SVU-International Journal of Engineering Sciences and Applications (2024) 5(1): 49-63
Print ISSN 2785-9967 | Online ISSN 2735-4571
DOI: 10.21608/SVUSRC.2023.224923.1143

Towards a Sustainable Future: Exploring the Integration of Architecture Education, Innovation and Sustainability

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Abstract The field of Architecture is at a crossroads, facing unprecedented challenges driven by global environmental crises. So, the need for sustainable design practices has become paramount. This research investigates the critical role of Architecture Education in fostering Innovation and Sustainability in the built environment. It examines how Architectural Education, through the integration of Sustainable principles and innovative thinking, can shape a more environmentally responsible and resilient future. The research explores the evolving role of Architectural Curricula and how they can be adapted to better equip future architects with the knowledge and skills required for sustainable design practices. The study investigates the relationship between Architectural Innovation and Sustainability, emphasizing the importance of pushing the boundaries of traditional design and construction methods. It examines case studies of innovative Architectural projects that exemplify sustainable principles, showcasing how they have redefined the possibilities of sustainable design. Ultimately, this research aims to pave the way for a sustainable future in which Architecture plays a central role in addressing pressing environmental issues. An experimental study was conducted on first-year students in Architectural Design Studio. The findings of the results endorse the role of technologies that can be integrated into Architectural Education to empower students to create more Sustainable and Innovative solutions.

Keywords: Architecture Studio; Creativity; Education; Innovation; Sustainability Concept.

1 Introduction

The need for sustainable design methods has increased across many industries, particularly in architecture, as a result of the pressing need to solve global environmental issues. In order to design ecologically responsible buildings and places, architects play a crucial role in influencing the built environment. As a result, it is necessary for architecture education to give the upcoming generation of professionals a thorough awareness of sustainable design principles as well as the ability to make creative decisions.

In order to advance sustainable practices, this research aims to investigate how innovation, sustainability, and architectural education are intertwined. The study acknowledges that the role of architects must change in the current setting of increased awareness of the environmental impact of the built environment in order to provide reliable and suitable designs that counterpart nature.

The objective is to develop a comprehensive and cogent educational approach that guarantees every student is well-versed in sustainable practices by investigating cutting-edge pedagogical approaches and integrating sustainability across diverse architectural disciplines and domains.

To build and perform a cutting-edge, interactive educational tool that is specifically designed for architecture students. This tool seeks to go beyond conventional teaching approaches through active student participation in the learning process and the facilitation of a deeper knowledge of sustainability ideas. To enable students to internalize sustainable design ideas and apply them with conviction throughout their careers by encouraging a more hands-on and immersive learning motivated by innovation and creativity, encouraging the next generation of architects to contribute to a sustainable future.

1.1 Research Objective

The objective of the research is to investigate and address critical aspects related to architecture education, innovation, and sustainability with the following key objectives:

Received: 31 July 2023/ Accepted: 24 October 2023
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- Create and deploy a cutting-edge instructional tool: Create and launch a creative, interactive educational tool that will help architecture students understand the fundamentals of sustainable design. This resource will be designed to actively involve students and provide a deeper comprehension of sustainability topics.

-Examine the Role of Architecture Education in Fostering Sustainability: Investigate how architectural pedagogy can contribute to the development of sustainable design thinking among students. Analyze the potential impact of architecture education on students' attitudes, knowledge, and skills related to sustainability. Explore the effectiveness of current sustainability-focused courses or modules within architecture programs.

- Examine Emerging Technologies and Trends: Explore the integration of these technologies into architecture education. And assess the impact of technological advancements on the design and construction of sustainable buildings.

-Innovation in Architecture Education: Develop guidelines and best practices for incorporating sustainability and innovation into architecture curricula. Provide recommendations for universities to adapt their programs to better prepare students for sustainable design challenges. Suggest strategies for fostering a culture of innovation and sustainability within architecture education.

- Contribute to a Sustainable Future: By equipping the next generation of architects with the knowledge and skills necessary to design environmentally responsible and resilient buildings and spaces. Architectural education towards greater sustainability and innovation, recognizing architecture's central role in addressing pressing global environmental issues.

1.2 Research Aim

The project aims to promote among Architectural students a unique and creative mentality with regard to sustainability. Workshops, campaigns, and other events that encourage students to approach problems in sustainable design with imagination and originality should be developed as part of the activities to accomplish this goal. Impart sustainable design education in a novel method.

1.3 Methodology

To achieve the research objective, the research follows the experimental application methodology where an experiment is conducted for first-year students, Architecture Design Studio, through implementing a competition with specific steps to be followed.

Determine the objective of how we wish new graduates in the field of architectural performance and knowledge, including:

Ability to collect and analyze information, presentation skills for their research, construction materials and methods, design techniques, design theory and practice, healthy built environment, planning and designing projects with a different concept, and sustainable built environment/adaptive design [2].

Emphasis should be placed on the relationship between the quality of education offered by the university to students and the effective integration of recent graduates into professional practice. Therefore, the Architectural Design Education system must be developed, and the principles of sustainability integrated with architectural design. A systematic framework for the architectural design course plan has been developed based on six main areas:

Teaching (direct information to the student from lectures), research (research carried out by the student), studying and analyzing similar projects, field visits to gain experience, sustainability elements that can be added to design projects, and Three-Dimensional Modeling workshops.

