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Evaluating Environmental Recycled Paper Design Projects: A sustainable Approach in Interior Design Education

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Abstract

Objectives: Achieving the United Nations' goals for tackling the global environmental crisis requires innovative, sustainable solutions. Material selection plays a vital role, as it directly influences both building energy efficiency and occupant health. This study examines recycled paper-based materials in design projects as an accessible, affordable, and versatile material, evaluating them from theoretical and empirical perspectives.

Methods: Mixed research methods were adopted within an exploratory study design, including case studies and a survey. The case studies examined 12 environmental design projects using recycled paper as a primary material, while the survey identified 14 dimensions of sustainable, creative, aesthetic, and spatial outcomes based on the Consensual Assessment Technique (CAT) proposed by Amabile (1982).

Results: A significant gap was identified between the conceptual stage of environmentally sustainable design projects and their practical implementation. Two themes emerged from thematic analysis: the use of 'fabricated' recycled paper and 'processed' recycled paper. The CAT results revealed that creativity, liking, complexity, consistency, and beauty were associated with the fabricated theme.

Conclusions: Recycled paper offers a functional, environmentally responsible, and practical material for indoor environments. Its capacity to reduce greenhouse gas emissions and its eco-friendly properties support the global shift toward a zero-waste approach. This study empowers practical implementation of recycled paper by encouraging designers to adopt sustainable practices focused on green material choices. It provides insight into effective recycled paper use while highlighting challenges associated with the identified themes and techniques.

Keywords: Materials, recycled paper, sustainability, environmental project-based design, CAT, interior design.

تقييم مشاريع تصميم الورق المعاد تدويره بيئيًا: نهج مستدام في تعليم التصميم الداخلي

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ملخّص

الأهداف: يتطلب تحقيق أهداف الأمم المتحدة لمعالجة الأزمة البيئية العالمية تطوير حلول مستدامة مبتكرة. حيث يلعب اختيار المواد دورًا حيويًا، إذ يؤثر بشكل مباشر على كفاءة استخدام الطاقة في المباني وصحة شاغليها. تبحث هذه الدراسة في استخدام المواد الورقية المعاد تدويرها في مشاريع التصميم، باعتبارها مواد متاحة وبأسعار معقولة ومتعددة الاستخدامات، وتقيمها من المنظورين النظري والتجريبي.

المنهجية: اعتمدت الدراسة مناهج بحثية متنوعة، شملت دراسات حالة واستبيانًا. تناولت دراسات الحالة 12 مشروعًا للتصميم البيئي استخدم الورق المعاد تدويره كمادة أساسية، بينما صُمم الإستبيان لتحديد 14 بُعدًا من أبعاد الاستدامة والإبداع والجمال والمكان، استنادًا إلى تقنية التقييم التوافقي (CAT) التي اقترحتها Amabile (1982).

النتائج: حُددت فجوة كبيرة بين المرحلة المفاهيمية لمشاريع التصميم المستدامة بيئيًا وتطبيقها العملي والتجريبي. وقد حُدد سمتان من التحليل الموضوعي لمشاريع تصميم الورق المعاد تدويره: استخدام الورق المعاد تدويره "المُصنّع"، واستخدام الورق المعاد تدويره "المعالج". أما من منظور تجريبي، كشفت نتائج CAT أن أبعاد الإبداع والإعجاب والتعقيد والاتساق والجمال كانت مرتبطة بسمة الورق المعاد تدويره "المُصنّع".

الخلاصة: يُوفّر الورق المُعاد تدويره مادةً عمليةً، وصديقةً للبيئة، وفعّالةً للاستخدام في البيئات الداخلية. إن قدرته على المساهمة في خفض انبعاثات غازات الاحتباس الحراري، وخصائصه الصديقة للبيئة، تُسهم في دعم التحوّل العالمي نحو نهجٍ خالٍ من النفايات. تُساهم الدراسة في تمكين التطبيق التجريبي للورق المُعاد تدويره من خلال تشجيع المُصممين على تبني ممارسات مستدامة تُركّز على اختيار المواد الصديقة للبيئة. و تقدم فهمًا أعمق لكيفية استخدام الورق المُعاد تدويره بفعالية، مع تسليط الضوء على التحديات المرتبطة بالسمات والتقنيات المُحددة.

الكلمات المفتاحية: المواد، الورق المعاد تدويره، الاستدامة، التصميم البيئي القائم على المشاريع، CAT، التصميم الداخلي.

Introduction

Human activities, such as transportation, construction, agriculture, and energy generation, have produced large amounts of greenhouse gases (Polášková, 2023). This has led to a dramatic increase in temperatures in recent times, with the thermal dome affecting large parts of the planet, providing clear evidence of global warming and, consequently, climate change. Therefore, achieving the United Nations' goals necessitates urgent action to reduce greenhouse gas emissions to net zero emissions by 2050, as established at the "Climate Action Summit" (United Nations, 2023). Promoting a zero-waste approach, eco-friendly methods, green material selection, the sustainable disposal of products, and the use of sustainable materials are some of actions encouraged to tackle the climate crisis and its impact.

Sustainable practices are pivotal in interior architecture projects, as the built environment has been found to be responsible for 42% of global CO2 emissions annually, including via building operations, infrastructure materials, and construction (Architecture2030, 2023). Sick-building syndrome (SBS) is an example of a common problem that needs to be tackled in indoor environments. Air contaminants, such as carbon dioxide in indoor air, often derive from the use of specific building materials, like paints, insulation materials, and adhesives. These contaminants contribute significantly to occupants' health issues, along with low levels of lighting, natural ventilation, and thermal comfort (Redlich et al., 1997). Therefore, adopting the principles of "Reuse, Reduce, and Sequester" is encouraged in existing and new built environments to achieve zero embodied carbon emissions. This means the use of recycled materials, material optimisation, low-to-zero carbon materials specification, and sequestering sites and materials (Architecture2030, 2023). However, the cost of materials and the principles of Life Cycle Design (pre-building, building, and post-building) determine the usage of building materials (Hussein, 2012).

Since interior design is not only about meeting functional requirements; it must also address historical context, architectural style, spiritual and environmental factors. As such, the concept of "green ecological design" is encouraged by focusing on the application value of new materials and technologies (Yan, 2022). Architects, designers, and even users share the responsibility for choosing sustainable materials and products that have low environmental impact, while offering durability, ease of maintenance, flexibility, comfort, safety, and affordability (Alfuraty, 2020). Based on this; to achieve sustainable practices, it is necessary to consider the properties of the materials used in built environments. Wood, clay, stone, sand, and paper are some examples of materials with the sustainable characteristics of durability, non-toxicity, and renewability. The paper recycling industry, in particular, has grown significantly due to the reduced availability of natural resources and raw materials (Han et al., 2021). Recycled paper now offers a good alternative to cutting down trees (Bon et al., 2022), and can help tackle deforestation.

Paper in interior design is a 'living material' (Gentenaar, 2015) that can be analogically represent various art, design, and sculptural forms to enrich any space with both functional and aesthetic qualities. Notably, there has been no research thus far examining spatial creativity for environmental or sustainable recycled paper design projects, nor an empirical assessment of their impact in the field of interior design. This study addresses that gap by involving recycled paper-based materials, from both a theoretical and empirical perspective, while also evaluating the creative, aesthetic, and spatial qualities of innovative environmental design projects.

Theoretical framework

Recycled paper in environmental education

Educational practices have an essential role in developing students' ecological awareness and their capacity to address environmental issues (Zangori & Cole, 2019). The effectiveness of experiential, place-based learning helps in connecting built and natural environments in education (Cole et al., 2024). Paper recycling is promoted on university campuses as part of general waste-recycling practices. For example, one study focused on the concept of "environmental clean-up" promoted paper recycling to reinforce ecological behaviour on the campus of Virginia Polytechnic Institute and State University (Geller et al., 1975). Students were asked to bring paper (e.g. magazines, newspapers, and computer printouts) to rooms designated as paper-collection centres in six dormitories. While the study highlighted the challenges of implementing

community programmes to reinforce and increase ecological behaviours, it argued that the use of informational posters on bulletin boards and the offering of theatre- tickets and prizes were practical, economical and effective solutions.

