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Implementation of a Practical Environmental Sustainable Design Project in Interior Architectural Education: A Case Study at the University of Jordan

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Abstract

Objectives: The purpose of this study is to discuss the implementing of a practical project as a new learning methodology to help students develop expertise in the functional, aesthetic, and creative aspects of environmental design.

Methods: The research is qualitative in design and based on a case-study approach, in which sixty-three environmental practical projects were explored. The examined design projects were conducted by interior design students at the department of visual arts of the University of Jordan as part of an environmental design course during three semesters in 2022.

Results: Nine themes emerged from the study, which were interpreted based on the selecting and processing of materials (either recycled or adapted from the local environment). These materials comprised recycled plastic, recycled paper, recycled metal, recycled wood, recycled glass, recycled threads, resin, ceramic, and plants. The study also found that working with and processing local or recycled materials in practical projects within the study curriculum helped students acquire skills and gain confidence in relation to environmental practice, and increased their awareness of the different usages of materials and their advantages from both a functional and aesthetic perspective.

Conclusions: The significance of the study lies in its adoption of a practical approach as a new active learning methodology within art and design educational programmes to meet the current educational standards stipulated by the Ministry of Higher Education and Scientific Research in Jordan. Real-world projects foster students' development of critical creativity to achieve the ultimate principles of environmental design and prepare them to deal with real challenges within the professional job market.

Keywords: Environmental design, sustainability, practical approach, materials, interior architectural education.

تطبيق مشروع تصميم بيئي عملي مستدام في التعليم المعماري الداخلي: دراسة حالة في الجامعة الأردنية

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ملخّص

الأهداف: الغرض من هذه الدراسة هو مناقشة تنفيذ مشروع عملي كمنهجية تعليمية جديدة؛ لمساعدة الطلاب لتطوير خبراتهم في الجوانب الوظيفية والجمالية والإبداعية للتصميم البيئي.

المنهجية: جرى استخدام المنهج النوعي لملاءمته لموضوع البحث، والاعتماد على منهجية دراسة الحالة؛ حيث تم استكشاف ثلاثة وستين مشروعًا عمليًا بيئيًا، وقد تم تنفيذ مشاريع التصميم المدروسة من قبل طلاب التصميم الداخلي في قسم الفنون البصرية في الجامعة الأردنية كجزء من مساق التصميم البيئي خلال ثلاثة فصول دراسية في العام (2022م).

النتائج: كشفت الدراسة عن ظهور تسعة محاور تم تفسيرها بناءً على اختيار ومعالجة المواد المستخدمة (سواء المعاد تدويرها، أو المتبناة من البيئة المحلية): البلاستيك المعاد تدويره، الورق المعاد تدويره، المعادن المعاد تدويرها، الخشب المعاد تدويره، الزجاج المعاد تدويره، الخيوط المعاد تدويرها، الراتنج، السيراميك والنباتات. كما وجدت الدراسة أن العمل مع المواد المحلية، أو المعاد تدويرها ومعالجتها في مشاريع عملية ضمن منهج الدراسة يساعد الطلاب على اكتساب الثقة والمهارات فيما يتعلق بالممارسات البيئية، ويزيد من الوعي بالاستخدامات والمزايا المختلفة للمواد من الناحيتين الوظيفية والجمالية.

الخلاصة: تكمن أهمية الدراسة في اعتماد المنهج العملي كمنهجية جديدة للتعلم النشط ضمن المساقات التعليمية للفنون والتصميم؛ وذلك لتلبية المعايير التعليمية الحالية التي تتطلبها وزارة التعليم العالي والبحث العلمي في الأردن؛ إضافة إلى تعزيز الإبداع النقدي لدى الطلبة لتحقيق المبادئ الكلية للتصميم البيئي، ومساعدتهم على التعامل مع التحديات الحقيقية في سوق العمل المهني.

الكلمات الدالة: التصميم البيئي، الاستدامة، النهج العملي، المواد، التعليم المعماري الداخلي.

Introduction

Jordan's Ministry of Higher Education and Scientific Research made a serious call to the country's universities to develop academic programs that align Jordan's educational outputs with the needs of the labor market. At the micro level, a thoughtful strategic plan is being developed by the University of Jordan to meet the rapidly changing societal needs. The university is developing its educational programs to be more effective, influential, and diversified to face many aspects of the current and future global concerns, including climate change.

With this perspective, the Environmental Design course at the University of Jordan's College of Art and Design is being developed to align with the pedagogies of environmental design and aspects of sustainability. The course aims to identify the fundamental components of the environmental design process, and their impact on interior design methods, including energy conservation and the use of environmentally friendly materials and techniques. Furthermore, students explore the relationship between buildings and their surroundings to help find the best building orientation in relation to sun and wind factors.

However, in the past, all of the aforementioned subjects were only studied in a theoretical form, without focusing on how much students really know about the environment that they are occupying. As the epistemology of any place includes assessing, knowing about, and acting in a real-world environment, the course lacked a well-established (or any) relationship with the process by which students know about and perceive their surrounding environment. Therefore, there is a crucial need to take a practical approach to design, or a practice-based pedagogy, in order to help students understand their environment and gain the skills required to enter the labor market.

The present study discusses the incorporation of a practical environmental project into the academic curriculum of the environmental design course at the Faculty of Art and Design at the University of Jordan. The academic discipline of interior architectural design is viewed as a creative discipline aimed at solving the problems encountered in the built environment. It aims to shape a comfortable, satisfying, and meaningful environment for the occupants. To overcome the practical and societal issues stemming from the global environmental problems, design disciplines need to be developed so as to include both theoretical and practical aspects.

This study presents certain actions taken to ensure the role of design in academia to raise awareness of environmental issues. Local and recycled materials were explored and implemented in creative practical projects that reflect a strong understanding of our surrounding environment and consider an effective approach to gain the practical skills needed for the labor market.

The role of interior architectural design is extraordinary. The practice is associated with establishing buildings that protect human beings from spatial and climatic variables. Its practitioners seek to provide the human needs for safety and comfort to be able to proceed with physical functions and activities. Interior architectural design is concerned with providing solutions to issues and challenges faced in the built environment in relation to its surroundings. The scale of a building, as well as its air circulation, ventilation, thermal comfort, and chosen materials, are all part of the considerations when designing a building to meet the needs of its environment.

Research Problem

Practice-based projects are not a central part of learning and teaching in the Environmental Design course at the University of Jordan. One concern raised by interior design students at the university relates to the absence of practical projects in the environmental design course. Hence, the course curriculum needs to be improved in order to meet the new standards required of educational programs. Students should acquire the real-life skills demanded by the labor markets. This study presents the process of implementing a practical project in an interior design course, for which students were required to conduct a real-world environmental design project that considered environmental, functional, and aesthetic aspects. The study set out to address the following questions:

1- What educational design processes have been employed in implementing practical environmental design projects at the University of Jordan?

2- How does a practice-based approach through design projects develop the academic curriculum?

3- How did the interior design students at the University of Jordan explore the environmental aspects of their practical design projects?

Significance of the Research

Theoretical approaches to learning and teaching in design courses have come into question in both the academic and the professional realm. Such an approach lacks the application of knowledge in real-world settings and overlooks aspects relating to doing and experiencing within a certain context. The importance of practice in design courses is that it encourages the mental process of learning, in which students are encouraged to question, analyze, act, and create based on what they are seeking to construct and how they interact with their environment. A practice-based approach is highly experiential, whereby students acquire knowledge through observation and real-world experience.

The significance of this study is that it presents a new learning methodology that focuses on the aspects of functionality, aesthetically, and creativity in environmental design. The proposed method incorporates responsive ways of thinking and doing using either local materials or materials recycled from the surrounding environment while designing an environmental partition. The study also sought to demonstrate how personal practices of experimenting and reflecting can help students to acquire the skills required for the labour market and meet the standards set out by The Ministry of Higher Education and Scientific Research in Jordan in developing academic curricula.

