THE ROLE OF THE DESIGN STUDIO IN SHAPING AN ARCHITECTURAL EDUCATION FOR SUSTAINABLE DEVELOPMENT: THE CASE OF BEIRUT ARAB UNIVERSITY

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Abstract

The level of interest in integrating understanding of sustainability into higher education is steadily growing. This paper investigates the principles of embedding this understanding in architectural pedagogy. It focuses on the role of the design studio as the heart of the architectural education process. It develops an approach that integrates both macro and micro-scale analysis to investigate the transdisciplinary and interdisciplinary aspects in architectural education. A questionnaire survey was carried out within the Faculty of Architectural Engineering at Beirut Arab University to assess the performance of five related elements: the education location, the curriculum, the external and internal characteristics of the design studio, and, finally, the evaluation process. The findings show lacking of synchronization between different interlocking disciplines and majors at university level. In addition, a clear individualism and a traditional studio culture are witnessed as main obstacles towards achieving cumulative experiences needed for sustainability understandings. Finally, the paper uses these findings to assure the need for a more comprehensive approach that draw the relation between macro- and micro-scale interventions to guarantee a better performance of the transdisciplinary and interdisciplinary aspects in architectural education.

Keywords

Architectural Education; Design Studio; Sustainable Development; Interdisciplinary; Transdisciplinary

Introduction

The momentum behind integrating knowledge about sustainability into higher education has been steadily increasing since the Stockholm Declaration of 1972 (Alshuwaikhat, and Abubakar, 2008:1777). Embedding these understandings has caused insightful shifts in educational paradigms. One aspect of these shifts is the movement of the focus from content and predetermined learning outcomes towards the nature of the learning experience. This vision is concerned with the kind of experience that is necessary if we are to care for personal or social transformation towards sustainability through learning (Sterling, 2004:52). Another important aspect is the move towards 'transdisciplinary knowledge' as the most suitable framework for conducting the complex and complicated practical realization of sustainability dimensions. Blewitt (2004) argues for the increasing role of knowledge that extends beyond the rules and perspectives of single subject discipline.

Gibbons et al. (1994) identify four features of this 'transdisciplinary knowledge': it develops a distinct but evolving framework to guide problem-solving efforts; the solutions involve movements in many directions, theoretical and empirical work, the diffusion and dissemination of new knowledge to participants that take place through rather than after this process; and finally, it is dynamic and constantly evolving. These features draw both the outlines required to embed the understanding of sustainability in education and the criteria used to set the problem in higher education at a number of universities (Blewitt, 2004:2).

Embedding sustainability in architectural pedagogy has brought a new paradigm of thinking about the manner in which architects, urban designers, and planners approach the design of built environments (Salama, 2002:51). This paradigm has to be seen within a wider understanding of the transdisciplinary thinking as a shifting attitude about the education for sustainable development. However, the challenge stands as how to integrate these shifting paradigms into architectural pedagogy.

Figure 1: Macro and micro scale of the study. (Source: Author).

This paper investigates the role of the design studio - as a major component of architectural education (Beamish, 2002:133) - in embedding the understanding of sustainability in architectural education. Its existence as the main forum of creative exploration, interaction, and assimilation in architectural education (Salama, 1995:1) formulates its potential role as a parameter for measuring the sustainability outcomes in the whole process of architectural education. This paper builds upon this understanding to analyze the role of the design studio for the Faculty of Architectural Engineering at Beirut Arab University. It investigates this role through the study of two different but compatible scales (see figure 1). The macro scale study addresses the principles of embedding (ESD) in higher education in general. These principles draw the broad outlines that the architectural education has to fit within to achieve the needed transdisciplinary and interdisciplinary understanding. The micro-scale study draws the link between the ESD in architectural education and the design studio as the core place of this type of education-related activity. Finally, this paper identifies five aspects related to this activity: place, curriculum, external aspects, internal aspects, and evaluation as an area of its micro-scale detailed study.