The experimental approach was tested on case studies through the Architectural Design experiment of first-year students, Department of Architecture, October 6 University, Egypt. An idea was implemented in a Tesla showroom design competition. Students were requested to formulate 3D models at the beginning of their design process using recycled materials available in their surroundings while incorporating the use of sustainability elements into the design.

Then, students followed the design steps: design considerations, analysis, development, and integration of design ideas to reach the final design. The last stage of this research included the critical analysis of the projects to select the winning projects. Finally, the students were honored and motivated.

An Approach to Measuring Innovation in Architectural Design:

Research on innovation architecture has focused on measurability, where creativity is defined as something new and relevant [3], measurement of ideas, and how close they come to meeting design specifications. The quality of an idea as a material property can be measured at the conceptual stage where this is feasible.

Evaluation of ideas using a matrix is suggested at the conceptual concept stage, but often the quality of

early-stage ideas is evaluated and the technical level, feasibility, and difficulty of the design are evaluated.

The measure of creativity depends on the novelty of the idea, the relative creativity, and the peculiarity or uniqueness of the idea compared to other ideas. Concepts with existing features.

Evaluate the innovation of ideas in terms of: (appropriate, useful, valuable, or meaningful), it is Vital to the discipline of engineering design for several major reasons:

1- Correct measurement helps researchers to identify the design methods used with students that help motivate them to form creative ideas more effectively or more frequently [4].
2- The creative performance of designers provides the right amount to properly evaluate the creativity of their ideas to develop more innovative solutions.

2. Literature Review

The development of Architectural design education tools has become a necessity for the future of architecture. Hence, various efforts have been made to achieve this type of integration.

In the research "Sustainability and Green Building in Higher Education, Cole and Anderson explore the increasing adoption of sustainability initiatives in higher education institutions. They discuss how universities are integrating green building practices, revising curricula to include sustainability, and involving students in advocating for sustainable practices. The article highlights the role of students in driving change and emphasizes the importance of universities as leaders in promoting sustainability in both campus operations and Education [5].

Downton and Harrison's research, "Architecture in Education: Design as a Pedagogic Tool to Promote Sustainability," featured in the Design Principles and Practices, explores the vital role of design as an educational tool to foster sustainability awareness and practices. It highlights how incorporating sustainable principles into architectural education can empower students to think critically about environmental issues and encourages them to apply sustainable design strategies in their work. It emphasizes that design-based learning approaches can effectively instill sustainability values and concepts within the curriculum. [6].

Steemers and Yannas' research, "Education for Sustainable Architecture," underscores the importance of architectural education in advancing sustainability within the field. The education should not only impart sustainable design skills but also instill a broader ethos of environmental responsibility and ethical practice. The article highlights the critical role of architecture education in shaping a new generation of architects who are not only equipped with the necessary tools but also motivated to address global environmental challenges through innovative and sustainable design solutions [7].

The Research by Buthaina Iloti, [8], is a framework that aims to integrate the concept elements, evolution phases, processing, layers, components, and aspects. Hence, the framework describes a comprehensive approach based on a design concept evolution process, aggregation, and development layers.

Buthania's study aims to develop architectural design educational tools in higher education institutions such as universities and to demonstrate its applicability, discusses various definitions of design concepts, associations between concepts, and design relations between concept generation and creativity. The ideas are evaluated in terms of their potential, uniqueness, creativity, and applicability. The evaluation criteria are based on their goals, originality, functionality, creativity, and aesthetic satisfaction [9]

3. Architecture Design Education

Architecture, which considers art and technology that shapes the built environment, becomes a vehicle for spreading sustainability as a tool for rationalizing technological innovation, design decisions, and the innovation of a wide range of control mechanisms called building rating systems, designed in general, providing energy ratings suddenly becomes necessary to regulate the harmful effects of a rapidly growing building Environment. Procedures that define "sustainability" and "environmental", design buildings with a safe environment and minimal damage to the environment [10] .

3.1 Creativity in Architectural Design Education

Creativity enhancement as a process required in students, affects their skills and to produce better solutions in projects, the Learning Outcomes expect the student to gain much knowledge besides other skills that encounter

his creativity in the future [11].

To enhance student practice, it is important to introduce new educational techniques that prepare architects for future sustainability. In addition to enhancing confidence in work when designing a project, these techniques include thinking about the design idea through a Three-Dimensional Model, recycling materials, teamwork, and using sustainability elements [12].

3.2 Sustainability System in Architectural Design Education

Students are introduced to sustainability concepts, and workshops are held to discuss what sustainability is, its principles, and how to emphasize and address it in their design projects. Despite this common focus, the attempt to achieve a sustainable built environment in architectural design.

Architectural design education aims to motivate students to design a project for sustainability, as by 2014 all residential and commercial buildings account for 14% of total energy consumption in the United States [13]. Therefore, it is necessary to expand the use of green buildings concept, sustainable design to reduce negative environmental factors, using sustainable building materials, natural light of the building itself, and daily operation of low-energy buildings.

The student's Three-Dimensional model exposes a variety of architecture concept designs, and the students' work exposes valuable skills that are needed in the field of architecture. Working as a part of a group encourages creativity and innovation. Teaching students about the sustainability system as it gives students an understanding of applying the sustainable concept in their design project.

Where the architect must understand how to create environmentally friendly buildings, and combat pollution and climate change, the construction industry plays a crucial role in creating pollution using natural resources, waste production, and high energy consumption [14].