Research Objectives

- Document the educational design process implemented for a practice-based project in an environmental design course at the University of Jordan's Faculty of Art and Design.
- Understand the benefits of a practice-based approach in developing an interior architectural design curriculum.
- Recognise potential materials from the local environment, and the ways to employ them in useful projects that meet the functional and aesthetical characteristics required for a practical environmental design project.

Research Hypothesis

Today's competitive world requires innovative programs that help to build skilled students. Therefore, a practical approach that includes design or practice-based projects in learning and teaching environmental design is playing an important role in increasing students' awareness of their surrounding environments and prepare them with the necessary life skills to enter the labor market.

Research Boundaries

The study involved case studies based on an environmental design course at the University of Jordan's Visual Arts Department in the Faculty of Arts and Design during the three academic semesters of 2022.

Methodology

The study employed a qualitative research design based on a case study approach as a design of inquiry. The study involved an in-depth exploration of 63 students' projects conducted over three semesters during the 2022 academic year in the University of Jordan's Visual Arts Department in the Faculty of Arts and Design. The study collected detailed information using different procedures, such as models, photographs, sketches, and writings. Based on the analysis, nine potential themes emerged, and three samples for each theme were presented and interpreted. The case study approach was selected due to the nature of the cases, which are design models (objects) based on the students' experiences and perceptions.

One of the advantages of conducting practical projects at the University of Jordan is that they enable each student to embark on their own learning journeys in the creative process. Nevertheless, all of the students followed the same

educational process when conducting their design projects, as shown in Figure 1. The first stage included asking the students to observe their local environments for potential materials that could be used in their projects. Individual site visits to their neighborhoods were aimed at giving the students the opportunity to look for and explore materials that might be recycled. This process is pivotal in raising students' awareness of materials. Furthermore, this process stimulates students' imaginations by encouraging them to think of ways to work with the materials and the potential results.

The second stage involved looking for inspired ways to use the collected materials in the design project. Here, written statements about concepts are generalized to help direct the project to reach to a unique result. The concept part of these statements includes a mood board that shows the written statements, sketches, and photographs that help to explain the ideas (see Figure.2). Furthermore, the students were introduced to advanced theory relating to environmental design, followed by multiple documentary videos about materials, in particular plastics, and the potential recycling processes that could be applied to achieve maximum benefit.

The third stage involves the process of shaping the project into its initial form. Here, the principles of composition in design are implemented, such as repetition, contrast, alignment, proximity, balance, and proportion, along with color theory. The final stage is about creation, where the skills of modelling and application are developed. These stages aligned with the educational process in terms of implementing practicality in interior design projects.

The main aims of the assigned project were: 1) to identify the basic aspects of environmental design and their impact on interior design methods; 2) to identify environmentally friendly materials and their various technologies, and acquire the ability to employ them in interior design; 3) To develop students' imaginative abilities and their capacities to draw inspiration from the local natural environment; 4) to endow students with technical and artistic skills, and expand their awareness in the specialized field; 5) to employ environmentally friendly materials in a practical design project that highlights the aesthetic aspects of art and design.

The project brief was to design an environmental wall that would function as an interior partition. It was to be a vertical structure made from sustainable materials and/or covered with vegetation. The dimension of the partition must be 3m in height, 2m in width, and 30cm in depth. The students were free to choose the scale of the model based on their chosen materials. The environmental wall design should reinforce the relationship between the internal and the external environment, while maintaining the functional and aesthetical requirements.

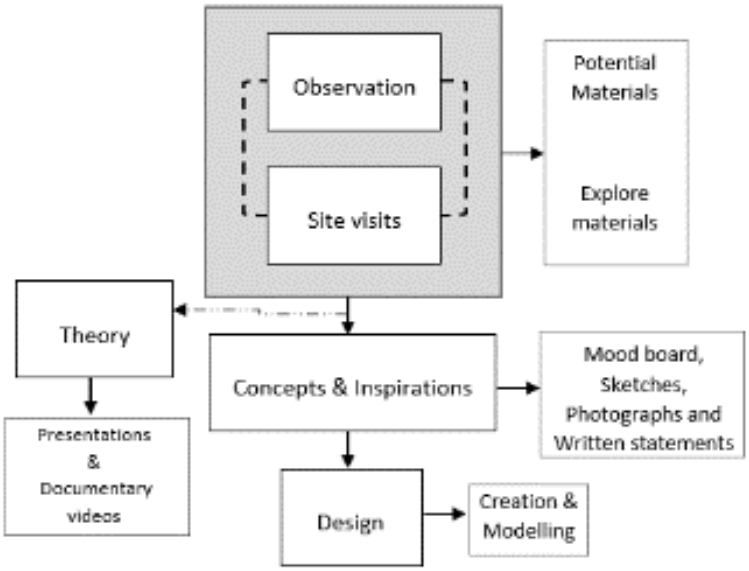
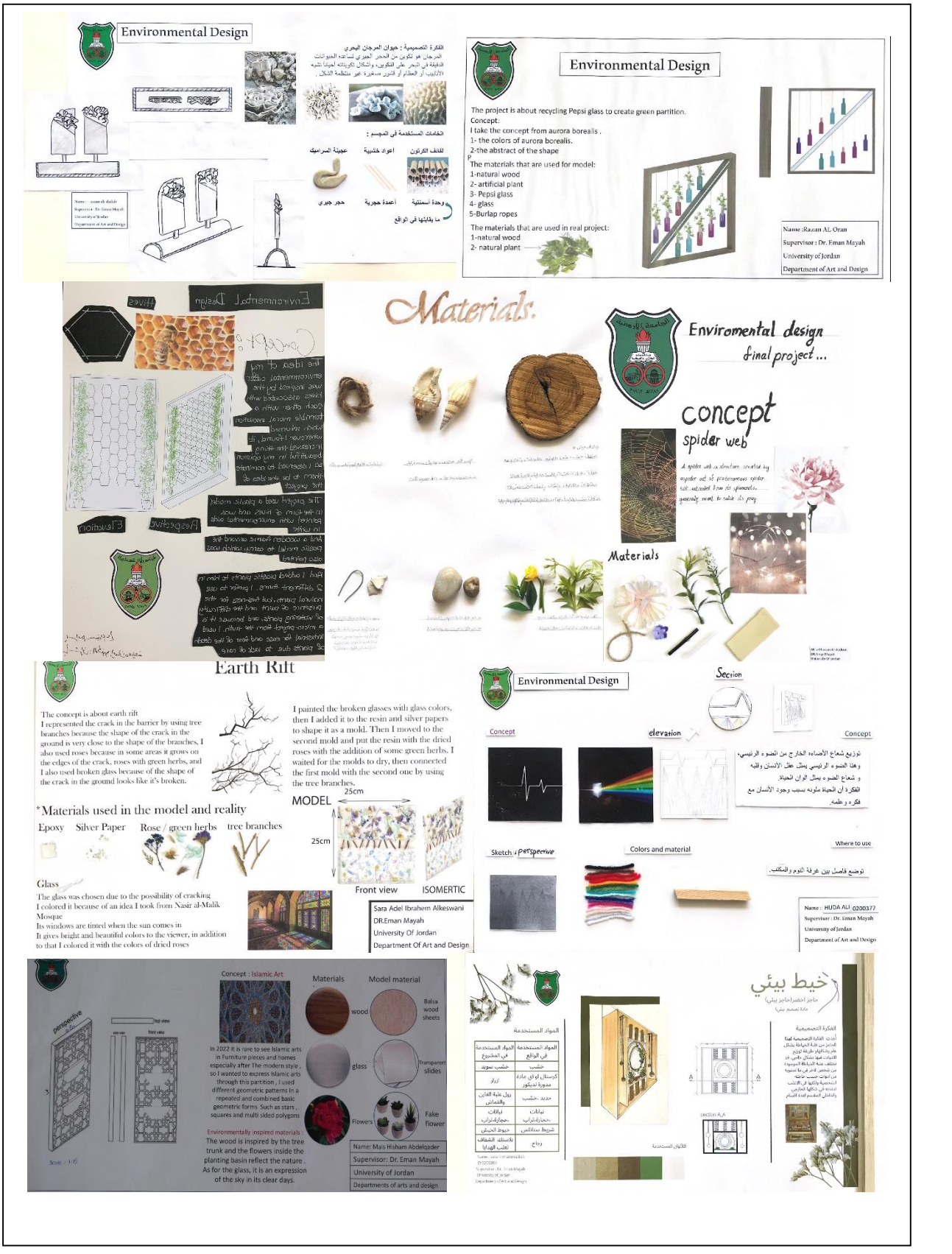