Combining materials and sustainable design has been encouraged in the educational sector. For instance, a study by Hasling (2018) involved a written assignment about the role of materials in sustainable design. The student participants were required to navigate and translate the physical and social aspects of materials and reflect on their own responsibilities when working with these materials (Hasling, 2018).

'Design for Recycling' offers a another strategy that focuses on the 'the recyclability of products at their end of life' during the design process (Lore et al., 2017). Material Driven Design (MDD), which facilitates design for material experiences (Karana et al., 2015). This method is intended to direct and support designers through exploration, understanding (technically and experientially), structuring, communicating, and reflecting on their design actions during their experiences with materials. It involves the designer embarking on a journey that starts from the properties and qualities of the materials, passes through experiences of the materials, before finally reaching an end-product.

In Jordan, the attitudes of interior designers toward sustainable interior design practices have been explored through an evaluation framework based on three sustainability dimensions: environmental, economic, and social. Mohsen and Matarneh (2023) study found a positive shift in the profession of interior design toward the significance of sustainability, with a strong awareness of its impact on the environment and the importance of preserving natural resources. However, interior designers were found to lack familiarity with applications of effective sustainable concepts and strategies in design. Although professionals appreciate the importance of sustainable interior design, there is a gap in terms of their understanding and implementation of practical sustainable principles in their design practice, where they lack extensive experience. Consequently, Mohsen and Matarneh (2023) recommend development education, training, and professional opportunities to enhance their expertise and reduce the experience gap.

A study by Mayah (2024) proposed a novel methodology based on an active practical approach to learn about environmental design and sustainability in interior design education at the University of Jordan. The methodology encourages students to adopt ecological behaviour while designing environmental projects using local or recycled materials from their surrounding environment. The study found that the relationship between students and their environments was strengthened, and the students' gained skills and confidence in relation to their environmental practice. The projects promoted awareness of working with materials from both a functional and aesthetic perspective (Mayah, 2024). From another perspective, a critical aspect of using sustainable materials lies in their renewable or recyclable potential.

Recycled paper has been employed in a wide range of applications. For instance, in the industrial sector, recycled waste paper (RWP) has been used as inner cladding material for buildings (Abdulmunem et al., 2023); paper crumb (PC) has been used to produce biogas and then digestate for sustainable concrete production (Hurst et al., 2023); the use of recycled paper (R paper) based on a mixture of waste-print-paper pulp and modified with other ingredients, such as ketjenblack, ammonium polyphosphate, and poly-dimethylsiloxane has improved electrical conductivity and flame-retardant performance for lighting LED bulbs (Fu et al., 2022); and treating recycled pulp and paper wastewater (RPPW) to produce biogas anaerobic digestion has been used to generate renewable energy (Bakraoui et al., 2020).

Although the significant growth of the paper recycling industry now offers a sustainable option for waste disposal, certain contradictions have emerged. The amount of water and energy waste that occurs within the recycling process is concerning (Habchi et al., 2022). The process of recycling paper generates effluent that has a negative effect when released into the receiving water (Bon et al., 2022). Furthermore, as a raw material, paper cannot be reused indefinitely (Kozlowski, 2017). Paper fibres can reused up to seven times due to the breakage of long fibres, which eventually undermines paper strength and durability (Han et al., 2021). Thus, wastepaper recycling depends on a grading system (e.g. wood-containing or wood-free grades) that is based on the type and properties of the fibre used (McKinney, 1994).

Creativity in environmental education

The field of interior design is working to meet people's needs for comfortable, healthy, and ecological living conditions (Wang, 2021), offering a unique and meaningful perspective. It not only explores new materials and tools for developing better environmental conditions but also develops new methods for documenting design processes (Poldma, 2008). Through design research, the process and practice of interior design can be studied, understood, and documented to create new knowledge specific to interior design (Poldma, 2008). In this framework, the designer becomes a practical problem-solver, equipped to address practical problems through a mastery of "visual language" (Wong, 1972).

It can be noted that sustainable design projects, as creative endeavours in interior design, stimulate spatial creativity, which is the ability to create novel 2D and 3D ideas for volumetric forms (Suh & Cho, 2020). This is exemplified by various case studies that have adapted art and design into environmental education. A qualitative case study by Ison and Bramwell-Lalor (2023) aims to connect undergraduate students with their Caribbean environment—specifically Jamaica—through a creative process that includes diverse eco-art artefacts, reflective writings, and interviews, helping students form deeper emotional and social connections with nature and their communities. Likewise, a proposed pedagogical concept called 'dispositif' by Dedieu and Plé (2023), applied in a French context, presents an integration of creativity, imaginative projects, and group collaboration within an interactive educational environment aimed at fostering student engagement in sustainable development at school.

Another example drawn from applied settings is a creative, practice-based project in environmental education called the 'Understories' installations by Orchard, Crutchett, and Moloney (2025). This multidisciplinary research project aims to use creative, art-based installations to translate the concept of species absence into embodied, sensory experiences that foster public engagement with environmental, place-based education in the eastern Riverina region of New South Wales, Australia. Here, the installations act both as a method of inquiry and as a pedagogical tool for fostering ecological awareness while integrating creative arts into environmental education.

Similarly, an action research method integrating visual arts was applied to identify, explore, and creatively address environmental issues, such as urban waste management, in a Greek kindergarten (Kalafati et al., 2025). The art-based method employed photovoice, photo-elicitation, collage, and media remix to stimulate children's creative thinking and emotional engagement with sustainability issues. Furthermore, the study used qualitative data—such as observation notes, reflective diaries, and parents' feedback—to evaluate creativity, and it presents a pedagogical framework that integrates art and environmental education, enabling young learners to become active problem solvers for sustainability.

Although the case studies have provided valuable insights using various art and design techniques to foster creativity in environmental education, several limitations and challenges have been acknowledged. First, the representative samples in most case studies are small, which constrains the accuracy and comprehensiveness of the findings and limits their generalizability beyond specific cultures, contexts, or educational settings. Second, the reliance solely on subjective data highlights the need for a mixed-methods approach that combines both subjective and objective data—preferably through a longitudinal design—to develop a valid and robust pedagogical model for effective art-based environmental education. Third, there is a noted difficulty in objectively defining and measuring 'creativity' within an environmental education context, a significant limitation due to the lack of standardized tools for evaluating creativity as a complex phenomenon (Kalafati et al., 2025).

As Blamires and Peterson (2014) argue, there is a significant lack of strong evidence for constructing validated educational models to recognize and assess creativity over time, as this process requires knowledge, skills, and domain-specific expertise related to a particular subject area. However, Leong and Qiu (2013) developed the Creativity and Assessment Scale (CAS) to address the critical gap in measurement tools that assess the relationship between teachers' conceptions of creativity and assessment practices in arts education. Yet, the tool has several limitations. The concept of creativity lacks a universal definition, making it difficult to assess across different educational contexts. Additionally, the CAS scale presents minor issues with its rating categories, likely due to limitations in sample size and variations in how creativity is conceptualized across disciplines.

From a different perspective, since most interior spaces are judged based on their aesthetic qualities, the pedagogies of interior design and aesthetics maintain a multifaceted relationship (Cho & Schwarz, 2015). Aesthetics in the field of interior design is understood within the context of experience. As Folkmann (2015) argues, design is perceived in terms of how it creates and stages experiences, and how these experiences are interpreted. The focus is on the characteristics of design objects and interiors, exploring how they interact with human subjects to produce meaning and experience. Design is a complex problem-solving activity in which creativity, spatial ability, and visual cognitive style are critical (Cho, 2017).