3.3 Teaching Strategies in Architectural Design Education

There are many teaching strategies used in Architectural Design Education such as in **Fig. 1** [15], [16]:

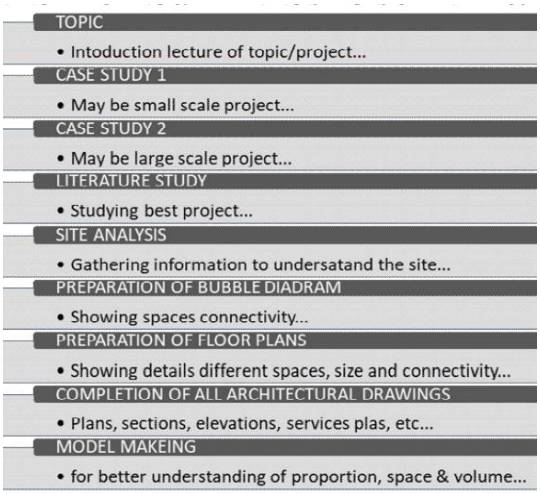

Fig. 1 Architectural design education of any project in architecture curriculum [17].

A. Lecture methods

In a lecture, the lecturer explains the architectural topics orally. The role of the student is to listen and obtain the information provided by the lecturer. The lecturer must attract the attention of the students in the lecture because they find it non-interactive and boring.

B. Case Study

A case study is an in-depth study that helps students develop an initial project idea and understand the key elements that must be provided in each project. A case study (projects similar to the one to be designed) mainly helps students collect data and understand the requirements for these projects [18].

Students are asked to visit every part of the project, every space, and the distribution of services in the project. The study of functional relationships. They are asked to draw and photograph each space in the project [19].

C. Site visits

In the pre-design phase, the site is visited where the student gets to know the plot of land allocated for the project. The following information is collected (site dimensions, orientation, topography, elements surrounding the site, service availability, site boundaries, climate, etc.).

D. Workshops

The workshop can enhance students' creativity. The process of participation of students in architecture workshops is the formation of an idea. The workshops aim to develop the student's ability to be creative and work intelligently and independently.

E. Conference:
The main objective in the education of architecture is the student's field of vision and design skills, and this is only possible by providing different means to provide students with the necessary skills and development, so it is necessary to encourage students to attend conferences.

F. Lectures from outside experiences
Guest lectures by distinguished speakers are essential in Architectural design education because these lectures provide students with current and new trends in the construction industry. These lectures motivate young people for their future careers.

To teach architecture and design, the language of geometric shapes must be understood as an educational tool in the form of architectural design, and Three-Dimensional Modeling. In addition to relationships between blocks, and critical thinking and creativity to solve problems.

4. Students' samples

In this part, the experiment conducted in the Architecture Design Studio applied is presented, in steps as follows:

The first part: is to apply the integration of sustainability into Architectural design education and the development of Architectural design education aids. This part is conducted through a competition by integrating sustainability concept through the following steps:

-Lectures about sustainability
-Research and case studies
-workshops
-discussions

The second part: A questionnaire has been implemented for students to assess their experience in this competition and how this competition motivates students to study.

In order to warrant the diverse academic levels of the architecture revealed in the survey sample, the educational architectural community was distributed into four categories by profession that represent their level as in **Table 1**: 1-Two Faculty Members: (PhD holders (Associate Professor & Assistant Professor)
2- Two lecturer assistants: (master degree holder). (**LAs)**
3- Three Teaching Assistants: (holding a bachelor's). (**TAs)**
4- Sixty-Four Students Involved
The final number was (71).
- The opinions of students were taken through a questionnaire designed to assess experience gained from the competition and areas of defect that can be modified, the final number of participants was (71).

Table 1: Distribution by Education, Source: The authors

Occupation	Faculty Members	LAs	TAs	Students	Total
Number	2	2	3	64	71

5. Case study (Tool testing)

To evaluate this tool for Architectural Design, it was decided to hold a competition for the first year in Architecture Studio (First year, second semester, Architectural Department, October 6 University, Egypt, 2022).

The subject has been taught by the same staff (Professors) for several years. In accordance, to meet Quality Assurance needs and to achieve Learning Outcomes the course has been modified regularly through course reports and questionnaires. Several attempts have been made to achieve creativity and foster innovation in teaching, examples include (workshops, students' teamwork, and using innovative recycled materials and techniques to construct simple Three-Dimensional Modelling)

In this Architecture Studio, students had to design a Tesla Car Showroom. Building design and beginning to think in different ways from traditional design methods, required the students to design buildings to meet a highly sustainable environmental performance. It was suggested to encourage students to get introduced to sustainability concepts and how to apply ideas in their design in the early design stages. A lecture with case studies was given to students, followed by research that was discussed with students before beginning the design part.
There were two key parts to this design process, which spanned over two weeks:

-**The first stage,** is group work inside the studio as in **Fig.2**. They were divided into groups of 5 students and were asked to work on the project during the studio period, which is 5 hours.

Fig.2 Student interaction, and group work during design studio time

When students work in design as groups, they are motivated to work, create, innovate, and finish the Three-Dimensional Model in the design studio, and they search for design and sustainable design considerations to apply in creativity. Results of the attempts were

satisfactory and measured regularly with the suggested measuring tool from the subject staff. Students understand that sustainable architecture aims for energy efficiency over a building's whole life cycle. Architects must analyze the site to maximize the use of local environmental resources, such as natural light during the day and ambient winds for heating and ventilation. They must employ a variety of techniques to reduce the energy needs of buildings and increase their capacity to capture or generate their own energy in their projects, as in **Fig.3**.