Figure 1 Educational design process for conducting practical environmental projects at the University of Jordan


Environmental Design
Environmental Design
The project is about recycling Pepsi glass to create green partition.
Concept:
I take the concept from aurora borealis .
1- the colors of aurora borealis.
2-the abstract of the shape
The materials that are used for model:
1-natural wood
2- artificial plant
3- Pepsi glass
4- glass
5-Burlap ropes
The materials that are used in real project:
1-natural wood
2- natural plant
Name :Razan AL Oran
Supervisor : Dr. Eman Mayah
University of Jordan
Department of Art and Design
Materials.
Enviromental design
final project...
concept
spider web
Materials
Earth Rift
The concept is about earth rift
I represented the crack in the barrier by using tree branches because the shape of the crack in the ground is very close to the shape of the branches, I also used roses because in some areas it grows on the edges of the crack, roses with green herbs, and I also used broken glass because of the shape of the crack in the ground looks like it's broken.
I painted the broken glasses with glass colors, then I added it to the resin and silver papers to shape it as a mold. Then I moved to the second mold and put the resin with the dried roses with the addition of some green herbs. I waited for the molds to dry, then connected the first mold with the second one by using the tree branches.
*Materials used in the model and reality
Epoxy
Silver Paper
Rose / green herbs
tree branches
Glass
The glass was chosen due to the possibility of cracking
I colored it because of an idea I took from Nasir al-Malik Mosque
Its windows are tinted when the sun comes in
It gives bright and beautiful colors to the viewer, in addition to that I colored it with the colors of dried roses
MODEL
25cm
25cm
Front view
ISOMERTIC
Sara Adel Ibrahem Alkeswani
DR.Eman Mayah
University Of Jordan
Department Of Art and Design
Environmental Design
Section
Concept
elevation
Concept
Sketch , perspective
Colors and material
Where to use
Name : HUDA ALI 0200377
Supervisor : Dr. Eman Mayah
University of Jordan
Department of Art and Design
Concept : Islamic Art
Materials
Model material
wood
Balsa wood sheets
glass
Transparent slides
Flowers
Fake flower
In 2022 It is rare to see Islamic arts in Furniture pieces and homes especially after The modern style , so I wanted to express Islamic arts through this partition , I used different geometric patterns In a repeated and combined basic geometric forms Such as stars , squares and multi sided polygons
Environmentally inspired materials
The wood is inspired by the tree trunk and the flowers inside the planting basin reflect the nature . As for the glass, it is an expression of the sky in its clear days.
Name: Mais Hisham Abdelqader
Supervisor: Dr. Eman Mayah
University of Jordan
Departments of arts and design
خيط بيئي

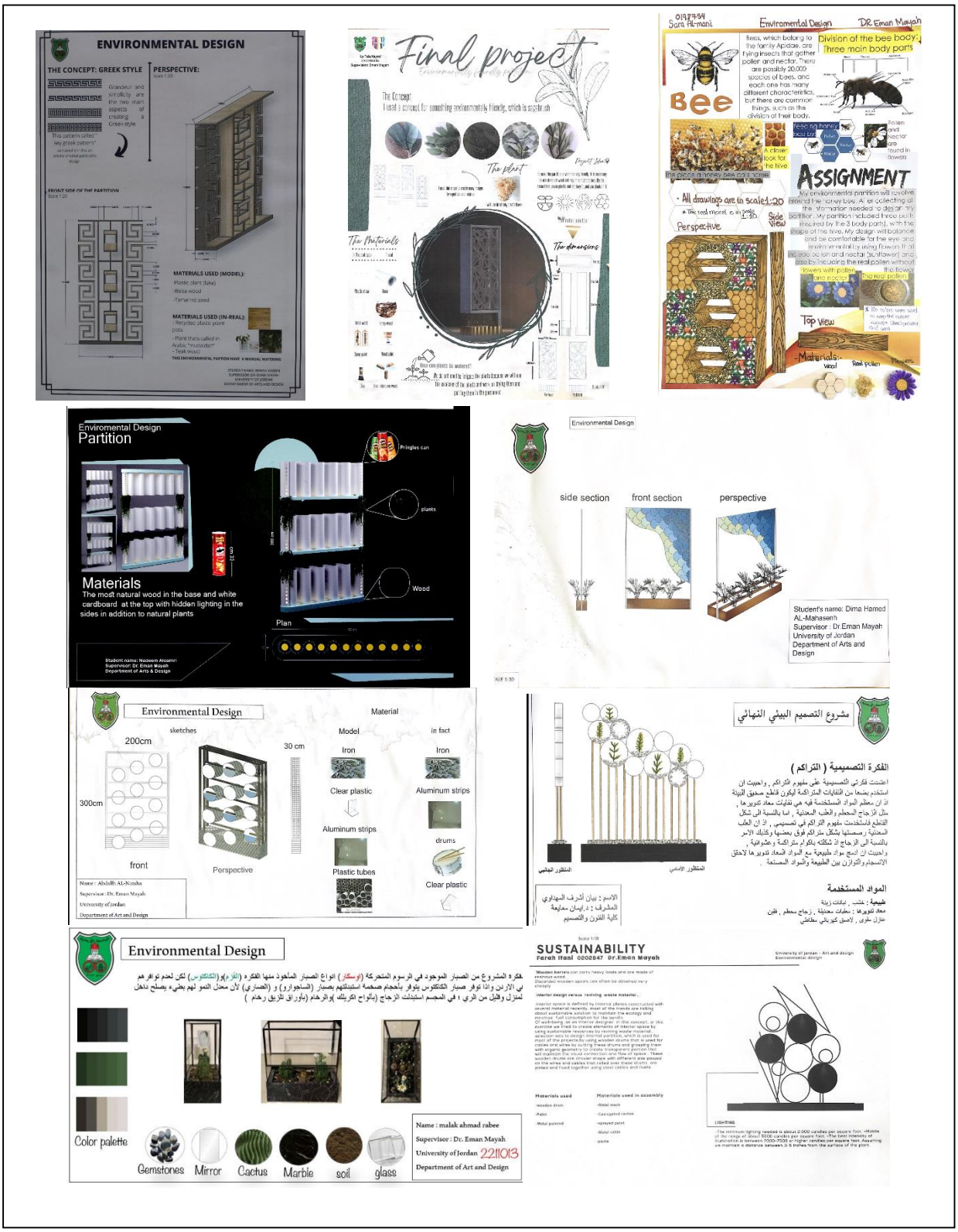


Figure 2 Mood boards containing written statements, sketches, and photographs related to the design concepts and ideas.

Research Community

The study examined sixty-three environmental design projects over three academic semesters in 2022. The practical projects were assigned to interior design students for the completion of an environmental design course at the University

of Jordan's Visual Arts Department in the Faculty of Arts and Design.

Research Sample

Based on the analysis, nine potential themes emerged from the sixty-three design projects conducted by sixty-three interior design students during three semesters in 2022. The themes were related to the materials used to meet the requirements of environmental practical design.

