function, context, and user experience (Ballast, 2019). The site survey was conducted in Karanganyar Regency to find a suitable and strategic location for the proposed Recycle Center. In-depth field observations were carried out at Potato Head Bali and Rumah Atsiri Indonesia, two facilities that exemplify the integration of educational and interactive environmental design. These observations yielded valuable insights regarding spatial flow, exhibit arrangement, and material usage (Kilmer & Kilmer, 2021). Simultaneously, documentation was conducted by capturing photographic records of spatial and display elements from those facilities. To deepen contextual understanding, interviews with the Karanganyar Environmental Service (DLH) were conducted, providing information on the current state of waste management, infrastructure limitations, and community behavioral patterns.

2.2 Data Analysis and Spatial Strategy

The data collected from surveys, observations, and interviews were analyzed to develop a coherent spatial strategy that aligns with the program's objectives. Zoning was divided into four core functional categories: private, public, semi-public, and service areas, each determined based on access level and activity type (Healey, 2009). The spatial arrangement was further refined by grouping each function accordingly—administrative tasks in private zones, visitor interaction in public and semi-public areas, and logistical support within service areas. Room dimensions were estimated based on ergonomic standards, user circulation flow, and the required furniture footprints. Circulation pathways were designed to ensure a fluid and intuitive user experience, especially in spaces dedicated to education and exhibition. Relationships between spaces were intentionally sequenced to reflect the flow of recycling activities, from initial information and engagement to practical processing and output display. This sequencing ensures that users are guided through an experiential and educational journey.

2.3 Conceptual Development

The conceptual development phase involved visualizing the interior design through sketches and 3D modeling using tools such as AutoCAD, SketchUp, and Enscape. The conceptual framework is grounded in the dual approach of education and entertainment. Inspired by the Action for Climate Empowerment (ACE) principles under the UNFCCC, the design aims to empower visitors with knowledge and emotional connection through six key pillars: education, training, public participation, access to information, awareness, and international cooperation (Pertiwi et al., 2023). These components are embedded in the spatial programming to ensure the center offers not only information but also memorable, enjoyable experiences. The interior is envisioned as a space where environmental awareness is cultivated through sensory engagement and active participation.

2.4 Green Building Integration

The design integrates the principles of green building to minimize environmental impact and promote sustainable behavior. Drawing on the characteristics, the design incorporates cross ventilation systems, renewable energy sources such as solar panels, and the extensive use of environmentally responsible materials (Budi et al., 2018; Ragheb et al., 2016). Natural lighting is maximized through careful orientation of windows and skylights, reducing dependence on artificial

lighting. The selection of local materials—such as teak wood, exposed cement, and recycled plastic—not only supports the regional economy but also reinforces the ecological mission of the project. The building layout is compact and efficient, optimizing space without compromising comfort. These strategies are aligned with the role of environmental quality in enhancing user well-being and productivity (Heschong, 2002).

2.5 Aesthetic and Material Considerations

Visual design elements are deliberately aligned with the educational and ecological objectives of the project. The use of geometric shapes serves to simplify spatial legibility and direct user focus toward the content and activities. The color palette incorporates green and yellow tones—sourced from recycled materials—to evoke freshness, energy, and environmental consciousness (Anwar et al., 2018; Vellinga et al., 2024). Materials are selected for their sustainability, durability, and symbolic value. Natural stone and wood provide a tactile connection to nature, while recycled plastic and aluminum are used in furniture and partition systems to exemplify the potential of waste transformation. These material choices are meant to reinforce the values promoted by the space: renewal, responsibility, and resilience.

3. Result and Discussion

3.1 Implementation of Green Building Concept in Interior Design

The interior design of the Recycle Center in Karanganyar integrates several key principles of the green building concept, aligning spatial and material strategies with sustainability goals. One of the main aspects implemented is an efficient natural ventilation system. Cross ventilation is applied by positioning air openings opposite each other to ensure effective air flow across the interior spaces. This is further supported by the use of roster walls, which allow air circulation between rooms without compromising spatial boundaries (Nurdiani & Dewanto, 2024). The approach not only ensures thermal comfort but also reduces dependency on mechanical ventilation.