Fig.3 (A) Group 1 attempt

Fig.(B) Group 2 attempt.

Fig.3(C) Group3 attempt.

Fig.3 (D) Group 4 attempt.

Fig.3 (A, B, C, and D) The final design project for first-level students.

5.1 Student Attempts to Apply Sustainability Idea in Architectural Design Competition

Several attempts were presented by students and then modified through monitoring and guidance from staff members while leaving the space to stimulate students.

5.1.1 Energy

Passive solar design as in **Fig.4,5,6,** employs sunlight to heat, cool, and light buildings without the use of mechanical or electrical devices and is part of the building design itself, the rules for passive solar systems are that the interior spaces that require the most lighting, heating should be along the building's southern facade. The areas that need the least heat and cooling should be in the north. Advantages of passive solar design less energy use all year round [20].

The successful design creates an appealing living environment, views large windows, sunny interiors, and accessible floor plans. The north facade as glass mass is best in summer but will be very cold in winter and has good lighting. Buildings must be well closed in winter to reduce heat loss through air leakage.

Fig.4 (A) An example of using a glass façade.

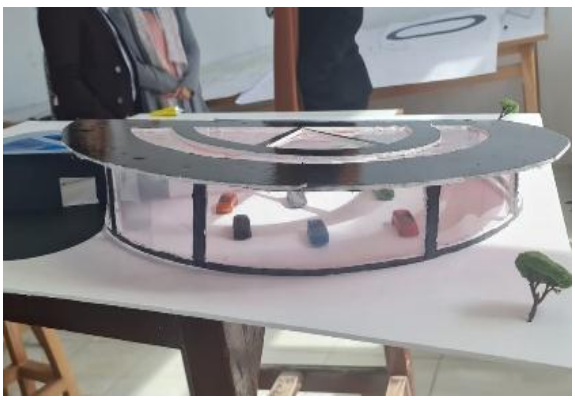

Fig.4 (B) An Example of using a glass façade.

Fig. 4 (A and B) Passive solar design uses sunlight to heat, cool, and light. (Source: The authors)

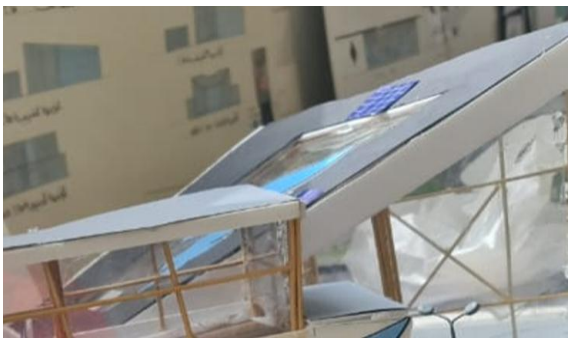

Fig5(A) Example1.

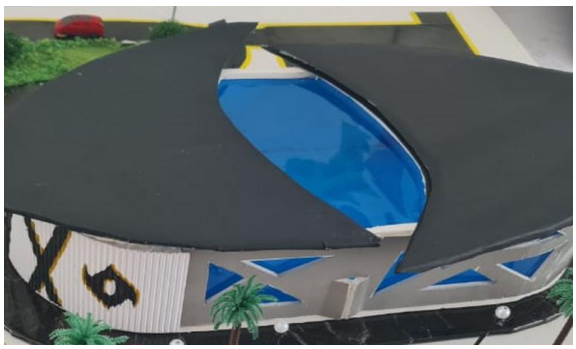

Fig5 (B) Example2**.**

Fig. 5 (A and B) Upper openings for daylighting to provide natural lighting in the building and save energy use. (Source: The authors).

Fig. 6: Upper openings for daylighting to provide natural lighting in the building and save energy use. (Source: The authors).

5.1.2 Renewable energy generation

Using heavy fossil fuels leads to global warming and environmental pollution. Therefore, new, and renewable energy resources which are environment-friendly began to be used in architecture and on buildings.

The renewable energy power resources which can be used in architecture are solar energy, wind energy, (bioenergy: biomass, biogas), geothermal energy, and environmental heat resources [21].

- **Solar panels**

Solar devices such as photovoltaic solar panels stipulate sustainable electricity for several uses. The electrical output of the solar panel depends on the direction, effectiveness, and climate, and the roofs are tilted at an angle towards the sun to allow the photovoltaic panels to collect the maximum amount of sunlight efficiently. In the Northern Hemisphere, a true south-facing orientation increases the productivity of solar panels, As in **Fig.7** [22].

Fig7 (A) Example1.

Fig7 (B) Example2.

Fig. 7 (A and B) Students used renewable energy generation from solar panels in the project. (Source: The authors).

- **Recycled materials**

Sustainable architecture involves the use of recycled or used materials, resulting in less use of innovative materials and a reduction in energy (the energy used to produce the materials). When old buildings are demolished, any good wood in the flooring is reused. Doors, windows, shelves, and hardware are reused, reducing the consumption of new merchandise [24], [25].

The students quoted the same concept of using recycled materials for the implementation of the third-dimension model, including an old thick paper sketch, the cardboard they have available, old boxes, carbonated drink cans, old parts of children's toys, and clay [26].

5.2 Evaluation of the competition and selection of the winning groups, As in **Fig.8.**

Fig.8 (A) First-place winning group.