Theoretical framework

The rising consumption of natural resources and increasing pollution require "sustainable systems" that can face up to the major environmental crises with which we are currently dealing (Kishawy et al., 2018). The term "sustainability" has no universally accepted definition, but the most common understanding is that it involves 'meeting the needs of the present without compromising the ability of future generations to meet their own needs', as stated by Dr Gro Harlem Bruntland, chairperson of the UN Brundtland Commission (World Commission on Environment and Development) (Jawahir, 2008). The objectives of sustainability fall under three main headings: society (ethics, health, safety, and quality of life), environment (clean air, water, and soil, accompanied by regulations and codes to ensure an ecological balance), economy (employment, innovation in production and processes, and new business opportunities) (Jawahir, 2008).

In terms of the aspects of environment and sustainability in interior architectural design, it is important to know about how building characteristics and interior environment affect health and productivity, as the rates of asthma symptoms, allergic reactions, and respiratory disease are found to be significantly related to the interior environment. Sick building syndrome (SBS) is a well-known concern. SBS is defined as symptoms suffered by the occupants, such as fatigue, difficulty in breathing, headache, and irritation of the eyes, nose, and skin due to poor conditions of the interior environment (Fisk, 1997). However, in real practice, interior designers rarely make sustainable choices, particularly in materials selection. To encourage the use of sustainable materials, it is necessary to raise awareness of the capacity of natural resources to provide healthier and energy-efficient conditions in both homes and workplaces. The concept of environmentally sustainable interior design (ESID) has been introduced, based on certain principles and criteria that ensure healthier interior environments from both a physiological and psychological perspective (Hayles, 2015).

From the above, there is intense debate over a re-orientation of learning and teaching in art and design within the higher education sector. Designing interiors during an environmental crisis requires great engagement and responsibility on the part of both educators and practitioners. In the field of interior architectural design, a practical design approach or practice-based projects are seen as the best strategies to link education with the current challenges and prepare students for the labor market.

Practice-based pedagogies possess certain characteristics that are believed to be central to creative programmes, as noted by Danvers (2003). Firstly, practice-based methods encourage and value "divergent" ways of thinking, through exploration of doing, making, and interpreting. Taking risks in articulating different ideas and experimenting with diverse materials is believed to foster responsiveness, innovation, and inventiveness. Secondly, practice-based approaches promote dialogical learning and teaching in art and design education, which involve exchanging ideas, knowledge, and experiences between students and teacher, which contrasts with an approach centered on the words and opinions of the teacher. Thirdly, collective transformative learning in art and design education is believed to lead to changes in people's ideas through dialogue and interaction with others. Fourthly, learning through art and design presents new opinions, views, and theories, thereby opening up new ideas and perspectives. Creativity, inventiveness, and innovation are developed by encouraging students to take risks, self-realize, and self-construct. Fifthly, a student-centered approach is central in art and design education. It involves a process of developing ideas, while experimenting with and exploring materials. All of this takes place in conjunction with research-based practice, which includes data collection, reviewing the literature, and performing analysis within the process of practical projects (Danvers, 2003).

A project called 'KNOWHOW' established an approach with common characteristics related to studio learning and teaching in six institutes across four European countries: Iceland, Hungry, Estonia, and the United Kingdom (Michael, 2007). The project focused on creative pedagogies in the studio environment for higher education courses in the visual arts. The

program based on the four themes of Place, Person, Performance, and Materials, was designed to create a philosophy of practice – a way of thinking and doing through materials. Blending the concept of the 'artist-teacher' with experimental methods was found to embed creativity in the experience of learning for both teachers and students. The educational engagement framework engaged students in critical creativity through materials and process. Students used drawings and sketches to communicate ideas and concepts that words cannot provide, while also applying fieldwork techniques, such as observation supported by sketches, drawings, models, and photographs, followed by reflection. One practical strategy that has been employed is individual research and inquiry, with a focus on materials as the core of the relationship between place, person, and performance. This approach constitutes a form of life-long learning, whereby students are engaged in a creative process in making connections between sources and a variety of materials. The project justified its experimental educational practice on the basis that it provided a perspective of living in a globalized world that may not be able to offer life-long career opportunities unless young people are endowed with "life-wide skills" and the confidence to use them. These skills can be classified as: a) the ability to identify what needs to be learnt; b) knowing how to learn; c) the capacity to think critically; d) the ability to embrace opportunities; and e) the ability to take risks and reflect while doing (Michael, 2007).

Bala (2010) presented a teaching methodology that supports sustainability in architectural education based on teaching/learning experiences. The study was conducted in two cities of Turkey, Izmir and Konya, in which students were aware of differences in climate, site, sun path, wind direction, and others. The proposed learning method was the design process itself, which consisted of two phases (see Table 1): design phase and evaluation phase. The design phase included three periods: a warm-up period using PowerPoint presentations, followed by the creation of a conceptual structure using posters, concepts, and mood boards, and then the design process itself, which incorporated three more stages. The first stage required students to understand the site by making detailed surveys (e.g. regarding solar orientation, wind direction, slope, daylight, size, and density), modelling the site, and carrying out site/environmental analysis. The second stage involved drawing up building proposals based on consideration of the information collected about the site. The third stage consisted of detailing the specifications of the proposed building, such as the construction details, local materials, and decisions about energy efficiency. After that, the evaluation phase started, which consisted of two steps: 1) project evaluation through class and jury; and 2) project evaluation via questionnaire and meetings. The study concluded that the proposed methodology increased the students' awareness of the relationship between buildings and the environment and prepared them to be professionals in the field of sustainability. Furthermore, an atmosphere of "learning synergy" was created in the sustainable architecture project for both the participating students and the higher and lower semester students who observed the studio. Finally, the study raised a specific question regarding the future teaching methods to be employed in architecture: How can architectural studios be redesigned so that they address questions of sustainability? (Bala, 2010).

Table 1 Teaching/learning method for sustainable architecture (Bala, 2010)

<table>
<tr><th colspan="5">DESIGN PHASE</th><th colspan="2">EVALUATION PHASE</th></tr>
<tr><th rowspan="2">Warm-up period to the project</th><th rowspan="2">To create a conceptual structure</th><th colspan="3">Design Process</th><th>Project Evaluation</th><th>Studio Circum-stance Evaluation</th></tr>
<tr><td>First phase of design process</td><td>Second phase of design process</td><td>Third phase of design process</td><td>Class Work Evaluation
First Jury</td><td rowspan="2">Question-naire</td></tr>
<tr><td>PowerPoint Presentation</td><td>Poster
Concepts
Mood Boards</td><td>1/500 scale</td><td>1/100 scale</td><td>1/20 scale</td><td>Second Jury
Final Jury</td><td>Meeting</td></tr>
</table>

Note: From Bala, H. A. (2010), Sustainability in the Architectural Design Studio: A Case Study of Designing On-Campus Academic Staff Housing in Konya and Izmir, Turkey. *International Journal of Art and Design Education*, *29*(3), 330–348. https://doi.org/10.1111/j.1476-8070.2010.01665.x

A study by Celadyn (2020) considered incorporating sustainability principles into the educational model employed in interior architectural design by suggesting the concept of an integrative design class (IDC). The study argued that the academic curriculum used by the Faculty of Interior Design at the Krakow Academy of Fine Arts required modifying in order to provide students with the knowledge and skills they requires in relation to sustainability and environmental performance in interior spaces. The improvements proposed to the courses helped students to form links between their theoretical knowledge about sustainability and their interior design practices. The proposed modifications were as follows: 1- Select building materials for their durability, conservation, recovery and reuse, and effective demolition waste. 2- Design building physics to optimise inner air humidity, daylight, and acoustics. 3- Focus on methods of building system enhancement. This process would involve an integrative design class (IDC) as a learning tool, which is a practical application incorporated into the suggested modified programme. The aim of the IDC is to move away from the standard classroom environment by providing a more creative and an active learning environment that can enhance teacher-student interaction and help to develop design process skills and decision-making. In the IDCs during the project, the students held discussions about and analysed related case studies, and were encouraged to use different presentation methods in their design projects, such as conceptual sketches, technical drawings, visuals, diagrams, and perspective drawings. The students also used design research methods, such as literature reviews and pre-design observations of existing spaces. Before starting the lectures on environmentally sustainable architectural design, the students were asked to complete a questionnaire to assess their knowledge regarding sustainability. The design project focused on identifying occupants' activities in modern co-working spaces and learning spaces, before highlighting specific related environmental issues that could be solved (Celadyn, 2020).