In terms of energy efficiency, the building is designed to maximize the use of renewable resources, particularly daylight and natural air circulation. Openings such as windows, skylights, and ventilated roof structures are strategically placed to enhance the penetration of natural light and minimize the use of artificial lighting and air conditioning. As Ching explains, natural lighting not only illuminates spaces effectively but also contributes to the aesthetic and psychological quality of interior environments (Dong et al., 2021). The orientation of the building, which faces slightly north, further supports the passive energy strategy. This layout allows for optimized daylight reception while minimizing heat gain, a principle commonly applied in sustainable building design. The integration of landscape design also plays a critical role in this approach, helping to regulate microclimatic conditions and maximizing solar exposure in appropriate areas.

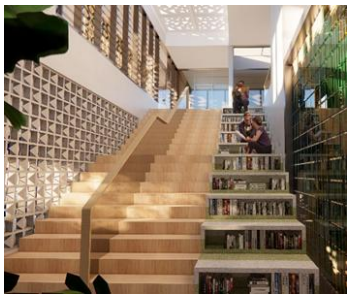
Material selection is central to minimizing environmental impact. The project makes use of natural materials such as stone and wood, alongside recycled components, especially plastics, for furniture, ceiling finishes, and visual displays. This selection not only reduces the carbon footprint of the project but also reinforces the thematic narrative of upcycling and waste transformation. Solar panels are installed on the building's roof as an alternative energy source, representing a concrete step towards energy self-sufficiency and low-impact operation. Local material use further strengthens the project's environmental and socio-cultural alignment (Shonfeld et al., 2021). Teak wood, which is abundantly available in Karanganyar, is used for doors and selected furniture elements, reducing transportation emissions and supporting the regional economy. The overall interior layout also prioritizes spatial efficiency by using modular and compact furniture, allowing for multi-functional use of space and reducing material redundancy.

3.2 Thematic and Atmospheric Considerations

The thematic direction of the interior design adopts a natural aesthetic that resonates with the green building concept. This theme is reflected in the selection of earthy colors, organic textures, and the integration of recycled materials. By highlighting visual elements sourced from waste, particularly plastic, the design embodies a narrative of environmental responsibility and transformation. The aim is to create a space that not only educates but also emotionally engages

visitors through its material storytelling. The spatial atmosphere is designed to be fresh, calming, and immersive. Through the use of natural materials and environmentally conscious design strategies, the interior is expected to foster a sense of well-being while simultaneously delivering educational content. This approach aligns with the principles of environmental psychology, where spatial qualities are seen as capable of shaping user behavior and perception. In this case, the hope is to instill awareness, curiosity, and active participation in sustainable practices through an environment that feels both inspiring and grounded.

(a) SPC flooring application.



(b) Conwood and recycle plastic flooring application.

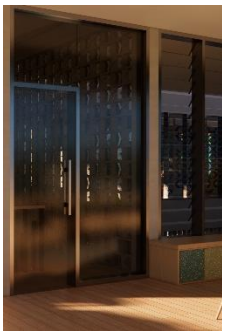
(c) Natural stone flooring application.

(d) Exposed cement flooring application.

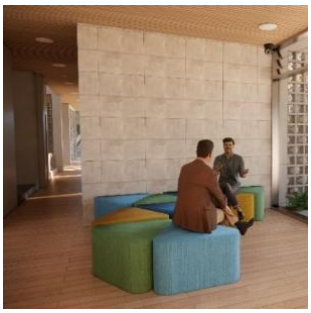
Fig. 1. Space designing aspect for flooring.

SPC (Stone Plastic Composite) flooring is used in main circulation and display areas. This material offers durability and visual warmth, making it an effective alternative to wood while reducing maintenance costs (see Fig. 1a). Conwood and recycled plastic flooring are installed in transitional spaces such as stairs and connecting pathways. These materials help minimize timber usage and demonstrate upcycling principles in the interior. (see Fig. 1b) Natural stone flooring is applied in restroom and wash area zones to create a clean, refreshing atmosphere with tactile textures that support the natural theme (see fig. 1c). Exposed cement flooring, finished with a clear protective coating, is used in workshop and exhibition zones for its practical maintenance, modern industrial look, and durability (see fig. 1d). Additionally, carpet tiles are placed in the seminar room to ensure better sound insulation and user comfort during discussions and presentations. Together, these choices illustrate the project's commitment to functional, durable, and eco-conscious interior design.

Moving forward, the wall applications follow the same sustainable approach, combining material efficiency and aesthetic coherence with the green building vision. The wall treatments throughout the recycle center are designed to balance environmental sustainability, visual appeal, and ease of maintenance.