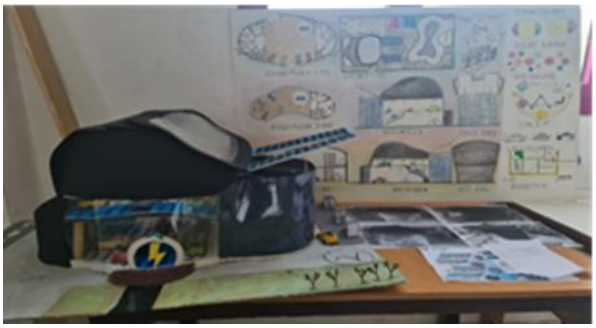

Fig.8 (B) Second place winning group.

Fig.8 (C) Third-place winning group
Fig. 8 (A, B, and C) Evaluation of the competition and selection of the winning groups (Source: The authors).

6 Towards Innovation in Architectural Design Education

Course students define their group role in a competition that demonstrates how they were asked to discover and solve a problem on their own as architecture students applied their talents and skills in architectural design using areas of interest new to the students.

6.1 Assessment Criteria

To assess students' output, Course moderators set criteria for assessment, by which weights have been modified several times until settled, and agree on assessment measures including achieving the following: A Three-Dimensional model with strong encouragement to use recycled materials, Sustainable Approach (Harmony in team/work in groups). Three groups were chosen on top of the evaluation "Jury members set some criteria innovation on using of materials and achieving sustainability ideas in addition to completion of the building in its selected context", followed by an exhibition where students gave feedback and interpretations on their work.

As in Table 2, the questionnaire implemented includes four main parts followed by a free space for students' notes. This four-part questionnaire assesses the completion and their reflections about choosing the topic and experiences gained, the extent of the success of teamwork, the integration of project design and sustainability concept, where encouraging students to search (reassuring self-study), their positive thinking consideration towards their surrounding environment, Three-Dimensional model and how to visualize the spaces assuring the scale, where criteria of a remarkable building are preferred. The last part examines their work in groups with tight and limited time resources and measures the success of teamwork and the ease of cooperation in order to obtain an innovative project in a competitive environment.

6.2 Survey Results Samples and Student Note

The number of students in the sample is 64 students.

- As in **Fig. 9** Students wanted to add a course in the academic year to learn and practice the Three-Dimensional Modelling Technique.
- Despite the modest equipment of the design studio, according to students' feedback, there is a clear positive impact of the workshop on the students in learning motivation and accept this type of learning method.
- Design the project on a competitive basis making the spirit of challenge high and helping them to create and innovate.
- Students' unanimity on the effectiveness of interactive activities and their desire to repeat them.
- Their awareness of the surrounding environment in a positive way and the importance of the sustainability concept in design projects.
- This workshop helped them with several courses, such as Working Design 2, where Three-Dimensional Modelling of a building's stairs was made.

Table 2. Survey for student feedback over the design process.

Components	Description	Disagree	Neutral	Agree	Strongly agree
1-The competition	What is your opinion about the idea of the competition?				
	Presenting the idea of the competition from the staff was in an interesting way				
	Do you think the competition helps you in gaining new experiences?				
2- Sustainability concept	You have prior knowledge of the sustainability concept				
	Ease of gathering information on sustainability principles				
	Knowledge about the sustainability concept and its reflection on design				
	After realizing the idea of sustainability, the awareness of the importance of interacting positively with the environment increased.				
3- Three-Dimensional Modelling	Ease of usage of materials in the Three-Dimensional Modelling				
	How do you find using recycled materials in your idea?				
	Studio time is enough to work in Three-Dimensional Modelling				
	The design studio equipment is suitable for the number of students and the required Three-Dimensional Modelling				
	Benefited from the discussions among the group members.				
4-Harmony in teamwork	How do you find working in groups?				
	I like to repeat similar group workshops.				
Student Notes					

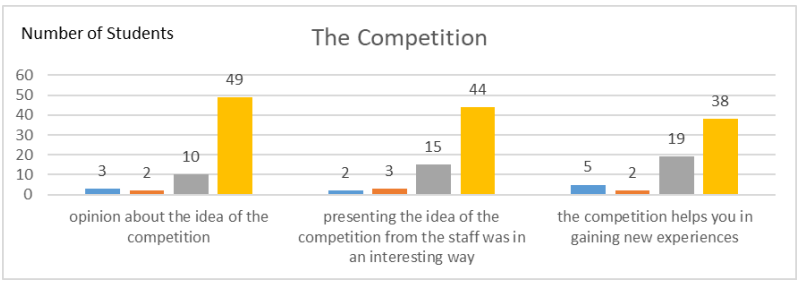

Fig.9 (A) The competition.