Research Methodology

This study design encompasses a three-stage approach to investigate the role of various variables that work as inputs in manipulating the education for sustainable development in architectural education in general and at the design studio in particular. A critical review of the literature provides a framework for examining

the issue under study, pilot study questionnaire, and the final developed questionnaire. In addition, the study incorporates two methods of data collection: document analysis and a questionnaire survey, which were designed to generate both statistical quantitative and qualitative data, this would yield explanations concerning the opportunities for and barriers to embedding ESD in the design studio. Specific respondents' comments were selected from the questionnaire sheets, which either illustrated a generally representative view or offered particularly interesting explanations (Jones et al., 2008:343).

Questionnaire

The questionnaire was designed to identify how educators perceive education for sustainable development as incorporated into studio-based architectural design education. The questions are focused mainly on the curriculum, the external and internal aspects, and the evaluation process. Questions were based on literature in the areas of ESD, architectural education, validation and accreditation, survey methods, and a pre-test survey. The questionnaire included only closed-ended questions with a comment area at the end (Milburn and Brown, 2003: 47-48). A rating system was developed based on a Likert-scale from 1 to 5, in which 5 is excellent. The sample included male and female students and encompassed the last three levels in the architectural design studio (third, fourth, and fifth level students) The responses were analyzed using a framework approach (Ritchie & Spencer, 1994), which involved a process of systematically coding and grouping data to provide a coherent thematic framework (Jones et al., 2008:344) to group comments reflecting similar attitudes.

Education for sustainable development (ESD) in higher education

The most, as widely acknowledged by literature, accepted rational for incorporating sustainable development in education is given in Agenda 21 at the UN Conference on Environment and Development - UNCED (Earth Summit, 1992) (Warren, 2004:104). This 40-chapter agreement, in its 36th chapter addresses that "Education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues. Despite, basic education provides the underpinning of any environmental and development education, the latter needs to be incorporated as an essential part of learning" (cited in Blewitt, 2002, p3). After about a decade of this agreement, the UN declared 2005 till 2014 as a Decade of Education for Sustainable Development.

Among the three sustainability dimensions (environmental, social, and economic), it is often the environmental angle that comes to the fore in ESD (Brunton, 2006:38). 'Greening the university' or 'greening the curriculum' have become commonly used phrases that tend to refer to the integration of environmental perspectives into university operations and teaching (Alabaster and Blair 1996). This is rooted in the analogy between the developments of environmental and ecological education and the understanding of sustainability. While the field of ecology shifted from a problem-solving focus to a systems approach stressing connectivity and relationships between organisms and communities (Capra, 1996), the epistemology of sustainable development literacy builds upon this shift with the addition of an emphasis on the interrelationship between

human and natural systems (Gough, 2002). Norgaard (1994) expanded this perspective by describing human and natural systems as co-evolutionary (Dale and Newman, 2005: 356). However, the comprehensive understanding of sustainable development literacy should go through all of its three spheres; the economic, the ecological, and the social. (Dale and Newman, 2005 and Brunton, 2006) Recently, a number of organizations such as University Leaders for a Sustainable Future [ULSF] (1999) and HEFCE (Higher Education Funding Council for England) have worked to emphasize the three-pronged approach of environmental, social and economic development (Brunton, 2006: 38). ULSF addresses this understanding in its vision: "'Sustainability' implies that the critical activities of a higher education institution are - at a minimum - ecologically sounded, socially just and economically viable, and that they will continue to be so for future generations. A truly sustainable college or university would emphasize these concepts in its curriculum and research, preparing students to contribute as working citizens to an environmentally sound and socially just society" (ULSF 2005).

