## From Theory to Practice – Interior Design Education for More Sustainable Future

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*Abstract:* - This article discusses the role interior design education plays in the development of greener buildings. Through the encouragement of making sustainable design choices along the design process, the education cultivates a sustainable mindset that contributes to the development of greener spaces, buildings and communities. Even though United Arab Emirates (UAE) shows relatively low per capita CO2 emissions, its building energy efficiency score lags behind that of other nations. This research applies a two-step methodology (qualitative and experimental) to investigate the nexus between interior design, education, and Leadership in Energy Efficient Design-Interior Design and Construction (LEED ID+C) in promoting sustainable buildings design in the UAE. Qualitative methods are applied for the review and analyses of the relevant literature, while experimental measures the efficiency of integrating the LEED ID+C framework into an interior design studio as a teaching method. This experimental teaching method challenges students to comply with LEED ID+C v.4.1 reference guide from the very beginning of the design project and throughout all phases until project completion. The success of the experimental teaching methods is measured through a set of criteria that include information acquisition, knowledge and skills development, and awareness enhancement. As the participant pool varies from level two to level four students, the experiment reflects a comprehensive educational perspective. The results of this study show that such experimental teaching methods contribute to bridging the gap between sustainable interior design theory and practice by instilling sustainability consciousness and skills in students. The results also demonstrate that the experimentation eradicates the barriers to sustainable interior design practice as it relates to Information, Knowledge, and Awareness. The study concludes by highlighting the benefits of the experimental teaching method and suggests how the method can be further improved.

*Key-Words:* - Sustainable Development, Sustainable interior design, education for sustainable development, LEED ID+C, Studio teaching approach, Experimental teaching.

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## **1** Introduction

Sustainability is the aptitude of our society to be, develop, and wisely utilize the available Earth's resources without compromising the needs of the generations to come. In order to maintain the existing ecosystems of the planet, the society needs to make more sustainable choices and practice sustainable living. In 2005 United Nations (UN) initiated a global partnership through the 2030 Agenda for Sustainable Development that offers future prosperity to the planet and its inhabitants via society transformation, [1]. In this process of society transformation into a more sustainable one, education plays a significant role. The role of education in sustainable development process is also accented by United Nations Educational, Scientific and Cultural Organization (UNESCO) through the Education for Sustainable Development (ESD): A road map, [2].

ESD recognizes the quality of teaching and learning as an essential component for creating a more sustainable future. In ESD five key aspects are highlighted – policy, learning environments, building capacity of educators, youth and local-level actions as playing a substantial role, [3].

Despite the fact that the nations all over the world adapted the SDGs and ESD, sustainability is still not fully addressed in interior design practice and education, [4], [5]. Does interior design play any role in transformation of the society into a more sustainable one?

According to records, [6], from 20 to 50% of the planet resources are consumed by buildings. Furthermore, buildings worldwide are accountable for 40% of all energy used, 30% of greenhouse gas emissions and for 40% of waste that is generated by the construction industry, [4]. In addition, buildings

along with the building industry utilize 35% of the total energy that is produced globally and are accountable for 38% of the emissions, [7]. Considering that interior designers are dealing with buildings/spaces and are the decision makers, when it comes to the systems, materials and products used in buildings, they have a substantial impact on buildings' overall sustainability, [6], [8]. Interior designers, analyze the needs and behavior of building's user as well as the ways the user interacts with the surroundings spaces and suggest spaces that are functional, healthy and also aesthetically pleasant, [9], [10]. As mentioned previously, interior designers select systems (such as heating, ventilating, air-conditioning, plumbing, acoustic, day- and artificial lighting, etc.) as well as specify materials products that deliver quality and indoor environments. Therefore, the sustainability of a building, as well as the building impact on environmental and user wellbeing is significantly subject to the choices interior designers make. Bearing that in mind, is important to transform the learning environment, educate future interior designers and ensure they make sustainable choices as future practitioners. As stressed by ESD, the transformed education should not target to change the climate, but rather the minds via equipping individuals and communities with the understanding, skills and attitudes for making better choices and creating a more sustainable world and climateresilient societies, [2].