Research problem

A significant gap has been identified in the examination of recycled paper-based materials from both theoretical and empirical perspectives. Although these materials are notably used across various domains of sustainable design, such as education, art, design, construction, and textiles, their functional and aesthetic potential remains largely underestimated in both research and practice.

Research questions

In this study, two research questions have been defined:

1- What themes emerge from using recycled paper in environmental design projects?

2- How do the emerged themes differ across the dimensions of aesthetics, spatial characteristics, and creativity?

Research objectives

The aim of this study is to explore a series of environmentally focused practical design projects involving recycled paper materials, based on 'Design as a Process; Design as a Research; Design as a Knowledge' framework (Poldma, 2008). Additionally, the study identifies and analyses the key themes that emerge from the use of recycled paper in environmental design projects and examines how these identified themes vary across different dimensions, specifically aesthetics, spatial characteristics, and creativity.

Ethics consideration

For the empirical assessment using a survey, the study received Institutional Review Board (IRB) approval and obtained the required official ethical clearance from the Deanship of Scientific Research at the University of Jordan (see Appendix 1). The study also obtained consent forms signed by the survey raters after they were informed about the study's aim, procedure, benefits, and their rights, emphasizing that participation is voluntary and can be withdrawn at any time (see Appendix 2).

Methodology

To answer the research questions, mixed research methods were employed: a qualitative case study approach and a survey to empirically examine 18 design projects involving recycled paper. In an exploratory study design (Creswell, 2014), a case study can be used to explore a phenomenon that can later be tested using a survey. Additionally, case studies can help articulate survey items and scales by identifying specific variables, issues, or themes. The projects in this study were assigned to interior design students enrolled in an environmental design course at the Department of Interior Design, University of Jordan. The students were asked to explore their surrounding environment to identify potential materials for designing an environmentally green partition, as part of a new learning methodology aimed at helping them develop expertise in the functional, aesthetic, and creative aspects of environmental design. The findings have been previously published in a separate study by Mayah (2024).

Paper is one of the materials explored by the students that allows for fascinating design outcomes. The design process began with students individually exploring their surrounding environments to gain inspiration for both a material and a "concept." This central step in the design process is intended to develop a sense of meaning, maintain cohesion, and inform

a strategy to guide the creative process (Badenduck, 2024). The process also involved taking notes and sketching, writing a design statement, experimenting, reflecting, and receiving feedback until the final designs were realized. By developing their spatial skills alongside their conceptual and perceptual thinking (Suh & Cho, 2020), the students were able to successfully complete the creative tasks required for environmentally-based design. Figure (1) illustrates the students' conceptual mood boards for their environmentally based paper design projects.

Using thematic analysis for the case studies, two key themes were revealed and identified in the projects: 1) fabricated recycled paper and 2) processed recycled paper. Thematic analysis was used as an appropriate method to explore thoughts, experiences, or behaviours within the qualitative data, actively identifying patterns, meanings, or themes to address the research questions through summarization or categorization (Kiger and Varpio 2020; Clarke and Braun 2017). This approach also supports the development of a shared understanding of these meanings and helps identify new possible directions for addressing the research problem (van Leeuwen et al., 2020). While the survey design consists of three sections for collecting quantitative data: the first covers consent for participation, followed by demographic questions, then Likert-scale questions (1–6 scale), comparing the two identified themes across various dimensions, based on the Consensual Assessment Technique (CAT) proposed by Amabile (1982), aesthetics and spatial richness (see Appendix 3).



Figure (1) Mood boards representing the conceptual ideas for the environmental paper design projects.

Results

The following sections address the first research question and analytically discuss the two emerging themes in relation to the examined design projects. In this context, 'theme' is used to describe and categorize the case studies that involve the use of recycled paper in design. Themes were constructed through a multi-step process (Kiger & Varpio, 2020): First, by familiarizing with the design projects serving as case studies. Second, by generating codes through identifying cross-connections between the projects. The coding framework was based on the specific techniques used to incorporate recycled

paper in the designs. Third, by grouping the coded case studies into themes that best reflect and align with the design approaches applied. Finally, by naming the themes in a way that clearly conveys the narrative and insights derived from the coding process.

First theme: Fabricated recycled paper

The "fabricated recycled paper" theme that emerged reflects the process of assembling parts made of paper to create or invent new structures and forms. Figure (2) illustrates examples of paper projects classified under the fabricated theme. In these projects, there were no modifications or alterations made to the original nature of the paper, which was simply remodelled to create meaningful design projects. It can be noted from the three-dimensional modelling of these projects that they were characterised by smooth curves, structure, and clear boundaries. Each group of elements is relational to one another, either by direction or position. An "inactive structure" can be observed, which means that lines are conceptual and shapes flow uninterruptedly to guide the form (Wong, 1993).

The resulting forms are often nonrepresentational or abstract, detached from specific subjects or concepts. Notably, the overlap and interpenetration of multiple planes are prominent features of the fabricated paper theme, along with rippling and curling effects. Symmetry is easily achieved, as components or shapes can be created and mirrored without disturbing the overall structure. Although texture is visible, it remains smooth and soft since no substances are added to alter the paper's natural texture. The primary paper materials identified in this theme are cardboard, foam, cigarette packets, A4 paper, and cardboard paper tubes. It is important to note that the fabricated recycled paper projects also incorporated other materials to ensure the required stability of form or to enhance their aesthetic appeal. These materials included rope, composite wood, glue or silicon, colour spray, and hidden lighting. However, these materials played minor roles in the projects and did not fundamentally alter the paper material itself.