Based on the above, there can be no doubt that practice-based learning and teaching are central in art and design education, as they foster students' capacity to think while doing, and encourage risk-taking, evaluating, and reflecting to arrive at new solutions and possibilities. It is evident that decisions taken in the early phases of design play a crucial role in addressing sustainability issues. Therefore, specific teaching is crucial to enable design students to tackle such environmental and sustainability concerns. For successful teaching about sustainability, the concept should be considered integral to the design process, rather than merely as a theoretical add-on. In other words, the product of learning should be effective evidence of applying sustainability in design courses (Bala, 2010).

Analysis

Sixty-three environmental projects were analysed across three academic semesters in 2022, from which nine potential themes were identified and examined based on the materials used: recycled plastic, recycled paper, recycled metal, recycled wood, recycled glass, recycled thread, resin, ceramic, and plants. Detailed thematic analysis was conducted to identify and analyse repeated patterns in the dataset (Glaw et al., 2017). It is important to mention that as the collected data relating to the models and images provided such rich information that winnowing was required before it could be divided into the five to seven themes suggested by Creswell for a research study (2014). Here, the study focused on achieving the objective of recognising and understanding materials in the local environment and exploring the different possibilities when working with certain materials. The data was hand-sorted and coded, and two to three samples are presented and interpreted below for each of the identified themes.

First Theme: Recycled plastic

The first theme established the use of recycled plastic as a primary material in the design project. Figure (1.a) shows a model of an environmental cutter inspired by a beehive. The project used a plastic model in the form of a honeycomb and was painted with environmental aids in white. The supporting frame was made from wood and painted with the same aid. Plastic plants were added as well. Similarly, Figure (1.b) shows a project that used plastic containers set on an MDF wooden frame. The concept was inspired by the irregular shapes of gravel, which the student noted after spending time in nature. The realization of the shapes of gravel switched the design from the use of rounded to uneven shapes. The plastic containers are spread in a random arrangement and filled with natural plants. Figure (1.c) presents the use of classical egg packaging made from plastic filled with plastic plants. The plastic containers are set on transparent recycled acrylic to allow for light

and shadow advantages.

As can be observed from the above projects, they all incorporated the use of recycled plastic materials. The plastic materials were empowered and used for functional and aesthetical design advantages. The forms employed can be seen to reflect the parametric design. In the first project, the form has a contradictory effect; with the outer frame reflecting stability and rigidity in form, while the inside reflects movement, making the eye move in a zigzag direction within the composition. While the project successfully represents the inspiration of the beehive, the two plants added to each side were not compatible with the composition or with its color.

In the second project, the form reflects lightness in terms of weight and color, and the plastic containers were empowered by using them as plants pots. The composition reflects the random movement inspired by the irregular shapes of gravel. However, the project has little harmony in terms of its color, in particular, the color of the wooden frame. The third project was also used for the function of planting. The composition shows stability in form and projects contradictions in terms of color, texture, and weight. The use of a transparent plastic background helps transmit light and shadow, which adds an aesthetical advantage.

From the above, it can be seen that reusing plastic offers many functional and aesthetical benefits, as its original form can be reused to provide different functions, such as for holding plants. Its light weight also allows for shaping and use with other materials. But careful consideration of color and texture is required to avoid projecting feelings of disunity or incoherence.

Figure 1.a

Figure 1.b

Figure 1.c

Figure 1.a: An environmental cutter inspired by a beehive

Figure 1.b: A project using plastic containers set on an MDF wooden frame inspired by the irregular shapes of gravel

Figure 1.c: A project using classical egg packaging made from plastic filled with plastic plants

Second Theme: Recycled paper

The second theme concerned the use of recycled paper as the primary materials in projects. In Figure (2.a), the project was inspired by the texture of fish skins and the shapes of waves. The project intended to emphasize that marine life is the most affected by global pollution due to waste, particularly plastics and food wraps from fast food chains. The materials used are packaging wrap, MDF, and glass. In Figure (2.b), the project used Pringles crisps packaging arranged in a wavy form that accommodates the cylindrical shape of the packaging, which also provides containers for plants. The structure was painted in white and wood was used as a base. In Figure (2.c), the project used cardboard tissue rolls, magazine papers, and artificial tree leaves arranged to form a partition wall.

From the above, it can be noticed that the project used recycled paper alongside MDF wood and glass materials to form

the partition. The arrangement and color of the recycled paper successfully renders the concept and adds great aesthetic value. However, given the proportion of paper to glass material, greater importance is given to the glass, which dominates the project. The plants added to the base balance the visual weight.

The second project shows a high level of creativity in reforming crisp packaging into a partition wall and plants pots. The design projects stability and heaviness in the composition, with the wavy form adding a sense of movement and aesthetic value. However, the addition of artificial plants did not correlate so well with the overall design. The third project used the original shapes of cardboard tissue rolls to form the partition wall that has harmony and good proportion. The project has a sense of movement, openness, and the natural, as the original colors of the materials are maintained. However, the project lacks a particular concept or inspiration that could add a special dimension to the design.

Figure 2.a

Figure 2.b

Figure 2.c

Figure 2.a: A project inspired by the texture of fish skins and the shapes of waves

Figure 2.b: A project using Pringles crisps packaging arranged in a wavy form

Figure 2.c: A project using cardboard tissue rolls, magazine papers, and artificial tree leaves

Third Theme: Recycled metal

The third theme relates to the employment of recycled metal in the partition design. Figure (3.a) presents a project inspired by the musical scale that incorporates recycled musical instruments (drums) as well as recycled plastic tubes, aluminum strips, clear plastic, and iron to form the final result. Another project, shown in Figure (3.b), adapted cables, wires, wooden drums, and glass, grouped with organic geometry to create a transparent partition that maintains visual connection and flow of space. The circular wooden drums are fixed together using steel cables and rivets. Meanwhile, the project in Figure (3.c) is based on the concept of waste accumulation to build an environmentally friendly cutter. The materials employed were metal cans, shattered glass, cork, wooden sticks, and artificial plants. The designer stacked the metal cans in an accumulative manner on top of each other above piles of glass to achieve harmony and balance between nature and manufactured materials.

The metal used in the first project reflects stability and heaviness in the composition, while the drums arranged in a musical scale way add movement and originality to the design. The colors of the metal added aesthetical value to the design and unity to the overall composition. The design featured drums used as plants pots, which adds a functional advantage.

The second project has great aesthetical value in terms of its form, composition, color, and texture, which together offer harmony, unity and good proportion. While the project is heavy in materials, the openness of some of the wooden drums and the use of glass material in the base balanced that effect. Still, the project would benefit from a concept or inspiration to add a sense of originality to the entire design. The third project reflects the concept of waste accumulation, thanks to the forms of the rounded metal cans and the broken glass in the base. However, the overall composition lacks harmony,

proportion, and unity of materials and color, which detracts from its aesthetic value.

Figure 3.a

Figure 3.b

Figure 3.c

Figure 3.a: A project inspired by the musical scale that incorporates recycled musical instruments (drums), recycled plastic tubes, aluminum strips, clear plastic, and iron

Figure 3.b: Circular wooden drums fixed together using steel cables and rivets

Figure 3.c: A project using metal cans, shattered glass, cork, wooden sticks, and artificial plants

Fourth Theme: Recycled wood

The fourth theme is related to the use of recycled wood in the projects. Figure 4.a shows a project inspired by classical Greek styles. It features a key Greek pattern called the Meander, or in Greek: Μαίανδρος. A repeating geometric motif forms a continuous line for use in decorative arts and buildings in which grandeur and simplicity are the two main aspects. The main materials used here are teak wood (represented by balsa wood in the model because of its light and soft characteristics, which is a hardwood with low density but high specific strength coming from the Ochroma tree, commonly known as the balsa tree.), artificial plants, and tamarind seeds.