Nations around the world, including United Arab Emirates (UAE) adapted UN 2030 Agenda for Sustainable Development and as a result developed their Sustainable Development Goals (SDGs). For instance, in 2017 UAE published its 2030 Agenda for Sustainable Development and identified the 17 SDGs that aim at creating a more sustainable nation, [11]. Goal 13, for instance, aims in mitigating climate change, while goal 11 in creating sustainable cities and communities. Statistic data for 2022 shows that the CO2 emissions from residential, commercial and public services in the UAE is comparatively low (0.5)per capita) to the USA (11 per capita), [12]. However, the comparison of the buildings' score in energy efficiency of the two above mentioned countries shows that the UAE is way behind the USA (UAE 9.5 and USA 17), [13].

Considering that interior designers play a significant role in overall sustainability of a building, (that includes also energy efficiency), this research focuses on interior design education and the role it plays in changing the mindsets of students for making more sustainable choices that in its turn will contribute to designing more sustainable and greener buildings in the UAE. The research attempts to bridge the theory and practice in sustainable interior design education via application of Leadership in Energy Efficient Design-Interior Design and Construction (LEED ID+C) in interior design studio. There reasons of choosing LEED ID+C as a bridge between theory and practice are: students are aware of it due to the program curriculum; it addresses different aspects of sustainability; and it aims to deliver the triple bottom line revenues to our globe, people and the economy, [14]. The research describes an experimental teaching approach applied in the Department of Architecture at American University of Ras Al Khaimah (AURAK), where three faculty teaching interior design courses got together for increasing students' awareness in sustainability through practicing it. Through monitoring and assessing the information, knowledge and awareness students acquired during the experiment, the research concludes with listing its benefits and suggests how the teaching method can be further improved.

## 2 Theoretical framework

Due to the fact that sustainable interior design considers user's emotional and physical wellbeing along with the environmental wellbeing, it can be defined as a wholistic practice that initiates from the triple bottom line (social, environmental and economic), [4]. Interior design is described as a multidisciplinary practice that explores and bridges the two environments - natural and the human. Interior designers must be aware of architecture and engineering, building systems and materials, human behavior, ergonomics, social, economic and environmental sciences and much more, [15]. Therefore, the education in interior design is also defined as wholistic in terms of sustainability. Sustainable education in interior design is much dependent on interdisciplinary curriculum and well as on transformative and innovative teaching approaches of the educators that contribute to the preparation of a new generation of designers equipped with knowledge and skills in sustainable design and are enthusiastic about creating a new, more sustainable world, [15]. Besides the application of transformative teaching methods, interior design educators must also employ methods to meet Council of Interior Design Accreditation (CIDA) program performance criteria. Additionally, they should be aware of green building regulations and various certification programs, [16], promote to sustainability and green design through embedding it into course content and delivery methods, [15].

Bachelor of Arts in Interior Design (BAID) program at AURAK was created to meet CIDA criteria and focuses on human and environmental wellbeing. The component of sustainability is considered in each of the courses the program offers, however there are several courses that explores it thoroughly. One of such courses is Sustainable approaches in interior design that offers knowledge in sustainable interior design as well as in LEED ID+C. As seen from the Table 1, students start accumulating knowledge and skills related to sustainability starting from level 1 with increasing complexity until level 4, when they graduate.