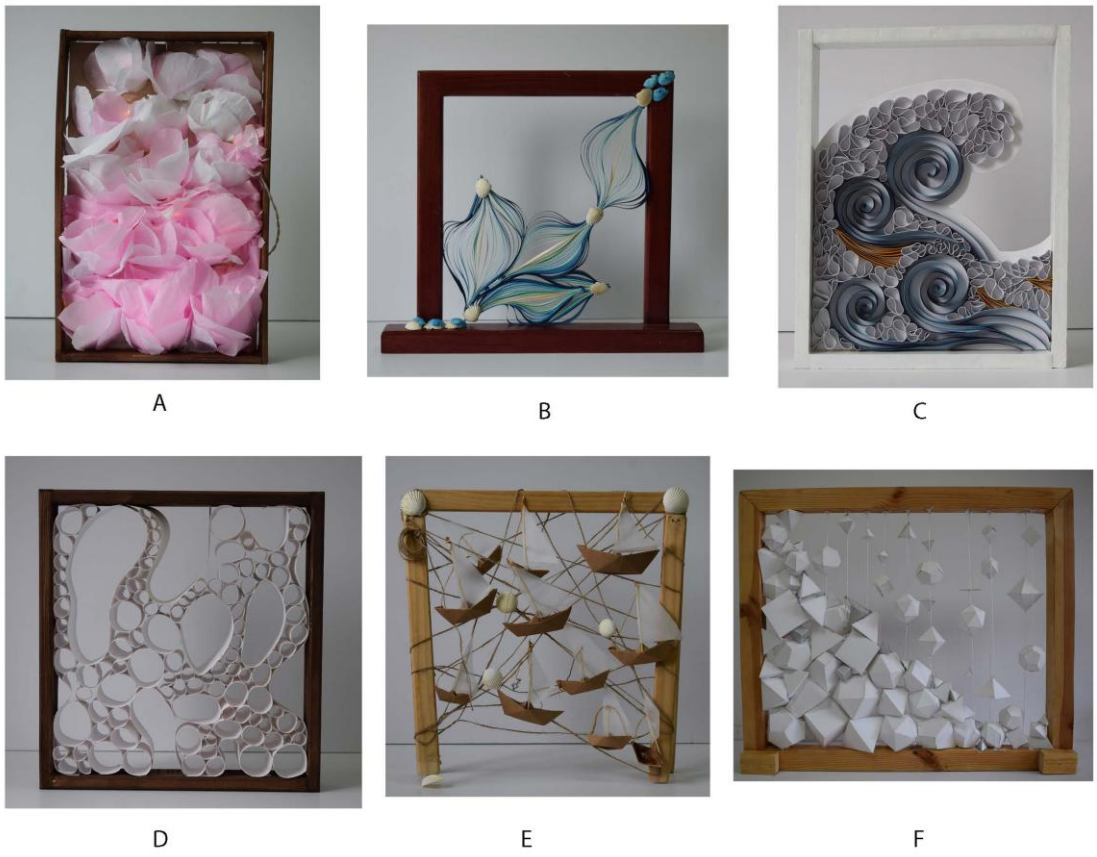


Figure (2) Recycled paper design projects under the fabricated theme

Second theme: Processed recycled paper

The second theme covers changes made to the original nature of the paper materials that result in new materials or objects, also known as recycling. Figure (3) illustrates examples of paper projects categorized under the processed theme. Here, modifications and alterations play an essential role, with wastepaper materials used to create the final product. Other materials were also added, such as water, glue, and colours, allowing for great flexibility in creating different objects and introducing subsequent changes, modifications, and transformations.

An examination of the design projects involving recycling paper materials shows that they are object-oriented, which means that each shape or component remains independent. While the lines are conceptual, they divide the form into individual subdivisions, creating an "active structure" (Wong, 1993). Unlike the fabricated paper theme, the forms of the projects involving processed paper tend to be representational, communicating recognisable subjects or concepts to viewers. Metamorphic effects, such as squeezing, pulling, and pushing, are evident in the processed paper theme.

Texture is a dominant characteristic in the processed paper projects and plays a spontaneous part of the process of visual creation (Wong, 1972). The resulting surfaces are rough and hard, providing both visible and tactile qualities (Wong, 1993). The texture can be modified and transformed based on the required concept or message of the design. In this theme, an essential component of the creation process is the making of paper pulp from such materials as newspapers, old schoolbooks, and egg cartons. The process for making the paste or clay includes shredding and soaking the paper in water for several days, blending the mixture into fine pieces, and then pressing out excess water. Materials such as gypsum powder, water, wood glue, gum Arabic, and varnish were used to maintain the consistency of the paper pulp. Framed nets or moulds were used to create and model the required shape of the paper paste. The final step involved a drying process, lasting several days. However, wrinkles might appear on the paper paste or clay during the dying, necessitating repetitions of the process to achieve successful results.

Unlike in the fabricated theme, the students tended not to cover or spray the final form with colours; rather, they added artificial colours or ink to the paper pulp so that the original shape and texture of the paper would not be affected. Experimentation with natural colours was also used in some of the projects. These initially involved the use of fruits, rose petals (e.g. from fresh roses and dried hibiscus), fresh blueberries, and spices (e.g. turmeric powder). However, although the results were promising, the students were unable to control either the amount of pigment to be used or the shade of colour they produced. Therefore, subsequent experimentations were performed with food dyes, which yielded promising results. Similar to the fabricated theme, other materials (e.g. plants, wood, and ropes) were used to add stability to the final form or to enhance the aesthetic appeal.



Figure (3) Recycled paper design projects under the processed theme

Assessment of creativity, aesthetics, and spatial qualities

To answer the second research question, the two emerging themes in the recycled paper design projects - fabricated recycled paper and processed recycled paper - were assessed based on the qualities of aesthetics, spatial characteristics, and creativity. Twelve out of the eighteen design projects were included in the assessment, with six projects selected to reflect each theme (see Figures 2 & 3). To assess creativity, we employed the Consensual Assessment Technique (CAT), proposed by Amabile (1982) as an empirical method for subjectively rating creative products rather the person or process. The CAT is based on an operational definition of creativity (Jeffries, 2017), and includes four dimensions (features): creativity, uniqueness; technical quality, and appeal. Aesthetics were assessed according to the following dimensions: beauty, emotion (impression), pleasing effect; symmetry; consistency, and meaningfulness (Cho, 2011). Additional dimensions of spatial richness used to evaluate overall creativity in the final designs included complexity, materiality and colour (Suh & Cho, 2020).

To ensure reliable and valid results, the raters included both experts from the design domain (i.e. lecturers and designers) and novices majoring in interior design (i.e. students). The creative output being assessed was a green design partition made using recycled paper. The assessment was conducted online, with assessors making their judgments independently. The selection criteria for novice participants were based on their knowledge of environmental design and its dimensions. A random sampling method was employed to select individuals who had participated in the survey and had either completed the environmental design course at the University of Jordan or were in the final stages of the course. For expert participants, random sampling was used to select lecturers and practitioners in the fields of design or interior design, all of whom were based in Jordan.

The expert raters had varying levels of experience in the fields of interior and environmental design. To protect the students' anonymity, each green partition created as part of the recycled paper design project was assigned a letter of the alphabet before assessment began. The students who designed the recycled paper projects did not participate as raters. The paper design projects were presented to each rater in a random order and were evaluated on a 1–6 scale, based on the raters' own subjective opinions and personal impressions, with no explanations of their ratings required (Kaufman et al. 2008; Jeffries 2017).

Previous studies have indicated that ten judges are sufficient to ensure reliability in CAT (Jeffries, 2017). In this study, the total number of project assessors was 100. Of these, 10% were experts (5 lectures & 5 designers), and 90% were novices (students). Among the raters, (79%) were female and (21%) were male. The majority (54%) were in the 18-21 age group, followed by (42%) in the 22-25 age group, and (2%) in the 26-30 or above category. Over (93%) of both expert and novice raters had between one and four years of study or professional experience, while (7%) had between five and ten years or more. Most participants (95%) were of Jordanian nationality. The inter-reliability of the gathered data was analysed using Cronbach's alpha test in SPSS. An acceptable reliability value is typically 0.7 or higher (Amabile & Pillemer, 2012). In this study, the overall reliability across the 14 dimensions was 0.97, indicating a high level of reliability. Subgroup reliability was 0.92 for the creative dimension (creativity, uniqueness, technical quality, liking), 0.94 for the aesthetic dimensions (symmetry, consistency, meaningfulness, beauty, emotion, pleasing), and 0.90 for the spatial dimensions (complexity, spatial richness, materiality, and colour).

Regarding validity, an independent samples t test (2-tailed) showed no significant differences ($p>0.05$) between novice and expert raters in their scores for the projects related to the fabricated theme across the different dimensions. Similarly, for the projects related to the processed theme, the results also showed no significant differences between novice and expert raters. Table (1) presents the mean comparisons between novice and expert raters for each theme and dimension.

Further analysis involved a paired comparison of the mean values for the fabricated and processed themes across all dimensions. The results showed no significant differences ($p>0.05$) between the two themes in the dimensions of uniqueness, technical quality, symmetry, spatial richness, materiality, colour, meaningfulness, emotions, and pleasing effect. However, significant differences ($p<0.05$) were found in the dimensions of creativity, liking, complexity, consistency, and beauty. Table (2) presents the comparison of rating results for the fabricated and processed themes across

the different dimensions. Notably, the fabricated theme was rated as more creative, more liked, more complex, more consistent, and more reflective of beauty. Figures (4.1), (4.2), and (4.3) illustrate the mean ratings for both themes across all dimensions.

Tabel (1) Mean comparison between novice and expert raters for the investigated projects for different dimension in each theme (fabricated & processed).