(a) Glass wall application



(b) Exposed cement finishing wall application

(c) Roster wall application

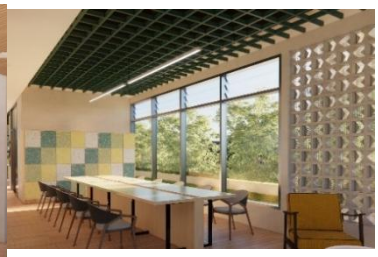
Fig. 2. Space designing aspects for wall.

Glass walls are used in public and semi-public areas to maximize natural lighting and visual connectivity while supporting an open, transparent atmosphere that aligns with the educational purpose of the center (see fig. 2a). Roster walls are incorporated as partitions that allow natural cross-ventilation between spaces without compromising privacy. This traditional yet practical material choice reduces energy consumption and supports the passive cooling strategy (see fig. 2c). Exposed cement finishing is applied on structural and boundary walls to minimize construction costs and maintenance needs while reinforcing the industrial, raw aesthetic of the green building concept (see fig. 2b). In addition to these primary materials, wooden wall panels are added in selected spots to bring warmth and visual contrast, enhancing the user experience and reinforcing the theme of natural materials.

The same thoughtful approach continues with the ceiling design, where eco-friendly materials and functional strategies are integrated to support the building's overall sustainability goals. The ceiling design of the recycle center further supports the overall sustainable approach by combining environmentally responsible materials with thoughtful visual planning.

(a) Gypsum application.

(b) Wood Panel Composite (WPC) application.



(c) Recycled plastic application.

Fig. 3. Space designing aspects for ceiling.

Gypsum board ceilings are installed in the main indoor functional areas to create a neat and modern finish that supports an organized layout. This material is not only lightweight and easy to maintain but also allows hidden installation of lighting fixtures and ventilation ducts for a clean visual line (see Fig. 3a). In transitional spaces such as reception and semi-public gathering zones, Wood Panel Composite (WPC) ceilings are applied to introduce a warmer, natural ambience while demonstrating sustainable material use through the combination of recycled plastic and wood dust (see Fig. 3b). For selected educational areas and the café, recycled plastic ceilings are chosen as a bold statement of the project's upcycling vision. This ceiling element transforms post-consumer waste into a structured design feature that enhances acoustic comfort while visually reminding visitors of the potential of recycled materials to become practical, durable, and visually appealing interior components (see Fig. 3c).

By carefully combining these materials, the ceiling design not only supports the building's passive cooling and lighting strategies but also contributes to the project's narrative of transformation and responsible resource use. Altogether, the floor, wall, and ceiling applications

work cohesively to create an immersive interior atmosphere that reflects the recycle center's thematic vision—educating visitors through a space that embodies sustainability, innovation, and meaningful environmental storytelling.

3.3 Interior System

The interior system of this recycle center is carefully designed to optimize environmental efficiency while maintaining user comfort and safety. Natural lighting is prioritized through the strategic placement of wide openings, glass walls, and skylights, allowing daylight to illuminate most indoor spaces and reduce reliance on artificial light. In areas where natural light cannot reach effectively, energy-efficient artificial lighting—such as LED downlights, LED strips, and focused spotlights—will provide sufficient illumination without excessive energy use. For thermal comfort, the ventilation system combines natural and mechanical methods. Cross ventilation is enhanced through well-positioned windows, roof vents, and roster walls, enabling fresh air to circulate freely throughout the building. However, to address peak heat conditions and maintain indoor air quality during extreme weather, the system is supported by central and portable air conditioning units installed in selected rooms.

To ensure safety and proper monitoring, the recycle center will be equipped with an integrated security system, including strategically placed CCTV cameras to supervise activities and minimize risks such as property damage or theft. In addition, smoke detectors and fire extinguishers (APAR) are installed as preventive measures to detect early signs of fire and help occupants respond swiftly, safeguarding both visitors and staff in daily operations.

3.4 Recycle Center Facility

The Recycle Center is designed as an educational tourism space that connects waste management with community learning through thoughtfully planned facilities.

(a) Entrance and introductory zone of the museum, featuring informational panels about waste types and impacts.

(b) Interactive display area inside the museum, showcasing recycled material exhibits and visitor engagement activities.

Fig. 4. Museum area.