Table 1. Sustainable design education courses in BAID at AURAK

Level	Course	Aim
1	Design Processes,	Educates students about
-	Human Factors and	the design process and
	Ergonomics	user-oriented design.
2	Sustainability and	Provide students with
-	Human-	basic knowledge in
	Environment	sustainability as it relates
	Relations	to human-environmental
		interactions
2	Sustainable	Offer in dept understating
	Approaches in	of the notion of
	Interior Design	sustainability as it relates
	U	to buildings, spaces,
		environment through
		LEED ID+C (Leadership
		in Energy Efficient Design
		Interior design and
		construction) rating
		system.
2	Interior	Explore materials and
	Construction	finishes, and their impact
	Methods, Materials	on environment and
	and Finishes 1&2	human wellbeing.
3	Environmental	Experience indoor
	Systems 1: Indoor	environmental systems
	comfort and human	selection, their integration
	wellbeing	into buildings/spaces and
		their impact on
		environmental and human
		wellbeing.
3	Environmental	Practice acoustic and
	Systems 2: Design	lighting design (including
	with light and sound	daylight) considering the
		impact design solutions
		may have on environment
		and spaces inhabitants.
4	Professional	Recognize wellness codes
	Practice 1: Codes	and regulations and rating
	and Regulations	systems (other than LEED
		ID+C)

Despite the fact that the program offers eight sustainability-oriented courses and that other courses' learning outcomes assess students' knowledge and skills related to environmental and human wellbeing too, a gap between the theory and practice is still evident. In interior design education this is often the case – sustainability theory and practice are disconnected, [4]. This discontinuation between theory and practice in education creates certain barriers to sustainable interior design practice. There are five barriers to sustainable interior design practice that are identified as: a) Economic, b) Attitude and Market, c) Information, Knowledge, and Awareness; d) Governmental, e) Technology and Training, [4]. However, this research focuses on one of them only that is the most closely related to education - Information, Knowledge, and Awareness.

## 3 Methodology

This research is divided into two steps and applies two different research methods - qualitative and experimental. During the first step of the study a qualitative research method is applied for exploring the role interior design, education, and LEED ID+C play in buildings sustainability, and executed through the survey of the relevant literature. The second step of the research - experimental, describes a method employed in teaching of design studio, where students are required to employ LEED ID+C v.4 as a guiding framework. From the very beginning of the semester, students are asked to set their sustainability goals, identify target LEED ID+C credit categories and make design decision for targets achievement. At the end of the experiment, students' achievements are measured against the criteria: a) information, b) knowledge/skills, and c) awareness. The set criteria assess student's design achievements as it relates sustainability, green building, systems, materials and products and compliance to LEED ID+C.

The participants in this experiment were students taking different levels studios: Interior Design Studio 2 focused on a coworking space design project; Interior Design Studio 4 with a thematic hospitality design project; and the Graduation Design Project, which encompassed a variety of topics chosen by the students themselves. In total, there were 25 participants in this experiment, consisting of 12 second-level students, 5 third-level students, and 8 fourth-level graduating students.

## 4 Results and Discussion

In LEED ID+C integrative process (IP) plays a key role as if offers to the designer opportunities to make better, greener design decisions related to building systems, materials and products that lead to reduction of the burden on environment and to improved user experience with the building/space. IP aims in obtaining a high-performance and cost-effective design projects through analysis of building systems and finding synergy among them. It requires that during the discovery phase of the project two of the following must be analyzed: energy and waterrelated systems, site selection, social equity, health & wellbeing, [14].

As per IP requirements, at the early stage of the project (predesign) suitability goals including health goals that safeguard the wellbeing of the environment, building occupants, surrounding community and supply chain are established, strategies for achieving those goals are developed, and outcomes anticipated. As a result of this exercise, a statement of project sustainability goals is written, LEED ID+C target credit categories are chosen and design strategies prioritized to be considered throughout all design phases of the project, [14].

#### 4.1 Bringing the Theory and Practice – Design Studio with LEED ID+C

At the beginning of the semester, during the predesign phase of the studios' projects, students were required to establish their sustainability goals (including health goals) and develop strategies for achieving those goals. To help the process of sustainability goals establishment, each student engaged in the experiment created a list of targeted LEED ID+C credit categories, specified each chosen category prerequisites and credits and developed a mind map that outlined priority goals and listed the for goals achievement. strategies required Throughout all phases of the project, the mind map that served as a guiding tool was informing students about the design choices. The map also assisted students in finding solutions to various design problems. It is important to mention here that, all students engaged in the experiment were either enrolled to the course Sustainable approaches in interior design (that was offered during the same semester) or previously successfully passed the course and that the course offers comprehensive knowledge in LEED ID+C v.4.1. The studio projects, depending on the level, were supported by other complementary courses such as Material and finishes (studio 2), Furniture design (studio 4), and Design with light and sound. All these courses also target environmental and user well-being and therefore, the assignments and projects were associated to the studios' projects. At each design stage, students were required to demonstrate how their design solutions aligned with the targeted goals and chosen credit categories. By the completion of the design projects, students were asked to prepare a comprehensive list of project sustainable features categorized as per LEED ID+C credit categories.