Similarly, the project in Figure (4.b) was inspired by Islamic art in its adoption of different repeated geometric patterns, such as stars, squares, and sided polygons. The use of wood material is inspired by the tree trunk and the flowers inside the planting basin to reflect nature. As for the glass, it is an expression of the sky on a clear day. Related to the two previous examples, the project in Figure (4.c) presents a rotated beehive shape in order to form a flat shape that can be settled on a floor. The shapes are distributed into three equal parts (inspired by the division of the bee's three main body parts), and are mixed and matched for a balanced effect. The project materials consist of wood, real pollen, nectar (sunflower), and artificial flowers. Another nature-inspired work is presented in Figure 4.e, which is based on the abstract shape of the sagebrush plant. The shapes made by the sagebrush are coarse, many-branched, and with three teeth at the outer end. The project features the use of recycled plastic straws, scrap wood, balsa wood, and spray paint.

From the above, it can be concluded that the use of recycled wood as the main material for designing a partition can offer significant functional and aesthetic results. The patterns, whether inspired by a particular style or art, offer balance, unity, and coherence, with each part of the projects correlating with the others. The natural color of the wood used provides aesthetic value and a pleasant result.

Figure 4.a

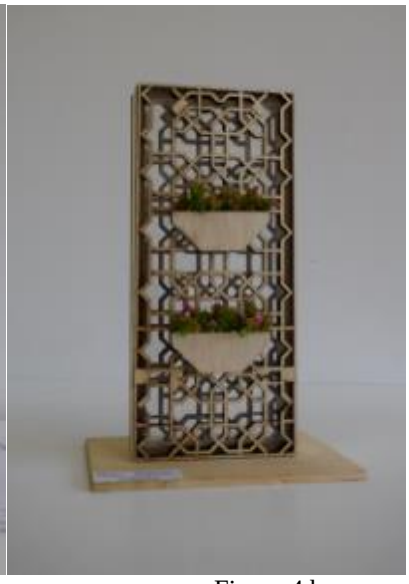


Figure 4.b

Figure 4.c

Figure 4.e

Figure 4.a: A project inspired by classical Greek styles

Figure 4.b: A project inspired by Islamic art

Figure 4.c: A project using a rotated beehive shape

Figure 4.e: Abstract shape of the sagebrush plant

Fifth Theme: Recycled glass

This section presents the use of recycled glass in the environmental projects. Figure (5.a) shows the use of suspended transparent lamps to reflect the concept of jasmine. The recycled lamps are filled with water and used as containers for the flowers, while the frame is made from wood to support the design partition. Likewise, the project in Figure (5.b) used suspended recycled glass bottles to represent the aurora borealis as the main concept, supported by a wooden frame. Similarly, the project in Figure (5.c) includes five forms of suspended cubes and cuboids based on the concept of jellyfish, considered to be one of the oldest animals on Earth. The design of the barrier, in addition to the fish tank inside, reflects the characteristics of the jellyfish's habitat, as well as the bioluminescent abilities possessed by some types of luminous jellyfish. The jellyfish also has long, and thin tips called tentacles. Accordingly, transparent threads are used to hold the

figures. As one of several names given to the jellyfish is a flower, roses were introduced into the design, and the shades of violet used in the roses to represent the colors of some jellyfish. Moreover, since jellyfish feed on fish, a tank containing fish was placed under the models. Natural marine elements are placed inside.

The use of recycled glass lamps in the first project offered functional and aesthetic value. The project's outer frame represents stability, while the interior elements represent lightness, clarity, and movement. The addition of white flowers suggests a natural positive feeling. However, the glass background and glass lamps strike one another whenever a breeze enters the room, which could lead to breakage. Similarly, the second project presents the same characteristics as the first project in terms of its contrasts of stability and clarity. The natural color of recycled glass bottles adds significant aesthetic value, while using the bottles as plant pots provides functional value. However, the colorful elements could be more empowered in the project. The third project features the creative use of glass material, a fish tank, flowers, and colors. While the project might be bulky in size and weight, it still offers significant functional and aesthetic value.

Figure 5.a

Figure 5.b

Figure 5.c

Figure 5.a: A project using suspended transparent lamps

Figure 5.b: A project using suspended recycled glass bottles

Figure 5.c: A project using suspended cubes and cuboids

Sixth Theme: Recycled threads

Recycled threads were used in the design projects related to the sixth theme. The central idea of the project shown in Figure (6.a) is that life is colorful thanks to humanity's ideas and knowledge. As such, the distribution of the light beams emerging from the main light represents the human mind and heart, while the light rays represent the colors of life. The materials mainly consist of colorful threads set on a wooden frame. The project shown in Figure (6.b) suggests the overall idea of a sewing box in terms of its shape and the distribution of tools inside. While the contents of sewing boxes may differ from one person to another according to their personal needs, the boxes tend to be somewhat similar in terms of their external and internal shapes, which are divided into several sections. The project in Figure (6.c) features the concept of a spider web, presented using threads and artificial flowers set on a round frame.

The different ideas and concepts related to the use of threads were successfully implemented. The material's light weight, natural color, availability, and ease of formation offer many opportunities for adding functionality and aesthetic value. However, a large-scale project like a wall partition requires a large amount of thread to cover the area.

Figure 6.a

Figure 6.b

Figure 6.c

Figure 6.a: Colorful threads set on a wooden frame

Figure 6.b: A project using the idea of a sewing box

Figure 6.c: Threads and artificial flowers set on a round frame

Seventh Theme: Resin

The seventh theme concerns the use of resin materials in the projects. Figure (7.a) shows a project based on the concept of a planetary rift. The crack in the barrier is represented using tree branches, since the shape of the crack in the ground is very close to the shape of the branches. Roses are used as well because, in some areas, they grow on the edges of the crack alongside green herbs. Broken glass is used to reflect the broken shape of the crack in the ground. The materials used in the model were resin, epoxy, silver paper, rose/green herbs, and tree branches. Similarly, the project in Figure (7.b) used mauve-colored resin set on a wooden base.

The idea of using resin material shows a high level of creativity as it involves a modern technique that requires skill. It can be noticed that the resin adds significant aesthetic value, either through its distinguished colors or its characteristics of clarity and transparency. Although resin can be molded into different shapes and forms, financial constraints would limit its use in large-scale projects. The first project has significant aesthetic value thanks to its use of plants and flowers inside the resin, which adds a more natural look. The transparency gives clarity and the crack in the middle adds a dynamic sense to the final result. However, one of the project's limitations is that it cannot remain vertical without some form of support. In the second project, the mauve-colored resin adds significant aesthetic value, while the sparkling creates a distinguishing effect. Yet, the project lacks a concept or inspiration, which affects the final result.

Figure 7.a

Figure 7.b

Figure 7.a: A project using resin, epoxy, silver paper, rose/green herbs, and tree branches

Figure 7.b: Mauve-colored resin set on a wooden base

Eighth Theme: Ceramic

The eighth theme was the use of ceramic as a main material in the design of an environmental wall. Figure 8.a shows a design based on the concept of marine coral. Coral is a limestone formation formed with the help of tiny sea animals. Its formations sometimes resemble tubes, bones, or small, irregularly shaped scales. The materials used in the model are cardboard rolls, wooden sticks, and ceramic paste. Figure 8.b shows a project inspired by the shape of a cactus plant and the texture of sand waves. The materials used are a white-coloured ceramic paste and a wooden base. Figure 8.c presents a project inspired by seashells/snails. Its distinguishing characteristics are its solidity and strength, its adaptability to the most extreme circumstances, and its protectiveness. Hence, the project presents rigidity and toughness.