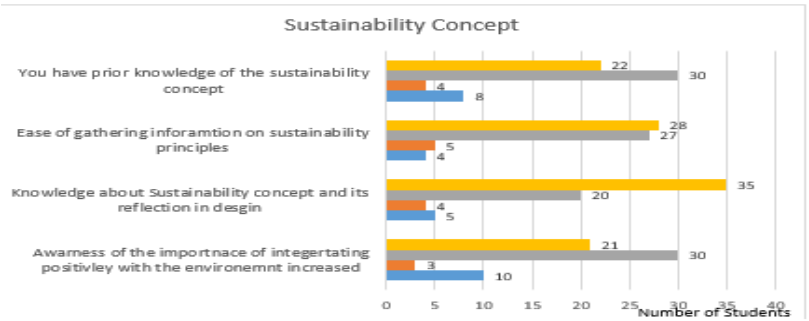

Fig.9 (B) Sustainability Concept

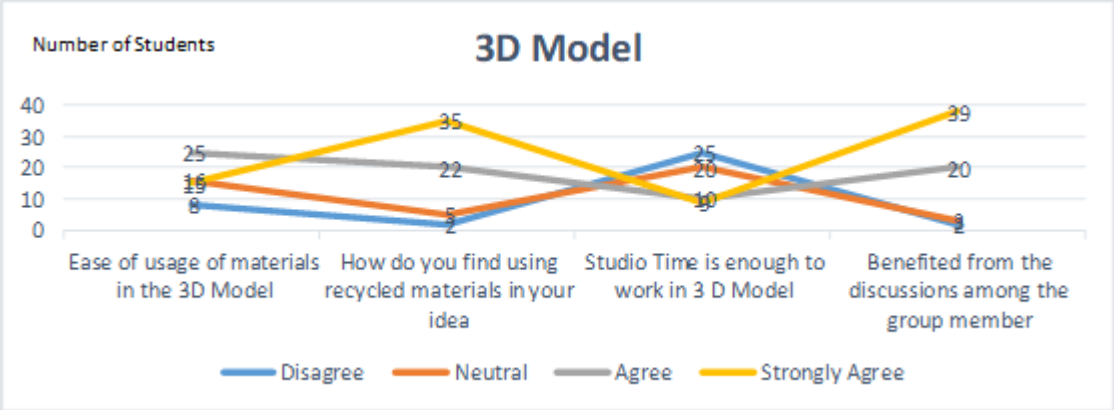

Fig.9 (C) 3 D Model.
Fig. 9 (A, B, and C) Survey Samples (Source: The authors).

7 Evaluation Tool: Easy Approach to Sustainability and Innovative Design

To evaluate students' success in integrating sustainability and architectural design, a jury has been established from all faculty members in the department. The exhibition began with an introductory question about the importance of integrating sustainability into architectural design education.

The responses demonstrated the success of the integration concept. The vast majority of respondents see sustainability as a necessity, and that curriculum development is a necessity and can be applied at all levels of study.

Attendees had a range of opinions, including that architecture is a way to accommodate people, respect for responsiveness to environmental issues; And that "sustainability is not just solar panels, wind turbines or construction materials, it is much more than that. Sustainability cannot be designed after it is completed, it is part of the design." A curriculum should be prepared and thought of to prepare students for the job market.

A faculty member's note, "In order to know how well this method works, it is necessary to monitor the progress of the students' design work," to verify that they are successfully integrating sustainability ideas into their designs, and benefiting from all the experiences gained and educational attainment.

7.1 Evaluation Matrix

The objective of evaluating the success of this research study is to assess and evaluate student projects from four aspects related to sustainable education design:

1. Building
2. Project spaces
3. Innovation (Design idea)
4. The sustainability concept (for environmental interaction, energy consumption)

is a scale of 0 to 100, in order to determine the good or bad performance of the project on this criterion. Good (value 100/100) or medium (value 50/100).

The assessment is presented by evaluation matrix, as in Table.3 the elements of which are:

1- The project:

(the building - design idea, design considerations) and its living capacity that ensures a good quality of life [14].

- Using different design concepts, whether they are geometric or organic

- Light and Dark: Because they create visual interest in the building. (Whether using wide openings or shapes stick out) [23]

- Three-Dimensional Modelling (the ability to express the design concept by Three-Dimensional Modelling.)

- The building texture by certain choices of materials, (Rough Texture, jagged stone or woodcarvings or Smooth Texture).

- The color choice and materials used to construct a building (Warm Color, Cold color).

2- The Main Spaces of the project

(enough interior space, open space, and green space).
- Interior space for displaying cars. (easy access, hall lighting) [23].

-Private open space for car show. (Clarity of the location, directing the lighting on the exhibit)

- Private open space to try out cars. (Easy movement, suitable width)

- Total open green spaces. (Movement guidance, routing confirmation)

3-Innovation in practice includes :

Architecture is a form of creative composition. It is therefore emphasized that architects, creatively integrate different layers (concept, spatial quality, accessibility, facilities, etc.) [8] Focus on the concept is the embodiment of knowledge that helps to imagine the final product with different ideas and to generate ideas in design.

The concept is always associated with creativity, and creativity is the ability to produce work with modernity, uniqueness, and suitability for the project. design as the only form of innovation. [27].

- Creative design potential.

-Creative thinking and skills of students (degree of flexibility - imagination and ability to express) [28]

-Visual and sensory appeal of buildings.

-Strong form attracts attention whether it is different or has a visual appeal.

-Encouraging a strong competitive environment through design. competition that develops cooperation among students.

-A strong competitive environment encouraged by design competition means collaboration between students.

- Strong eagerness within a practice to innovate.

- Innovation in the selection of materials used in Three-Dimensional modeling and the corresponding building materials in nature.

4-Sustainability Concept:

High attention should be given to sustainability in architecture, and concepts of sustainability should be listed during the discussions of systematic thinking to develop a sustainable architectural approach with different weights for its components (context, social construction, energy performance, investment, internal environmental health, etc.) [29].

- Reflection on understanding the principles of sustainability in design

-Positive interaction with the environment. (Choose the direction, the shapes are prominent.) [30]

-Renewable energy generation (Solar panels, Recycled materials)

-Passive solar design uses sunlight to heat, cool, and light.

Table 3. Matrix Evaluate Student Project.