#### 4.2 Students' Assessment

Notably, students' achievements varied across the studios, depending on the studio level and the complexity of the projects (Table 2).

Table 2. Sustainability	goals and LEE	) targe
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categories chosen by students			
Studio	Sustainability goals	LEED ID+C targets	
Studio 2 –	Achieve synergy between building	IP	
Coworking	systems (IP) (goal 1)		
space	Reduce indoor water consumption (WE) (goal 2)	WE	
	Reduce energy consumption (EA) (goal 3)	EA,	
	(goal $d$ ) Reduce resources consumption (MP) (goal $d$ )	MR	
	Improve indoor air quality and user wellbeing (EQ) (goal 5)	EQ	
Studio 4 – Hospitality	Achieve synergy between building systems (IP) (goal 1)	IP	
± v	Reduce indoor water consumption (WE) (goal 2)	WE	
	Reduce energy consumption (EA)	EA	
	Reduce resources consumption	MR,	
	(MR) (goal 4) Improve indoor air quality and user wellbeing (EO) (goal 5)	EQ	
Graduation project –	Achieve synergy between building systems (IP) (goal 1)	IP	
Community Hub	Reduce greenhouse emissions, air pollution and promote healthy lifestyle (LT) (goal 6)	LT	
	Reduce indoor water consumption (WE) (goal 2)	WE	
	Reduce energy consumption (EA)	EA	
	Reduce resources consumption	MR	
	(MK) (goal 4) Improve indoor air quality and user wellbeing (EQ) (goal 5)	EQ	
IP – Integrativ	ve Process		
LT - Location and Transportation			
WE – Water Efficiency			
EA – Energy and Atmosphere			
MR – Materia	ls and Resources		
IQ – Indoor Environmental Quality			

Table 2 shows the sustainability goals set by students and the respective LEED ID+C credit categories targeted. For instance, most of level two students working on the coworking space design project choose to target IP, WE, EA, MR, EQ. Likewise, level three students performing hospitality project targeted IP, WE, EA, MR, EQ. However, level four students, demonstrated a wider number of targeted credit categories - IP, LT, WE, EA, MR, EQ. This is due to the fact that for level three and level four students, credits categories such as WE and EA were mandatory. The comparisons of credit categories targeted by students, show consistency despite of the level (Table 2). However, the comparison of targeted prerequisites and credits per category differs depending on the student level and the nature of the project.

Figure 1 shows that 100 percent of students applied Integrative Process (IP). From the LT credit category, 10 percent of students targeted LT -Surrounding Density and Diverse Uses and 10 percent LT Access to Quality Transit. The low percentage is due to the fact that level two students were not assigned a site, therefore they couldn't pursue LT. Due to the fact that WE and EA were mandatory for level three and four students only, WE Indoor Water Use Reduction was targeted by 60 percent of students. From AE, 100 percent of students targeted Minimum Energy Performance and 20 percent Optimize Energy Performance.



Fig. 1: LEED ID+C credit categories targeted by students

The second popular credit category among students is MR, they targeted three different credits: 10 percent - Storage and Collection of Recyclables, 70 percent - Interiors Life-Cycle Impact Reduction, and 40 percent - Sourcing of Raw Materials. And the most popular credit category among students was EQ, where students targeted nine different prerequisites and credits: Minimum Indoor Air Quality Performance (100 percent), Environmental Tobacco Smoke Control (10 percent), Enhanced Indoor Air Quality Strategies (50 percent), Low-Emitting Materials (100 percent), Thermal Comfort (30 percent), Interior Lighting (100 percent), Davlight (100 percent), Quality Views (10 percent), and Acoustic Performance (100 percent) (Figure 1).