The museum serves as the central narrative space where visitors begin their journey by exploring informative panels and visual displays about various types of waste, their origins, and the environmental challenges they cause. Upon entering, guests are greeted by a sequence of partitioned zones that guide them through stories of waste generation and its hidden value when properly managed (see Fig. 4a). Deeper inside, the interactive gallery allows visitors to engage with touch-friendly installations and digital screens, encouraging them to test their knowledge or simulate sorting waste correctly. Many of these installations are constructed from recycled plastic, demonstrating first-hand how post-consumer waste can be turned into educational media and attractive exhibition features (see Fig. 4b). The overall atmosphere combines educational content with immersive spatial storytelling, making the issue of waste tangible and relatable.

(a) Plastic-waste workshop area. (b) Workshop room. (c) Organic-waste workshop area.

Fig. 5. Workshop areas.

The workshop areas of the recycle center are designed to provide practical, hands-on experiences that connect visitors directly with waste management processes. The plastic waste workshop area displays functional recycling machinery and open pathways where visitors can observe how discarded plastic is processed and repurposed (see Fig. 5a). Adjacent to this is the main workshop room, a flexible space equipped with long worktables and chairs for making accessories and other products from recycled materials. Large windows ensure ample natural light, while furniture made of recycled plastic and wood reinforces the upcycling theme; the partition wall proudly features the recycle center's logo as a subtle reminder of its mission (see Fig. 5b). Complementing these indoor zones, the organic waste workshop area is set outdoors to facilitate composting activities. Here, benches and cabinets made from recycled plastic provide durable seating and work surfaces, encouraging community interaction in an open, nature-integrated setting (see Fig. 5c). Together, these areas enable visitors to gain knowledge through doing, supporting the center's goal of inspiring practical environmental action.

Fig. 6. Collection room.

Fig. 7. Recycle store.

The collection room acts as an inspiring gallery where finished products and experimental works from the workshops are displayed. Visitors can see up-close examples of how discarded materials have been reimagined as functional objects or artistic pieces, reinforcing the value of upcycling. Display shelves, plinths, and supporting structures are made from a mix of exposed cement, recycled plastic panels, and glass to align with the building's green aesthetic. This space not only showcases outcomes but also invites reflection on design innovation in the circular economy (see Fig. 6). Adjacent to the workshop, the recycle store bridges educational insights with everyday application. Here, visitors can purchase souvenirs and lifestyle products made from recycled plastics, reclaimed wood, or upcycled textiles. The store's layout highlights product stories, explaining the origin of each item's materials and the process behind their transformation. Shelving and counters integrate recycled plastic and wood panel details, subtly reinforcing the center's mission and extending the educational experience to a retail context (see Fig. 7).

Fig. 8. Café.

Fig. 9. Library.

The café and library are designed as complementary spaces that extend the recycle center's educational purpose into moments of relaxation and reflection. The café offers visitors a warm yet modern spot to pause, socialize, or enjoy refreshments without stepping away from the sustainability message. Furnished with tables and ceiling panels crafted from Wood Panel Composite (WPC) and recycled plastic, the café's design highlights how reclaimed materials can shape a welcoming environment. A unique recycling vending machine rewards guests for depositing plastic waste, transforming casual breaks into interactive acts of circular economy awareness (see Fig. 8). Just nearby, the library invites guests to dive deeper into topics related to sustainability, design, and environmental stewardship. Open shelving made from recycled plastic panels and reclaimed wood holds curated books and magazines, while soft seating and generous natural light create a quiet zone for reading, contemplation, or idea-sharing inspired by the exhibits and workshops. Together, the café and library demonstrate how informal spaces can reinforce learning and encourage visitors to carry sustainability values beyond their time at the center (see Fig. 9).

Beyond the main educational and interactive zones described earlier, the recycle center is also supported by a range of functional spaces that ensure smooth daily operations and enhance the overall visitor experience. Supporting spaces—such as the foyer, prayer room, lavatory, seminar room, meeting room, head office, staff area, and pantry—provide essential amenities for staff and guests alike. Although these areas are not the primary focus of the design, they are intentionally planned with the same green building principles, including the use of locally sourced materials, ergonomic and durable furniture, and energy-efficient systems. Together, these supporting facilities complete the recycle center as a comfortable, well-organized environment where sustainability is consistently reflected in every detail.

4. Conclusion

The interior design plan for the recycle center in Karanganyar Regency responds to persistent challenges in local waste management, especially the public's habitual reliance on burning and landfilling due to limited awareness and inadequate facilities. While the Environmental Service (DLH) has made efforts through outreach and training, participation has remained low, limiting the effectiveness of these programs. As a practical solution, this project proposes a recycle center that functions not only as a waste processing hub but also as an educational tourism destination. By integrating learning with interactive and immersive spatial experiences, the design encourages community engagement and fosters new habits of responsible waste management.