Components		Description	Alternatives	Achieve	Rating
Evaluate Student Projects.	1-The project	Design concept	Geometric		
			Organic		
		Light and Dark: Because they create visual interest in the building.	wide openings		
			Shapes stick out		
		Three-dimensional model and landscape.	Unique		
			Creative		
		Texture building texture by certain choices of materials	Smooth Texture		
			Rough Texture		
		The colour choice and materials used to construct a building.	Warm Colour		
			Cold Colour		
	2-Project Spaces	Interior space for displaying cars.	Easy access,		
			Hall lighting		
		Private open space for car show.	Location		
			Lighting		
		Private open space to try out cars.	Easy movement		
			Suitable width		
		Total open green spaces.	guidance,		
			Clarity		
	3-Innovation	The potential of the creative design.	Unique		
			Strong imagine		
		Creative-thinking	Flexibility		
			Imagination		
		Innovation in the selection of materials used in Three-Dimensional Modelling	Recycled		
			New		
		Strong form	difference		
			visual appeal		
		Visual and sensory appeal of buildings.	Interesting		
			Insipid		
		Strong willingness within the practice to innovate.			
		The activity that will occur in space, is to make a building more interesting.			
	4. Sustainability concept	Reflection on understanding the principles of sustainability in design	achieve		
			not achieve		
		The positive interaction with the environment.	the direction,		
			shapes are prominent		
		Renewable energy generation	Solar panels		
			Recycled materials		
		The passive solar design uses sunlight to heat, cool and light	Sunlight		
			outstanding roof		
Total					

8. Results

The results of the questionnaire are as follows:

-The students find in the beginning challenging to work in groups and over time gained the ability to handle competition in groups.

- The competition topic was interesting for students to research as it is new.

-Despite the modesty of the drawing studio equipment, according to their assessment, a positive effect of the student's workshop is evident in terms of learning motivation, accept this style of learning, innovation, and creativity.

-The results show that each of these are factors affecting the success of learning methods to help creative ideas for students and have an impact on the outcomes.
-The results of this study indicate many meaningful effects for universities wishing to enhance creativity.

9. Discussion

-One of the most important goals for students be capable of treating sustainability as an essential part of the design, as sustainability should not be an overlay on projects instead sustainability should be well integrated and emerge from the design. It should be the same structure and interacts with context.

-Discussing the importance of using new teaching methods in Architectural design education, including organizing competitions for designing architectural projects for students, and directing them to think through the Three-Dimensional Model, where project design on a competitive basis played a role in increasing students' creativity and innovation.

- Regarding the curricula, the first thing to do is to update the curricula in architecture,

Curriculum that meets the current requirements of society. The incorporation of sustainability into the entire architecture curriculum must be applied until the end of the study.

-It will be useful if students apply sustainability concepts in all design studios at different levels, with different dosages, different capacities, and different complexities, which vary from climatic issues to building materials and appropriate construction techniques.

10. Conclusion

The study results corroborate the dissemination of the importance of using new teaching methods in Architectural design education including the experience of organizing competitions to design architectural projects for students, on a competitive basis, that help motivate students, raise the spirit of challenge, and increase creativity and innovation among students. It also guides students to think through a Three-Dimensional Modelling while integrating sustainability into design, and keeping it up-to-date.

The purpose of the research was to take a basic step in the future of architecture through the development of an architectural design studio for first-year students, the experimental research conducted supports the practice of novel teaching methods in Architectural design education, and the application of sustainability concepts in design to contribute to reducing the negative environmental impact. It was concluded that the concept of sustainability has to be incorporated into all design studios in doses and capacities through various methods and complications. Also, the idea of integrating sustainability should be mainstreamed into all other courses.

Finally, we strongly hope that the schools of architecture will succeed in using the results and recommendations of the study aimed at improving and enhancing the integration of sustainability in Architectural design education to produce a sustainable building environment and raise community awareness about sustainability. Not only design studios, but all other courses must follow this rule.

11. Recommendations

- Focusing on realizing the concepts of sustainability in Architectural design education and developing academic curricula to achieve integration of sustainability in Architectural design education.

-The design process frequently entails both theoretical and empirical study, and the student may come up with several ideas before settling on the optimal solution to the problem. Sustainability development's guiding concepts must be taught to students of architecture.

- Recommending adding educational courses and workshops for students in the academic year to learn and practice Three-Dimensional Modelling and have a role in increasing students' creativity.

- Recommending the repetition of organizing competitions for designing architectural projects for students, as the design of the project on a competitive basis and raising the spirit of challenge played a role in increasing creativity and innovation among students.

- It is highly recommended to educate the entire university community about the importance of sustainability through workshops and campaigns that will stimulate the architect to think creatively and innovatively.

- It is recommended to deal with sustainability in various disciplines and fields in architecture.

-Integrating innovative methods in learning enhances and improves students' productivity and skills.

-Recommending updating the curricula in architecture, Curriculum that meet the current requirements of society.

References

[1] Shari. Z, Fakri.M, "Integration and Implementation of Sustainability in Malaysian Architectural Education",. Annual Conference of the Architectural Science Association ANZAScA, 40th,2006, pp239-246.

[2] Kharrazi, A., Qin, H., Zhang, Y, "Urban Big Data and Sustainable Development Goals: Challenges and Opportunities. Sustainability",2016, 8(12):1293. DOI: 10.3390/su8121293.

[3] Shah, J., Smith, S., and Vargas-Hernandez, N. "Metrics for Measuring Ideation Effectiveness", Design Studies, 2003, 24, pp. 111-124.

[4]Christiaans, H. H., "Creativity as a design criterion", Communication Research Journal, 2002,14(1), pp. 41-54.