To achieve the goal 1 - integration, students followed the requirements of IP to obtain synergy between various systems of the building by selecting them prior the start of schematic design phase of the project. The strategies applied by the students for achieving goal 2 - indoor water use reduction (WE),

were to specify WaterSense (or equivalent) plumbing fixtures and ENERGY STAR (or performance equivalent) appliances. For goal 3 achievement reduce energy consumption (EA), the following strategies were used by students: Specify high thermal performance materials for building envelope; Specify energy efficient light bulbs; Select daylight and electrical light controls; Specify ENERGY STAR (or equivalent) equipment. Reduce resources consumption - goal 4, which is associated with MR, was achieved through design for flexibility and disassembly; spaces design based on products dimensions; storage and collection of recyclables; sourcing local products; specifying certified wood products, reused or with recycled content products; specify products from environmentally responsible manufacturers that provide disclosure of material ingredients. To achieve goal 5 that was aligned to EQ, students selected several strategies such as: provide naturally ventilated spaces and operable windows, designated smoking areas and signage, provide CO2 monitoring devices for densely occupied areas, select low-emitting materials, provide thermal comfort controls, specify lamps with color rendering (CRI) at least 90, provide light controls, control glare via finishes selection with appropriate reflectance (min 80 for ceilings, min 55 for walls, and max 20 for floors), provide shading devices for daylight control, provide quality views for all permanently occupied spaces, and specify finished and furnishes with high acoustic performance.

At the end of the semester, when the projects were completed, the achievement of sustainability goals (that were set by students at the beginning of the design project) were measured using rubrics as demonstrated in Table 2. The rubrics were categorized as A and B and measured acquired during the experimentation information (R1), knowledge and skills (R2) and awareness (R3) in LEED ID+C (rubric A) and in green building, systems, materials and products (rubric B) (Table 3). The assessment of students' knowledge demonstrated that by the end of the experimentation students were informed about U.S. Green Building Council, it's mission and vision and rating systems. They could easily navigate through the website and find all the required information as well as certified projects as case studies (R1.1). They were also well informed about LEED ID+C rating system, credit categories, prerequisites and credits and their intent, as well as v4. reference guide (R1.2). Student about demonstrated knowledge of green labeling and certification programs (R1.3), were able to recognize products environmentally green (R1.4) and responsible manufacturers (R1.5).

In terms of knowledge/skills, the assessment through rubric R2, shown that students understood LEED ID+C reference guide and its content (R2.1), were able to select respective to their sustainability goals credit categories, use the guide develop strategies for goals achievement and implement them in their design projects. They were also able to list green labeling programs and select green products (R2.3) and to create a database of green products (R2.4) and sustainable manufacturers (R2.5).

Table 3.	Assessment rub	rics used	for mea	asuring
	students' acl	hievemer	nts	

	students	define verificints	
Category/	R1-	R2-	R3-
Rubric	Information	Knowledge/Sk	Awareness
		ills	
	R1.1-	R2.1-	R1.1-
	Explore	Comprehend	Promote
	USGBC and	LEED ID+C	LEED ID+C
	green	v.4.1 reference	certification
	building	guide	
	rating	-	
A-LEED	systems		
ID+C	R1.2-Survey	R2.2-Apply	R3.2-
	LEED ID+C	LEED ID+C	Promote
	v.4.1	for design	sustainable
	reference	project	design
	guide		C
<b>B-Green</b>	R1.3-	R2.3-List green	R3.3-
building,	Recognize	labeling and	Promote
systems,	green	certification	green
materials	labeling and	programs	building
and	certification		design
products	programs		
	R1.4-	R2.4-Create a	R3.4-
	Identify	database of	Promote
	green	green products	green
	products		systems,
			materials
			and products
	R1.5-	R2.5-Produce a	R3.5-
	Distinguish	data base of	Promote
	green	environmentall	environment
	manufacture	y responsible	ally
	rs	manufacturers	responsible
			manufacture
			rs

The results of assessment through rubric R3 – Awareness, demonstrated that students were keen to increase public awareness and promote LEED ID+C (R3.1), sustainable interior design (R3.2), green materials and products (R3.4) and environmentally responsible manufacturers (R3.5). These was done through posters and oral presentation during the open jury week, an event held by the department, to which were invited local industry representatives, high schools, students and staff of the university as well as students' families and friends.