Dimension	Independent Samples T Test									
	Fabricated projects					Recycled projects				
	F	Sig.	t	df	Sig. (2-tailed)	F	Sig.	t	df	Sig. (2-tailed)
Creativity	.054	.816	.113	98	.911	2.516	.116	-1.192	98	.236
Uniqueness	.110	.741	.636	98	.526	4.066	.046	-1.058	98	.293
Technical quality	.638	.426	.450	98	.654	5.987	.016	-.773	98	.441
Liking	.034	.854	.119	98	.906	2.547	.114	-.934	98	.353
Symmetry	.023	.881	-.110	98	.912	3.228	.075	-1.162	98	.248
Complexity	.793	.375	.115	98	.909	.031	.860	-.645	98	.520
Spatial richness	.262	.610	.217	98	.829	1.964	.164	-1.330	98	.187
Materiality	.129	.720	.312	98	.755	.040	.842	-.666	98	.507
Colour	.000	.990	.481	98	.632	.167	.684	-.188	98	.851
Consistency	.701	.404	.461	98	.646	2.296	.133	-.708	98	.481
Meaningful	.279	.599	.597	98	.552	.360	.550	-.449	98	.655
Beauty	.016	.901	-.043	98	.966	.711	.401	-.613	98	.541
Emotion	.000	.998	.115	98	.909	.198	.657	-.365	98	.716
Pleasing	1.679	.198	-1.202	98	.232	3.127	.080	-1.535	98	.128

Table (2) Mean comparison of the two themes where there are significant differences in some of dimensions.

Dimension	Paired sample correlation			Paired sample test				
			Significance					Significance
	N	Correlation	Sig.	Mean	Std. Deviation	t	df	Two- Sided p
Creativity	100	.367	.000	.206	.983	2.101	99	**.038**
Uniqueness	100	.459	.000	.098	.906	1.085	99	.281
Technical quality	100	.429	.000	.178	.940	1.896	99	.061
Liking	100	.415	.000	.193	.947	2.040	99	**.044**
Symmetry	100	.561	.000	.021	.851	.254	99	.800
Complexity	100	.449	.000	.220	.923	2.383	99	**.019**
Spatial richness	100	.455	.000	.151	.969	1.565	99	.121
Materiality	100	.493	.000	-.093	.864	-1.079	99	.283
Colour	100	.342	.000	.036	1.021	.359	99	.720
Consistency	100	.397	.000	.263	.917	2.870	99	**.005**
Meaningful	100	.517	.000	-.065	.854	-.761	99	.448
Beauty	100	.429	.000	.198	.932	2.126	99	**.036**
Emotion	100	.516	.000	.018	.888	.206	99	.837
Pleasing	100	.468	.000	.095	.941	1.009	99	.316

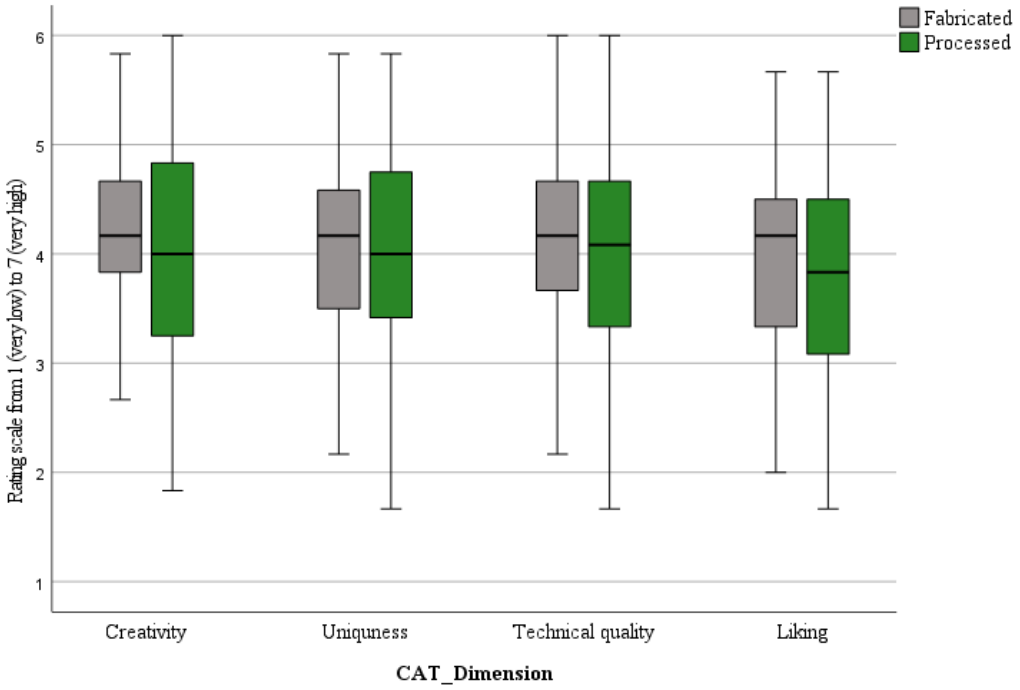


Figure (4.1) Boxplot representing the mean ratings for the investigated themes (fabricated vs. processed) for CAT dimension; rating scale from 1 (very low) to 7(very high).

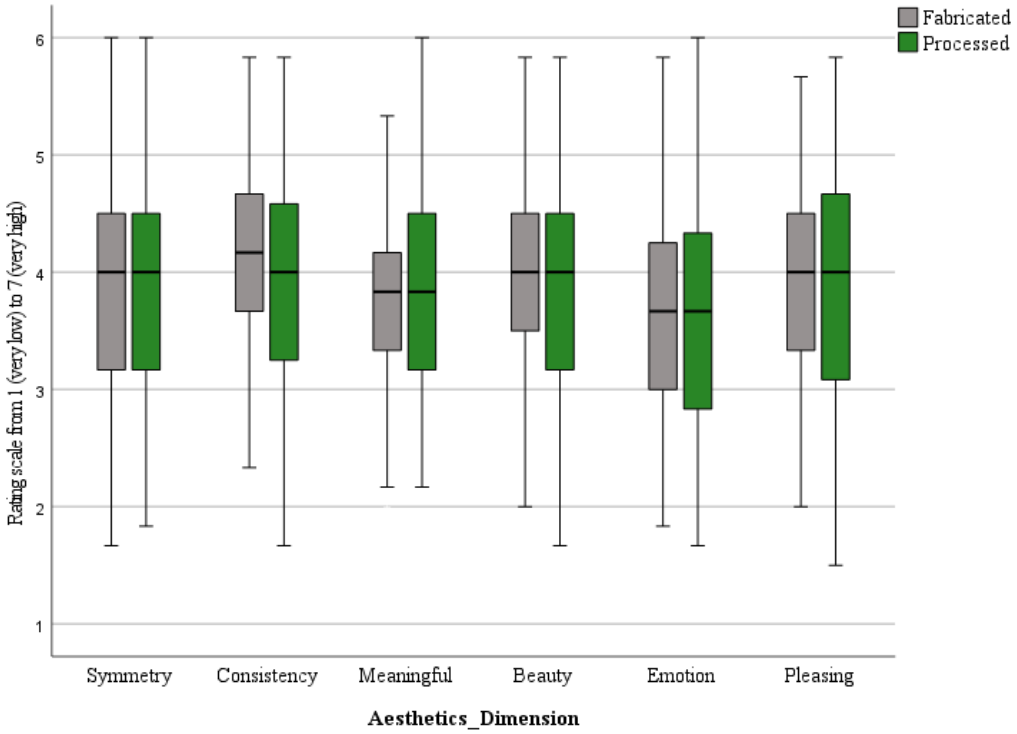


Figure (4.2) Boxplot representing the mean ratings for the investigated themes (fabricated vs. processed) for aesthetics dimension; rating scale from 1 (very low) to 7 (very high).