Embedding sustainability in higher education implies a shift in a paradigm that highlights the values of both interdisciplinary and transdisciplinary understandings. Dale and Newman (2005: 357) assure the importance of acquiring knowledge of "interdisciplinary and transdisciplinary research methods. They include both natural and social science methodology; multiple perspective taking and making; contextual appreciation and analysis, on multiple scales of interaction; and multiple complex systems perspectives that encompasses both the parts and the whole in dynamic interactions." They classify the required skills into facts based and process-based skills (see table 1). In this regard, adaptability stands as the key to the utilization of the above skills. The basic requirement of sustainable development literacy is 'adaptive flexibility', which means "the ability to address changing conditions through a process of continuous adaptive learning and the possibility to initiate new development trajectories" (Rammel, 2003: 397). In addition, Sustainable development education encourages learners to develop problem definitions from several perspectives,

Facts-based skills	Processed-based skills
Systems theory	Systems thinking
Related disciplinary based knowledge pertaining to the ecological, social and economic imperatives	Interdisciplinary and transdisciplinary research methods
Natural and social science research methodologies	Perspectives taking and perspectives making
Action research	Contextual appreciation and analysis
Governance	Barriers analysis
	Backcasting and scenario building
	Multi-stakeholder processes
	Values articulation

Table 1: Sustainable development literacy skills (Source: Dale and Newman, 2005:357).

and most critically, from interdisciplinary and transdisciplinary critiques and perspectives (Dale and Newman, 2005: 357). Moreover, Rassool (1999) assures the importance of 'multi-literacy' as a concept that introduces the idea that our civil societies have to become knowledgeable and literate of the general approaches to interdisciplinary problems.

Sterling (2004) highlights the most important features of the sustainable education paradigm as "implies embedding, embodying and exploring the nature of sustainability as intrinsic to the learning process. This is education 'as' sustainability – nurturing critical, systemic and reflective thinking; creativity; self-organization; and adaptive management - rather than education 'about' sustainability, or education 'for' particular sustainable development outcomes."

Education for sustainable development (ESD) in architectural education

As many other disciplines, the movement from modernism to post-modernism has profoundly affected the approach to architectural design. While the modernist movement has encouraged the perception of the designer as supreme creator, making decisions based primarily on aesthetic, financial, theoretical, and political concerns, the move to post-modernism has placed a greater emphasis on issues, such as social responsibility, sustainability, environmental responsiveness, environmental integrity and human health (Milburn and Brown, 2003: 47). Salingaros and Masdenm (2008) call for a new paradigm that reveals a greater concern to structural principles found in the physical universe, supplemented with a deep understanding of the human psyche: of human needs, activities, and perceptive mechanisms. This shift is clearly reflected in architectural education. Salama (2008) depicts it as a shift from 'Mechanistic' to 'Systemic' pedagogy, where the latter works for a more integrated vision for education as part of a process much of which takes place within society. He highlights three knowledge content areas emerging to reflect continuous shifts in knowledge content. These are: environment behavior studies - EBS, sustainability and environmental consciousness, and digital technologies or virtual practices (Salama, 2007). Regarding sustainability, he argues for the challenge of embedding knowledge content that works for the practice of interdisciplinary and transdisciplinary and to develop lifelong learning skills in architectural design education.

This changing attitude towards architectural design highlighted teaching sustainable design to architects as a fundamental base for their study (Fleming, 2002: 146). However, the challenge is to put this need in such an operational way. Esmail Baniassad (2001), Chair of Architecture at Chinese University of Hong Kong emphasizes this point as he says "The challenge of sustainable design education lies not in our recognition of the need for a change in our values. It lies in how to take it beyond a mere change in our verbal vocabularies. The challenge is to go beyond intentional to operational.