## 4.3 Limitations and Challenges

The experimentation encountered several constraints, imposing considerations for the interpretation of the findings. These limitations offer insights into the scope and context of the study.

1. Temporal Constraints: An inherent limitation emerged from the constrained timeline of the projects, limited by the 16-week duration of the semester. The students faced time limitation challenges to comprehensively achieve their goals within the allocated timeframe, especially those related to sustainability and health objectives.

2. Prior Knowledge of LEED ID+C: We observed a clear variation in student's familiarity with LEED ID+C since their main exposure came from a single course, the depth of its implementation in design projects might have been uneven. This challenge will be addressed in the future by considering additional exposure to LEED ID+C concepts throughout the program.

3. Digital Visualization Skills: The variability in digital media representational skills was also an important challenge that impacts student's design decisions digital implementation to demonstrate exactly how their designs make spaces healthier using digital tools.

4. Sourcing Sustainable Manufacturers and Suppliers: It was challenging for students to find sustainable sources intended for their projects due to resource and time constraints. This challenge will be addressed in the future by considering providing access to green supplier databases and/or offer more time for research.

5. Unexplored Role of Technology: We observed limitations in the allocated time for students to properly address and experiment with the role technology to foster healthy interior. Students had some great ideas for using technology to make spaces healthier, but they needed more time to really test out how well these features would work in their designs.

These above limitations provide a nuanced understanding of the experimental framework and inform the interpretation of the findings within their context. While they contribute to shaping the study's scope, they also point out potential directions for future research, aiming to overcome these challenges and broaden the study's implications.

## **5** Conclusions

This study has delved deeply into the integration of the Leadership in Energy Efficient Design-Interior Design and Construction (LEED ID+C) framework within interior design education, catalyzing the advancement of sustainable building design practices in the UAE. The results of the shows that students were able to make greener design choices for their studio design projects. As from the beginning of the project students established their sustainability goals based on LEED ID+C pre-requisites and credit categories, and designed strategies for goals achievement, they were able to achieve synergy between building systems and produce not only greener but also better-quality projects. The findings of this research also demonstrate that students became more informed about green buildings and rating systems (LEED ID+C), students' knowledge and skills on green design were improved and they became more aware of sustainable design possibilities. Furthermore, due to the requirements set for the studios (to follow LEED ID+C reference guide), students were able to practically apply their knowledge in sustainably they obtained in other courses. As such, this experimental method shows its potential in bridging the sustainably theory and sustainability practice.

Moreover, with the newfound passion for sustainable design ignited among students, a future emerges where these individuals will carry forward this enthusiasm into their professional practices, thereby promoting sustainable design principles in the UAE interior design practice.

It is important to acknowledge that this study recognizes the limitations, including the sample size and the context-specific nature of the findings. As the path forward unfolds for the broader implementation of LEED ID+C integration in interior design education, addressing these limitations becomes crucial.

As sustainable design continues its dynamic evolution, this study invites further research and experimentation to explore the even deeper transformative potential of education, underscoring its role in nurturing a more sustainable built environment. In future research, the authors will extend the experimentation to the 2023-2024 academic year, in which a larger number of students will be engaged and the limitations considered with the aim of outcomes of the experiment improvement.

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#### Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

- Liudmila Cazacova and Anis Semlali designed, and implemented the experimentation, and assessed the achievements of students.
- Liudmila Cazacova gathered the qualitative data.
- Anis Semlali systemized the experimental data.

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#### **Conflict of Interest**

The authors have no conflicts of interest to declare.

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