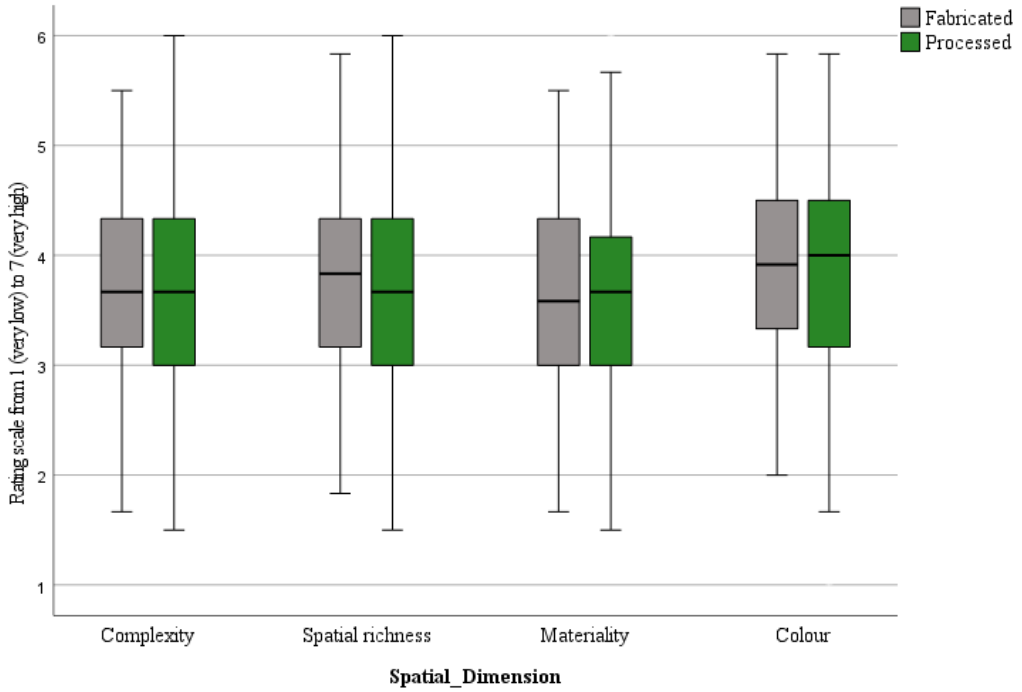


Figure (4.3) Boxplot representing the mean ratings for the investigated themes (fabricated vs. processed) for spatial dimension; rating scale from 1 (very low) to 7(very high).

Discussion

Interior design plays a special role in interdisciplinary contexts (Marshall-Baker, 2005). The constant interaction between humans and the environment activates the principles of sustainability and ecological behaviour. Interior design, therefore, evolves alongside the emergence of global environmental issues. It is not solely a 'visual discipline'; it also involves 'thinking and doing' (Poldma, 2008). Interior designers seek to positively impact human, social, and global affairs through their knowledge and designs, which serve to enhance occupants' experiences of interior built environments (Poldma, 2008).

This study focuses on the use of recycled paper materials in environmental design projects, encouraging students to adopt wise ecological behaviour based on a novel leadership model in sustainability. In such projects, interior designers become 'reflective and reflexive' practitioners (Poldma, 2008). After exploration of the projects, two themes emerged: fabricated recycled paper and processed recycled paper. The fabricated theme relates to the assembling of paper materials based on a certain concept to form a structure or form. In this case, no changes were made to the original nature of the paper, and no new substances were added. As such, the degree of fabrication is limited, as the project depended on the versatility of paper and its natural fibres. Parametric fabrication was the general design employed in the projects related to this theme, which is a creative process used to manipulate structures and forms into certain patterns. However, it is important to note that the students did not create the parametric designs in these projects using computer algorithms but employing their manual skills and their imaginations. One key advantage of using fabrication methods in paper-based designs is the stability it affords. The project results analysed in this study generally featured a high degree of rigidity and durability, which supports the use of this method in large-scale paper projects, such as designing an environmental partition. Furthermore, the time required to make the fabricated paper projects was reasonable compared to the longer duration needed by the projects involving processed paper. Besides offering functionality, the projects were also pleasing to the eye, creative, and unique. Each project's harmonious appearance – its shapes, colours, and textures – evoked positive emotions and meanings. Each project symbolises cognitive unity both in terms of its functionalism and aesthetics.

The processed theme, in contrast, relates to projects that involved changing the original nature of paper so that it could be formed to produce the desired design. The addition of new substances (e.g. water, glue and /or flour) was essential to the success of the recycling process. One advantage of using processed paper is that it allows the creation of challenging shapes or forms that are difficult to produce only using fabricated materials. Paper paste offers great flexibility and plasticity for bending and compressing. Moreover, there was a great deal of interaction between the students and their projects throughout the making and experimenting processes, with the students spending extensive time exploring the recycling processes. However, some constraints were found in relation to this theme based on the students' experiences. Time is a key factor in design projects during an academic semester. Indeed, the students were required to finish the design project by a certain deadline. The experimenting process to turn the paper paste into the desired softness involved waiting a couple of days for the mixture to dry, before testing whether it was rigid enough to ensure durability. In addition, the dried paper paste could have wrinkles and eventually be subject to breakage. Furthermore, colours needed to be added (either natural or artificial) to achieve the right pigment and shade of the coloured paper paste, which added an extra challenge. From an aesthetic perspective, the projects under this theme succeeded in presenting unique shapes, forms, and colours that evoke feelings and meaning. The efforts put into making the design projects can be seen in the unity and harmony achieved in the final products. The multiplication technique, which involves creating the same shape more than once, can be seen in all of the design works (Wong, 1993). Repetition, whether with connected or disconnected shapes, was a notable feature of both themes. Additionally, organic shapes were to be found across both themes.

Regarding the empirical assessment, the Consensual Assessment Technique (CAT) was applied as a reliable method for evaluating creativity. This tool was able to correlate the objective features of the recycled paper projects with subjective judgments of creativity (Amabile, 1982). The involvement of interior designers familiar with paper projects ensured objective agreement on the perceptions of product features. Furthermore, no significant differences ($p>0.05$) were found between the novice and expert raters in their assessments of projects under each theme across different dimensions. This strengthened the validity and reliability of the results.

In the empirical comparison between the two themes, a paired sample t-test found no significant differences ($p > 0.05$) in the ratings of uniqueness, technical quality, symmetry, spatial richness, materiality, colour, meaningfulness, emotion, and pleasing effect. However, significant differences ($p<0.05$) were found between the two themes, with the fabricated theme receiving higher ratings in creativity, liking, complexity, consistency, and beauty. This finding has important implications for design projects involving recycled paper, suggesting that designers could intensify their efforts to create more sophisticated projects within this theme.

The implications of the study findings for current developments span several key areas. Firstly, there are both theoretical and practical implications. The study promotes recycling practices on university campuses by using wastepaper as part of a place-based learning approach that connects environmental awareness with education. The use of practice-based design projects, adapted to explore recycled paper, supports learning theories related to design, the environment, and sustainability. This study contributed to increasing students' awareness of current environmental issues through the application of experimental methods in environmental education. The effectiveness of this approach is demonstrated through the creation of environmentally friendly partitions that reflect both functional and aesthetic values in interior design.

Secondly, there are methodological and future research implications. The use of an exploratory study design, incorporating both case studies and surveys, allowed subjective and objective perspectives to complement each other in examining the use of recycled paper materials in environmental design projects for interior design. This approach opens new avenues for future research, where the identified themes and scientific findings can guide further development and application of recycled paper across a wide range of design strategies. Additionally, the CAT framework proposed by Amabile (1982) has been expanded into a new line of inquiry, in which environmental projects in interior design are examined through multiple dimensions of creativity, aesthetics, and spatial quality.