The adoption of green building principles reinforces the center's mission to minimize environmental impact through renewable energy use, natural ventilation, eco-friendly materials, and efficient spatial strategies. It is expected that this recycle center will inspire greater public interest, provide accessible knowledge about recycling and sustainability, and serve as a model for similar initiatives in other regions. Ultimately, the design contributes to broader efforts to reduce environmental damage and promote a culture of sustainability within the community.

References

Alimin, N. N., Pertiwi, E. G., & Purwaningrum, L. (2021). Establishing sustainable habits of students in Green School Bali through green interior design. IOP Conference Series: Earth and Environmental Science, 905(1), 012075. https://doi.org/10.1088/1755-1315/905/1/012075

Anwar, R. K., Hapsari, I. A., & Sinaga, D. (2018). Analisis semiotik Charles Sanders Pierce mengenai logo baru Perpustakaan Nasional Republik Indonesia. Jurnal Kajian Informasi Dan Perpustakaan, 6(2). https://doi.org/10.24198/jkip.v6i2.15689

Ballast, D. K. (2019). PPI Interior Construction & Detailing for Designers & Architects eText-1 Year. Simon and Schuster.

Bobulski, J., & Kubanek, M. (2019). Waste Classification System Using Image Processing and Convolutional Neural Networks. In I. Rojas, G. Joya, & A. Catala (Eds.), Advances in Computational Intelligence (Vol. 11507, pp. 350–361). Springer International Publishing. https://doi.org/10.1007/978-3-030-20518-8_30

Budi, J. B. S., Fifthariski, K., Yuliani, S., & Setyaningsih, W. (2018). Strategy of green design implementation for optimizing of the natural ventilation at high-rise building. Arsitektura: Jurnal Ilmiah Arsitektur Dan Lingkungan Binaan, 16(2), 155–164.

Dong, X., Wu, Y., Chen, X., Li, H., Cao, B., Zhang, X., Yan, X., Li, Z., Long, Y., & Li, X. (2021). Effect of thermal, acoustic, and lighting environment in underground space on human comfort and work efficiency: A review. Science of The Total Environment, 786, 147537. https://doi.org/10.1016/j.scitotenv.2021.147537

Healey, P. (2009). In search of the "strategic" in spatial strategy making. Planning Theory & Practice, 10(4), 439–457. https://doi.org/10.1080/14649350903417191

Heschong, L. (2002). Daylighting and human performance. ASHRAE Journal, 44(6), 65–67.

Jassim, R., Farhan, S., Al-Dabbagh, S., & Shamam, Z. (2022). Ecological architecture and its impact on human behavior and human health. Journal of STEPS for Humanities and Social Sciences, 1(1), 8.

Kilmer, R., & Kilmer, W. O. (2021). Construction drawings and details for interiors. John Wiley & Sons.

Malihah, E., & Setiyorini, H. P. D. (2014). Tourism education and edu-tourism development: Sustainable tourism development perspective in education. The 1st International Seminar on Tourism (ISOT)-"Eco-Resort and Destination Sustainability: Planning, Impact, and Development, 1–7.

Nurdiani, N., & Dewanto, R. (2024). The Application of Terawang (Roster) Wall Material on Building Facades in Tropical Climate Areas. IOP Conference Series: Earth and Environmental Science, 1324(1), 012063. https://doi.org/10.1088/1755-1315/1324/1/012063

Pertiwi, A. R., Sumarno, & Indarto. (2023). Innovation of Tourism Icons through Blender Software Utilizing Natural Fibers in Sukoharjo. Pendhapa, 14(2), Article 2. https://doi.org/10.33153/pendhapa.v14i1.5579

Ragheb, A., El-Shimy, H., & Ragheb, G. (2016). Green architecture: A concept of sustainability. Procedia-Social and Behavioral Sciences, 216, 778–787. https://doi.org/10.1016/j.sbspro.2015.12.075

Shonfeld, M., Cotnam-Kappel, M., Judge, M., Ng, C. Y., Ntebutse, J. G., Williamson-Leadley, S., & Yildiz, M. N. (2021). Learning in digital environments: A model for cross-cultural alignment. Educational Technology Research and Development, 69(4), 2151–2170. https://doi.org/10.1007/s11423-021-09967-6

Vellinga, M., Oliver, P., & Bridge, A. (2024). Atlas of vernacular architecture of the world. Taylor & Francis.