The use of ceramic in the environmental design projects discussed above was successful. The three projects reflect a high degree of aesthetic value; the colour combinations and textures worked very well together; the projects' components exhibit similarity, integrity, and balance. The ceramic materials produced natural and grounded effects, which made them authentic environmental options. However, it is important to mention that using ceramic material is challenging. In the first and third projects, the students had to produce several replicas before creating the final end-product as the ceramic paste kept cracking and collapsing because of its softness. Hence, it requires more time and effort compared with other materials.

Figure 8.a

Figure 8.b

Figure 8.c

Figure 8.a: A project based on the concept of marine coral

Figure 8.b: A project inspired by the shape of a cactus plant and the texture of sand waves

Figure 8.c: A project inspired by seashells

Ninth Theme: Plants

The ninth theme relates to the use of mainly plants in the environmental project. These can be called "green partitions". Figure (9.a) shows the adoption of recycled plastic pipes that create a base for the plants and connect them with a watering system. Likewise, the project in Figure (9.b) also presents a proposal for a green wall with a watering system, but the flowers here are artificial. Figure (9.c) shows another green project that accommodates cactus plants, recycled glass, and marble for the base.

The use of different types and colors of plants reflects the ultimate aim of this assignment, which is environmental design. The plants project a sense of breathing and connection with nature along with green colors, which give a pleasant feeling. While the projects have significant aesthetic value, the plants require a watering system (as described above) to keep them alive and fresh, especially in a Jordan's climate, which is dry and hot most of the year.

Figure 9.a

Figure 9.b

Figure 9.c

Figure 9.a: A project using recycled plastic pipes with watering system
Figure 9.b: Green wall with a watering system
Figure 9.c: Cactus plants, recycled glass, and marble

Research Results

Based on the study's examination of the implementation of a practical environmental project in interior architectural education, the following results were obtained: Nine potential themes were identified after analysing the environmental design projects based on the materials used: recycled plastic, recycled paper, recycled metal, recycled wood, recycled glass, recycled thread, resin, ceramic, and plants. As shown in Figure 3, recycled wood was the most used material in the projects, accounting for 41% of all the used materials, followed by recycled paper (17%), recycled metal (10%), recycled glass (8%), and recycled thread (6%). Plants, ceramic, and recycled plastic each accounted for 5% of the total, while the least used was resin (3%).

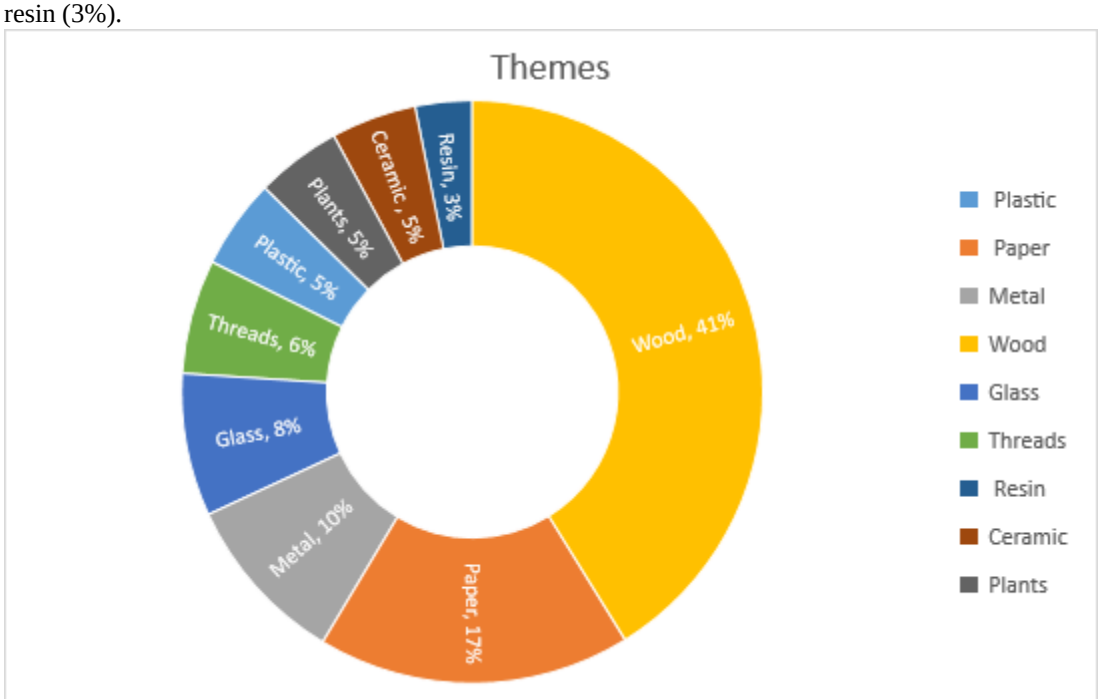


Figure 3 Shares of materials used in the environmental projects

There is no doubt that recycled wood was used in most of the projects. It is a very popular sustainable material that is available in many types, colours, and textures, making it the first choice for use in design projects. Most of the furniture and interior finishing were made from either natural or recycled wood. Wood can be shaped thanks to the development of machines, and its strength and durability render it suitable for different kinds of interior projects. However, wood is vulnerable to water, as moisture can cause swelling and shrinkage, and certain insects and fungi can proliferate if the wood is not treated or maintained properly.

Recycled paper, especially recycled wastepaper, is a sustainable option that has the characteristics of durability, non-toxicity, and renewability. However, recycled paper does not provide stability or strength, unless it is treated with other substances to increase its rigidity; but this requires more time and effort. Recycled metal is a functional and aesthetic material for design projects that offers stability, durability, and low-maintenance requirements. Nevertheless, it is heavy and hard to shape making it a challenging material to use in a wide range of projects.

Glass or recycled glass has great potential for use in design projects. It transmits a sense of modernity but has a high risk of breakage during formation. Thread offers great aesthetic possibilities as it can easily be shaped. However, they are difficult to debug and maintain, and are not widely used.

The use of recycled plastic is highly encouraged nowadays; it is affordable, stable, and resistant to strain. Despite these advantages, its use was limited in the students' projects. Plants and ceramic are environmentally friendly materials. However, plants need a watering system and protection from insects, while ceramic is a challenging material to work with. The students had to make several ceramic replicas before reaching the end-product as the ceramic paste kept cracking and collapsing because of its softness. Therefore, it requires more time and effort compared with other materials. Moreover, in large-scale projects, ceramic must be fired to achieve an effective durable result, which needs special high-temperature ovens.

Despite being the least used material in the projects, resin has great potential for use in design projects. It is durable and strong, and has a broad aesthetic appeal, particularly given the range of colour choices it allows. However, as some types of resin are toxic, it does not meet the requirements of an environmentally friendly material. Furthermore, casting the resin requires skills and accuracy to achieve appealing results.

Another finding of the study was that the projects did not consist of just a single material; rather, a combination of materials were used to form the environmental wall (partition). The combination process was necessary as using the main target material alone may not have been sufficient to provide the desired ultimate environmental result. For example, some projects required a wooden base or frame for stability and rigidity (see first, fifth, sixth, and eighth themes).

Figure 4 illustrates the number of projects with each combination of materials. It can be noted that recycled wood combined with plants was the most common combination. It was used in a total of twenty projects (32%). Recycled wood combined with recycled metal or resin was the least common pairing, with only one project each (2%). The combination of recycled wood with recycled glass featured in six total projects (10%), while the combination of recycled wood with recycled plastic, or recycled paper, or recycled thread was found in three projects each (5%). Recycled wood was combined with ceramic in two projects (3%).

The combination of recycled plastic with plants was found in four projects (6%). Recycled paper was combined with plants in three projects (5%), as was the combination of recycled metal with plants and recycled glass with plants. Recycled paper was combined with recycled plastic or recycled glass in two projects (3%). Recycled metal was combined with recycled plastic, recycled paper, recycled wood, recycled glass, or recycled thread in one project each (2%). The same was the case for the combination of resin with recycled wood or with plants.