Thirdly, there are educational policy implications. Based on the findings of this study, educational institutions, particularly those with design-focused departments, should consider incorporating the subject matter and methodologies

presented into their curricula. As previously noted, achieving the United Nations' sustainability goals requires urgent action to address the climate crisis and its impacts. This study supports a zero-waste approach by promoting the use of recycled paper as a sustainable material, employed in the creation of functional and aesthetically appealing green wall partitions. This represents an eco-friendly strategy that can contribute to sustainability practices in interior design education.

The use of recycled paper materials in environmental design projects has the potential to promote more sophisticated, effective, and creative standards in the architecture and interior design industries. As a sustainable material, paper (especially recycled paper) offers high levels of functionality and aesthetic value. Its eco-friendly properties are compatible with global initiatives to develop sustainable and zero-waste approaches to reducing greenhouse gas emissions and creating healthy indoor environments. Nevertheless, the aesthetics and performance of sustainable materials need to be further developed to increase their adoption in sustainable environmental interior design (Alfuraty, 2020). In this study, the fabricated themed projects were rated as more creative, likable, and beautiful, potentially influenced by their parametric design and fabrication features. The generated geometries and structures are visually unique and attention-capturing; however, their performance requires usability testing and expert evaluation to assess comfort and durability. A computer algorithm approach is also encouraged for parametric fabrication projects.

Future quantitative studies are recommended to focus on experimenting with the strength of paper fibre and recycling processes. In the processed theme, changing the intrinsic nature of paper was dominant to reach to high flexibility in bending for creating challenging shapes and forms. Therefore, the type and properties of the fibre used are crucial for a successful recycling process, as the structural integrity of recycled paper declines over time. Additionally, life cycle assessment (LCA) is required to evaluate the potential impact of the real-world design projects on the environment, society, and the economy (Rodrigues et al., 2022).

Large-scale projects should be undertaken to test the durability, stability, and usability of recycled paper materials in real-world environments. In this context, large-scale refers to human-scale projects that can be integrated with other architectural and interior elements such as furniture, lighting, and landscape features. In the present study, the projects were designed at a relatively small scale, with dimensions of 1.20 m in height, 0.70 m in width, and 0.20 m in depth, and were not related to any specific building elements. Accordingly, human-scale projects contribute to more relatable designs that are oriented toward users' needs, spatial experiences, and interactions with objects.

Finally, educators should prepare future designers to solve interdisciplinary problems by promoting both breadth and depth of knowledge and by strengthening the bridge between education and practice (Guerin and Thompson 2004). As the interior design profession grows ever more complex, curricula must incorporate such subjects as sustainable design, structure, universal design codes, and mechanical systems. These design project foster the development of essential skills such as critical thinking, problem-solving, and design communication (Guerin and Thompson 2004).

Limitations

This study has potential limitations related to contextual factors, which may be influenced by specific cultural, institutional, and environmental conditions. The current research focused on environmental recycled-paper design projects created by interior design students at the University of Jordan. To enhance generalisability in environmental design research, it would be beneficial to examine different contexts that reflect diverse cultural and environmental backgrounds. Additionally, another limitation lies in the evaluation framework employed. This study relied on the Consensual Assessment Technique (CAT), proposed by Amabile (1982), to empirically evaluate the projects. However, alternative techniques may also be effective for empirical evaluation in environmental design. A further limitation lies in the type of recycled paper and the properties of its fibers used in this study; identifying and characterizing these materials would help ensure functional performance and durability in environmental design. Lastly, current environmental projects have been designed independently, without reference to specific interior contexts, thereby limiting the depth of spatial experience, the integration of external stimuli, functional adaptability, and the potential to influence behavioural change.

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Data availability statement

The data that support the findings of this study are available from the corresponding author [Dr. Eman Mayah], upon reasonable request.

Disclosure statement

No potential conflict of interest was reported by the author.

REFERENCES

Abdulmunem, A. R., Hussein, N. F., Samin, P. M., Sopian, K., Hussien, H. A., & Ghazali, H. (2023). Integration of recycled waste paper with phase change material in building enclosure. *Journal of Energy Storage*, *64*. https://doi.org/10.1016/j.est.2023.107140

Alfuraty, A. B. (2020). Sustainable Environment in Interior Design: Design by Choosing Sustainable Materials. *IOP Conference Series: Materials Science and Engineering*, *881*(1). https://doi.org/10.1088/1757-899X/881/1/012035

Amabile, T. M. (1982). Social Psychology of Creativity: A Consensual Assessment Technique. *Journal of Personality and Social Psychology*, *43*(5), 997–1013.

Amabile, T. M., & Pillemer, J. (2012). Perspectives on the social psychology of creativity. *Journal of Creative Behavior*, *46*(1), 3–15. https://doi.org/10.1002/jocb.001

Architecture2030. (2023). *WHY THE BUILT ENVIRONMENT?* Architecture 2030. https://architecture2030.org/why-the-building-sector/#:~:text=The built environment generates 40,for an additional 13%25 annually.

Badenduck, N. (2024). Nebulous, Abstract, Elusive: Examining Design Concepts Within Interiors Practice and Pedagogy. *Journal of Interior Design*, *49*(2), 75–81. https://doi.org/10.1177/10717641231202472

Bakraoui, M., El Gnaoui, Y., Lahboubi, N., Karouach, F., & El Bari, H. (2020). Kinetic study and experimental productions of methane production from UASB reactor treating wastewater from recycled pulp and paper for the continuous test. *Biomass and Bioenergy*, *139*. https://doi.org/10.1016/j.biombioe.2020.105604

Blamires, M., & Peterson, A. (2014). Can creativity be assessed? Towards an evidence-informed framework for assessing and planning progress in creativity. *Cambridge Journal of Education*, *44*(2), 147–162. https://doi.org/10.1080/0305764X.2013.860081

Bon, D. C., Okada, D. Y., & Coneglian, C. M. R. (2022). Benefits of biological additive inoculation in the treatment of effluent from the paper recycling industry. *Journal of Water Process Engineering*, *50*. https://doi.org/10.1016/j.jwpe.2022.103269

Cho, J. Y. (2011). Understanding the Process of Aesthetic Education in Design Studios: Toward a New Framework for the Pedagogy of Aesthetics. *IDEC 2011 ANNUAL CONFERENCE*, 208–211.

Cho, J. Y. (2017). An investigation of design studio performance in relation to creativity, spatial ability, and visual cognitive style. *Thinking Skills and Creativity*, *23*, 67–78. https://doi.org/10.1016/j.tsc.2016.11.006

Cho, J. Y., & Schwarz, B. (2015). Aesthetic theory and interior design pedagogy. In *The Handbook of Interior Design* (pp. 478–

496). wiley. https://doi.org/10.1002/9781118532409.ch28

Clarke, V., & Braun, V. (2017). Thematic analysis. In *Journal of Positive Psychology* (Vol. 12, Issue 3, pp. 297–298). Routledge. https://doi.org/10.1080/17439760.2016.1262613

Cole, L. B., Priscilla, L., Zangori, L., Kania-Gosche, B., & Burken, J. (2024). Raising the Green Roof: Enhancing Youth Water Literacy through Built Environment Education. *Sustainability (Switzerland)* , *16*(10). https://doi.org/10.3390/su16104262

Creswell, J. W. (2014). *Research design: qualitative, quantitative, and mixed method approaches* (C. Thousand Oaks (ed.); Fourth). SAGE.

Dedieu, L., & Plé, E. (2023). A sustainable development project including a role-play: analysis of teachers' intentions to promote students' engagement. *Environmental Education Research*, *29*(8), 1104–1117. https://doi.org/10.1080/13504622.2023.2185573

Folkmann, M. N. (2015). Aesthetic coding in interior design. In *The Handbook of Interior Design* (pp. 97–111). wiley. https://doi.org/10.1002/9781118532409.ch6

Fu, J., Yang, F., Cheng, F., & Guo, Z. (2022). Preparation of an electrically conductive, flame-retardant, and superhydrophobic recycled paper. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, *642*. https://doi.org/10.1016/j.colsurfa.2022.128671

Geller, E. S., Chaffee, J. L., & Ingram, R. E. (1975). Promoting Paper Recycling on a University Campus. *Journal of Environmental Systems*, *5*(1), 39–57. https://doi.org/10.2190/E2LM-JNTV-NBJ6-ETJF

Gentenaar, P. (2015). *Paper Art II*. Artpower International Publishing.