[5]Summarize of Cole, R. J., & Anderson, J, " Sustainability and green building in higher education: What's happening?" Journal of Cleaner Production, 2018,172, 4205-4217.

[6]Downton, P., & Harrison, L., "Architecture in education: Design as a pedagogic tool to promote sustainability". Design Principles and Practices: An International Journal, 2013, 7(1), 259-270

[7] Steemers, K., & Yannas, S, "Education for sustainable architecture". Building Research & Information ,2017, 45(4), 427-431

[8] Eilouti, B. "Concept evolution in architectural design: an octonary framework". Frontiers of Architectural Research, 2018, Higher Education Press Limited Company. Production and hosting by Elsevier. https://doi.org/10.1016/j.foar.2018.01.003

[9]Scarlett R, Samuel T, Elizabeth S, "How Should We Measure Creativity in Design Studies? A Comparison of Social Science and Engineering Approaches", International Design Engineering Technical Conferences and Computers and Information in Engineering Conference, 2020, IDETC/CIE.

[10]Lance N, Mynor P, Carlos P, Victor R, Damian S, Jillian S, Louisa S, Tadeh Z, David B, "Undergraduate Design and Analysis of a LEED Certified Building", Journal of Civil Engineering and Architecture, 2022, 227-234 doi: 10.17265/1934-7359/2022.05.001

[11]Paola S. F, "Emmanuel. R Sustainability in higher education: a systematic review with a focus on management education", Journal of Cleaner Production 106:P.P 22-33, 2015. doi: http://bit.ly/1mStOhe.

[12] Spiridonidis. C, Voyatzak .M, "Educating Architects Towards Innovative Architecture", Editions EAAE Transactions on Architectural education no 50, 2011,, ISBN 978-2-930301-48-8.

[13] Khashe, S., Heydarian, A., Gerber, D., Becerik-Gerber, B., Hayes, T., and Wood, W, "Influence of LEED Branding on Building Occupants", Pro-Environmental Behaviour." Building and Environment, 2015, 94: 477-88.

[14]A Saker. Mohamed, "Harmonizing Human Needs and Sustainability in Islamic Architecture: A Case Study of Zenab Khatoun House" FACULTY OF ENGINEERING – SOHAG UNIVERSITY. Sohag Engineering Journal (SEJ), 2023, Vol. 3, No. 2,

[15] UNESCO/UIA. (2004) UIA Work Programme 'Education' UIA/UNESCO Charter for Architectural Education.

[16] Ambrose, G. H, "Design thinking for visual communication ". (2nd ed.), 2015,. London, New York..

[17] Mussi. A , Nercolino. L , Ami, Martins. A, "Architecture, Design and Computer Science: Professional Training for Elementary School Teachers", Journal of Civil Engineering and Architecture 15, 2021, 640-653 doi: 10.17265/1934-7359/2021.12.005.

[18] Cross, N, "Design thinking. Understanding how designers think and work", (Reprinted ed.). 1 st ed,2019, London.

[19] Ar. Shibli Meraj, P, " Appropriate Teaching and Learning Strategies for the Architecture Students". International Journal for Research in Applied Science & Engineering Technology (IJRASET), 2019, Volume 7 Issue V. www.ijraset.com.

[20] Randolph.J and Gilbert M. Masters, "Energy for Sustainability: Technology, Planning, Policy," Island Press. Washington,2008, DC. pp. 213- 250.

[21] Altın M, "Future of Architecture: Buildings as Power Plants" Journal of Civil Engineering and Architecture 15, 2021, doi: 10.17265/1934-7359, pp 119-127.

[22] Marszal, A, " Zero Energy Building – A review of definitions and calculation methodologies". Energy and Buildings. 2010, vol 43,

issue 4, pp. 971-979. https://doi.org/10.1016/j.enbuild.

[23] A Saker. Mohamed, "Towards Developing Sustainable Design Standards for Open Spaces", International journal of architectural engineering and urban research, ONLINE ISSN 2785-9673 Volume 6, ISSUE 1, 2023, 167 – 186

[24] Machine, p. I, " Information on low-emitting materials may be found", 2008, www.buildingecology.com/iaq_links.

[25] Frank. S& Michael. H, "Collection of background information for the development of EMAS pilot reference sectoral documents: The Construction Sector", Karlsruhe Institute of Technology (KIT), 2010. pp. 198-204. Toolbase.org

[26] Yang,Y& Giard.J, "Industrial design education for sustainability: structural elements and pedagogical solution", Proceedings of IDSA National Design Education conference, 2001, Boston.

[27] Manu S, "Architectural Curriculum Enhancement for Promoting Sustainable Built Environment in India," pres. at The ACEEE Summer Study on Energy Efficiency in Buildings (Pacific Grove, CA,), 2010, P.P196-212.

[28] Yun, J. H. J., Jeong, E. S., and Yang, J. H., "Open Innovation of Knowledge Cities." Journal of Open Innovation: Technology, Market, and Complexity 1 (2)2015, 1-20.

[29] Olweny, M, "That is Too Radical For Us: Sustainable Design Education in East Africa, PLEA Passive Low Energy Architecture", Conference, 2016, Los Angeles, p. 1856.

[30] Dwaikat, L. N., and Ali, K. N, "The Economic Benefits of a Green Building—Evidence from Malaysia." Journal of Building Engineering, 2018 18: 448-553. https://doi.org/10.1016/j.jobe.2018.04.017.