It was also found that ceramic was only combined with wood (3%) or plants (2%). Hence, there was no combining of ceramic with plastic, paper, metal, glass, thread, or resin. Similarly, resin was not combined with any materials other than with wood or plants (2%). Thread was also limited in terms of its combination with other materials, only paired with plants (2%), wood (5%), and metal (2%). Plastic and glass were not combined together in any project.

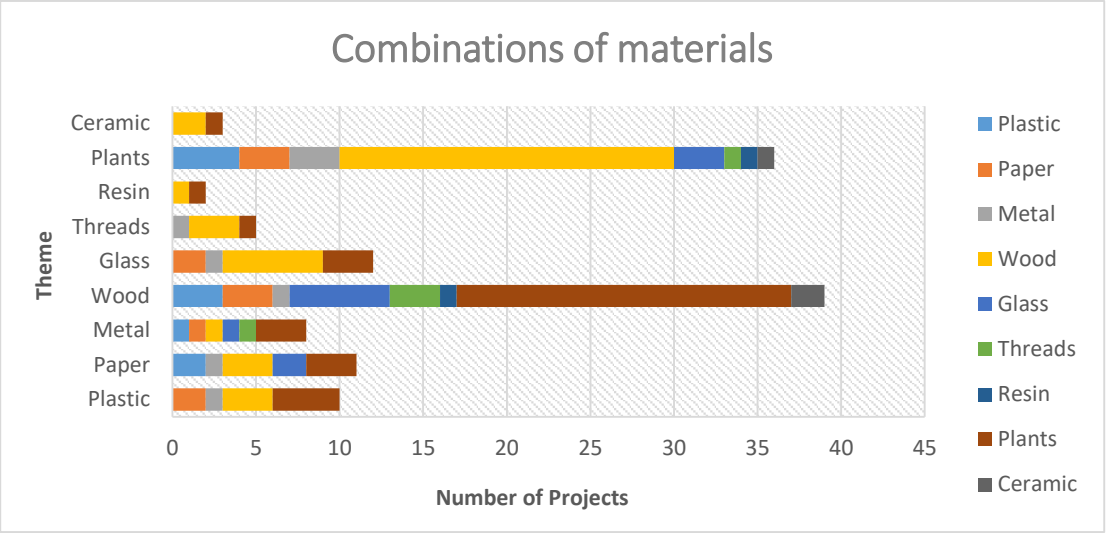


Figure 4 Number of projects featuring each combination of materials

Discussion

A practical-teaching and learning approach was implemented rather than a theory-driven approach in an environmental design course at the University of Jordan. This adjustment to the academic curriculum was essential given the major shift taking place in interior architectural design education around the globe in order to address sustainability and environmental concerns. The project focused on aspects related to interior environments, with students asked to design an environmental wall (partition) using local materials or recycled materials from their local surroundings.

Based on the theoretical framework, this study's main focus on materials selection is in line with previous studies in the field. The process of thinking and doing is highlighted in the selection of materials, which is the core of the relationship between students' environments and performances. Through active learning, the students experimented with potential materials, and in return gained awareness and knowledge relating to the materials' durability, recovery, and effective reuse.

It was also found that the practical project promotes divergent learning and teaching. The first part of the project was intended to give students a theoretical basis for understanding the importance of protecting the environment and the impact of materials selection. This was followed by the practical part, where the students were able to engage personally with local materials or recycled materials from their environment. Furthermore, it was found that the project encourages dialogical learning and teaching, where ideas and experiences are shared between students and teacher. The design process started with site visits, before moving on to observations, drawing inspiration, developing a concept, materials selection, and, finally, modelling, all of which required systematic communication between students and teacher and evaluation to develop the students' ideas until a pleasant result was achieved from both a functional and aesthetic perspective.

However, it is important to note the role of the place (studio) within the learning process. In this study, there was no suitable studio available in which the students could work and experiment freely. Therefore, the students had to take sketches and pictures of their experimentation process in their homes before showing them to the lecturer in the assigned lecture hall for feedback and reflection. In previous studies of this nature, a studio or workshop was available to students, where they could work, receive feedback, and reflect. Noting this constraint highlighted the urgent need to provide a suitable studio to the students for conducting their environmental projects. Moreover, previous related studies did not work extensively with materials; rather, they focused on environmental analysis of interior spaces and their surroundings. It is also important to mention that the students in the current study were advised to work with materials that they could handle on their own. For example, in the metal-based project shown in Figure 3a, the student already had the required skills and knowledge to work with metal as he was working in his father's metal workshop. Other students needed to use the carpentry tools in the college or privately owned ones to cut wood or laser-cutting machines to shape glass, before collecting the

pieces on their own.

Another finding worth highlighting emerged from the thematic analysis. Nine potential themes were identified based on the students' selection of materials. This result gives high significance to this study, as it enabled deep analysis of the environmental projects. The positives and negatives of each selected material were observed and interpreted, and the potential combinations of materials were explored. Here, the selection of materials was linked with practice by their use in real-world projects.

Finally, the proposed environmental projects offer significant value, not just in terms of their functionality and aesthetics, but also in terms of their capacity to bring about social change towards greater sustainability in interior spaces. These projects' use of certain materials and concepts reflect the personal feelings and great practical efforts that led to fascinating results.

Conclusion

Raising awareness of practical environmental design is becoming a necessity in interior architectural education. Looking for materials either from the local environment or that are recycled reinforces the relationship between students and their environment, and enhances their abilities to work with materials within the design process.

It also promotes the principles of sustainability and increases awareness of the different usages of materials and their advantages from both a functional and aesthetic perspective. Practical design projects help the academic curriculum meet the current educational standards required by the Ministry of Higher Education and Scientific Research in Jordan. Such projects can equip students with the skills demanded by the labour market and increase Jordan's educational output. Students can acquire a range of different skills, such as critical thinking, observation, environmental awareness, and modelling techniques, all of which are required by the labour market.

Limitations

A potential limitation of this study is that the environmental design course was delivered in a lecture hall, rather than in a design studio. This limited the sphere of experimentation with materials to students' homes as it was difficult to perform practical tasks in the lecture hall. Furthermore, as the current design studios at the college do not provide the machinery or equipment needed for experimenting with or modelling materials, the students tended to visit college workshops or private ones to perform certain tasks such as working with metal or glass.

Another potential limitation is that the academic semester may not be long enough to achieve advanced outcomes. Time proved to be a very challenging factor, especially as students also had to study for exams in the theoretical part of the course to meet the current requirements of the course curriculum.

Another limitation relates to the type of collected data. Although the visual materials (models, pictures, and design sheets) can be considered a creative method by which the participants could share their realities, and they provide dense and rich information, the data may be difficult to interpret and/or it may be interpreted differently based on the observers' perspectives. Furthermore, as sustainability encompasses environmental, social, and aesthetic values, it would be very challenging to cover all of these aspects in one project during one academic semester. Therefore, the proposed methodology was aimed at covering the environmental aspect with a focus on identifying and working with potential materials.

Recommendations

Based on the outcomes of this study, it would appear advisable for the proposed practice-based projects to be employed in different Jordanian universities, so that the processes and results can be analysed and compared with this study's outcomes, particularly if other themes emerge.

It is recommended also that a well-prepared design studio be provided that can accommodate practice-based projects, with suitable space, lighting, and ventilation, to allow a place for technical work, modelling, and receiving feedback. Another recommendation is an intensive examination of the materials used and their combinations. In addition, an

evaluation study based on different students' responses could be carried out. Moreover, a study should be made of the cultural values and social changes that could emerge from the aforementioned environmental projects.

Finally, the study recommends including professionals from the labour market within the teaching and learning process, as both teachers and students could benefit from their expertise and experience in the industry.

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