Habchi, S., Lahboubi, N., Karouach, F., Naim, I., Lahlou, Y., Bakraoui, M., Sallek, B., & El Bari, H. (2022). Effect of Thermal Pretreatment on the Kinetic Parameters of Anaerobic Digestion from Recycled Pulp and Paper Sludge. *Ecological Engineering and Environmental Technology*, *23*(1), 192–201. https://doi.org/10.12912/27197050/143568

Han, N., Zhang, J., Hoang, M., Gray, S., & Xie, Z. (2021). A review of process and wastewater reuse in the recycled paper industry. In *Environmental Technology and Innovation* (Vol. 24). Elsevier B.V. https://doi.org/10.1016/j.eti.2021.101860

Hasling, K. M. (2018). Perspectives on the role of materials in sustainable product design education. *Temes de Disseny*, *34*, 104–115. https://doi.org/10.46467/tdd34.2018.104-115

Hurst, G., Ahmed, A., Taylor, S., & Tedesco, S. (2023). Anaerobic digestion of recycled paper crumb and effects of digestate on concrete performance. *Renewable Energy*, *208*, 577–582. https://doi.org/10.1016/j.renene.2023.03.061

Hussein, M. F. (2012). The Ideal Usage of Sustainable Materials and Local Resources of the Interior Space Design in Jordan. In *Journal of Civil Engineering and Architecture* (Vol. 6, Issue 6).

Ison, M., & Bramwell-Lalor, S. (2023). The arts in environmental education: connecting learners with their talents and nature. *Environmental Education Research*, *29*(7), 964–979. https://doi.org/10.1080/13504622.2023.2205062

Jeffries, K. K. (2017). A cat with caveats: Is the consensual assessment technique a reliable measure of graphic design creativity? *International Journal of Design Creativity and Innovation*, *5*(1–2), 16–28. https://doi.org/10.1080/21650349.2015.1084893

Kalafati, M., Flogaiti, E., & Daskolia, M. (2025). Enhancing preschoolers' creativity through art-based environmental education for sustainability. *Environmental Education Research*, *31*(1), 46–73. https://doi.org/10.1080/13504622.2023.2291319

Karana, E., Barati, B., Rognoli, V., & Zeeuw van der Laan, A. (2015). Material driven design (MDD): A method to design for material experiences. *International Journal of Design*, *9*(2), 35–54.

Kaufman, J. C., Baer, J., Cole, J. C., & Sexton, J. D. (2008). A comparison of expert and nonexpert raters using the consensual assessment technique. *Creativity Research Journal*, *20*(2), 171–178. https://doi.org/10.1080/10400410802059929

Kiger, M. E., & Varpio, L. (2020). Thematic analysis of qualitative data: AMEE Guide No. 131. *Medical Teacher*, *42*(8), 846–854. https://doi.org/10.1080/0142159X.2020.1755030

Kozlowski, B. (2017). *If all paper cannot be made from 100% recycled fiber, what should we use?* GreenBiz. https://www.greenbiz.com/article/if-all-paper-cannot-be-made-100-recycled-fiber-what-should-we-use

Leong, S., & Qiu, X. L. (2013). Designing a "creativity and assessment scale" for arts education. *Educational Psychology*, *33*(5), 596–615. https://doi.org/10.1080/01443410.2013.827154

Lore, V., Bois, E. Du, Sara, H., Karen, V. K., & Kim, R. (2017). Design from Recycling. *The International Conference 2017 of the Design Research Society Special Interest Group on Experiential Knowledge (EKSIG)*, 129–143.

Marshall-Baker, A. (2005). Knowledge in interior design. *Journal of Interior Design*, *31*(1), xiii–xxi. https://doi.org/10.1111/j.1939-1668.2006.tb00412.x

Mayah, E. K. (2024). Implementation of a Practical Environmental Sustainable Design Project in Interior Architectural Education: A Case Study at the University of Jordan . *Dirasat: Human and Social Sciences*, *51*(6). https://doi.org/10.35516/hum.v51i6.5

McKinney, R. (1994). *Technology of Paper Recycling* (1st ed.). Springer Dordrecht.

Mohsen, M. S., & Matarneh, R. (2023a). Exploring the Interior Designers' Attitudes toward Sustainable Interior Design Practices: The Case of Jordan. *Sustainability (Switzerland)*, *15*(19). https://doi.org/10.3390/su151914491

Mohsen, M. S., & Matarneh, R. (2023b). Exploring the Interior Designers' Attitudes toward Sustainable Interior Design Practices: The Case of Jordan. *Sustainability (Switzerland)*, *15*(19). https://doi.org/10.3390/su151914491

Nations, U. (2023). *Sustainable Development Goals: Goal 13: Take urgent action to combat climate change and its impacts*. United Nations. https://www.un.org/sustainabledevelopment/climate-change/

Orchard, C., Crutchett, T., & Moloney, D. (2025). The 'Understories' installations: a creative practice-based case-study in environmental education. *Environmental Education Research*, 1–22. https://doi.org/10.1080/13504622.2025.2527835

Polášková, M. (2023). *Climate Change*. People in Need. https://climate.peopleinneed.net/climate-change?gclid=EAIaIQobChMIpbXXyLmhgAMVvQwGAB0-LgncEAAYAiAAEgKtFfD_BwE#degrees-of-global-warming

Poldma, T. (2008). Interior design at a crossroads: Embracing specificity through process, research, and knowledge. *Journal of Interior Design*, *33*(3), vi–xvi. https://doi.org/10.1111/j.1939-1668.2007.tb00547.x

Redlich, C. A., Sparer, J., & Cullen, M. R. (1997). Sick-building syndrome. *The Lancet*, *349*(9057), 1013–1016.

Rodrigues, I., Mata, T. M., & Martins, A. A. (2022). Environmental analysis of a bio-based coating material for automobile interiors. *Journal of Cleaner Production*, *367*. https://doi.org/10.1016/j.jclepro.2022.133011

Suh, J., & Cho, J. Y. (2020). Linking spatial ability, spatial strategies, and spatial creativity: A step to clarify the fuzzy relationship between spatial ability and creativity. *Thinking Skills and Creativity*, *35*. https://doi.org/10.1016/j.tsc.2020.100628

van Leeuwen, J. P., Rijken, D., Bloothoofd, I., & Cobussen, E. (2020). Finding New Perspectives through Theme Investigation. *Design Journal*, *23*(3), 441–461. https://doi.org/10.1080/14606925.2020.1744258

Wang, B. (2021). Interior decoration design and ecological reconstruction based on ecological energy saving technology. *Energy Reports*, *7*, 49–61. https://doi.org/10.1016/j.egyr.2021.10.054

Wong, W. (1972). *Principles of Two-Dimensional Design* . John Wiley & Sons,Inc.

Wong, W. (1993). *Principles of form and design*. John Wiley & Sons,Inc.

Yan, L. (2022). An Analysis on Sustainable Development of Interior Design. *Proceedings of the 2022 3rd International Conference on Language, Art and Cultural Exchange (ICLACE 2022)*, *673*(Iclace), 342–346. https://doi.org/10.2991/assehr.k.220706.069

Zangori, L., & Cole, L. (2019). Assessing the contributions of green building practices to ecological literacy in the elementary classroom: an exploratory study. *Environmental Education Research*, *25*(11), 1674–1696. https://doi.org/10.1080/13504622.2019.1662372