As a response to these challenges many architectural programs have struggled to find solutions which lie a common goal of establishing opportunities within the design studio pedagogy to incorporate collaborative and interdisciplinary teaching and learning as

a key factor in achieving future sustainability (Fleming, 2002: 147). The argument lies beyond this assumption is that designing for sustainability is a more complex process that requires a horizontal multidisciplinary interventions from the outset of a given project (Fleming, 2002: 147). Douvlou (2006) suggests a problem-based learning as an approach in the teaching of sustainable design. Boyer and Mitgagng (1996) asserts this vision; "Sustainable architecture suggests a curriculum built around collaboration and team work, not only with other architects but with other disciplines". Accordingly, achieving a high level of sustainable design comes through teaching the students how to work together and across disciplines. One good example of developing strategies to integrate sustainability into curriculum is in the 'Educating Architects for Sustainable Future' - EASE from Ball State University. These strategies include "developing a fabric of many voices in studio instruction ... replacing the architect as hero model with architect as team player; and promoting an interdisciplinary/collaborative approach among designers, sociologists, ecologists, etc" (Boyer and Mitang, 1996). The need for this multimodal character is insured in the practical world. The NAAB (the sole agency authorized to provide national accreditation to professional degree programs in architecture in the USA), states programs are "to produce graduates who: . . . are able to solve architectural design problems, including the integration of technical systems, health and safety requirements. They comprehend architects' roles and responsibilities in society" (NAAB, 1998). The process of accreditation requires that students of the program possess skills and knowledge defined by a set of performance criteria (NAAB, 1998).

Attaining the needed collaborative and interdisciplinary teaching and learning as a key factor in achieving future sustainability raise the question about how to integrate sustainability into the fabric of the architecture curriculum. Wright (2003) classifies three different approaches to introducing sustainable design into the curriculum regarding its degree of intervention. All of these approaches include the assumption that sustainability already permeates the curriculum by its nature, expansion of the existing courses concerning environmental systems, and the revision of the entire curriculum to fully integrate the subject (Wright, 2003: 102). The first approach is based on the belief that sustainable design is so fundamental that it is simply a part of all we do in architecture and therefore must permeate the entire curriculum by its very nature. "Furthermore, all courses simply begin with the assumption that the affinity of architecture with the natural processes is historically based, theoretically critical and a technically inventive way to (re) inform design" (Wheelwright, 2000). However, this approach assumes the sustainability understandings are rooted in all aspects of different courses. Wright addresses this approach as "it supports the premise that sustainable design is so fundamental to architecture that it should not be necessary to address the subject outside of the normal theory and practice" (Wright, 2003: 102). However, this approach seems to be too idealistic as it assumes that the faculty will act on their own accord and introduce sustainability into all aspects of their area of teaching emphasis, which is actually not achieved. The second approach builds upon the already existing courses related to environmental control systems - ECS. It utilizes the technical knowledge - normally presented

in these courses - to develop an understanding of the building elements, which pertain to the modification of the microclimate for purposes of human use and comfort (NCARB, 2000). This approach makes minor intervention to the curriculum as the overall curriculum remains largely unchanged and the importance of the ECS subjects and environmental topics in related courses are increased. In addition the curriculum has to be adapted to contain more in depth courses in environmental controls (Fraker, 2000).

While having an advantage that the faculty who has an understanding of the technical aspects of the subject material is central to the introduction of sustainability into other areas of the program, this approach is criticized for a number of defects. The first is the shrinkage in the importance of a number of courses including the design studio compared with the growing importance of ECS subjects. The second is narrowing the responsibility of conducting the sustainability understandings to a very few faculty that may not be in a position to fully integrate the subject into the design studio 'they are not the individuals guiding the design theory in the program' (Wright, 2003) put a limitation to this approach. However, this approach needs to highlight the technical aspects of sustainable design with the possibility of understating the need to place the issues in a larger context within the program (Wright, 2003: 102). The third approach draws a wide range of integrating the sustainable design understandings into all the course work and states it in the curriculum, which needs drastic changes to curriculum to be reviewed and revised to introduce sustainability. One good example of such comprehensive approach is the center for Regenerative Studies at Cal Poly Pomona where it offers a physical community where students from different majors live, study, and work together in a permaculture setting (Fleming, 2002: 147). This approach is characterized by including the entire faculty in the subject of sustainability and ensures the integration of the subject into all the course work, including the design studio (Wright, 2003: 103). The difficulties of this approach are that it needs a commitment of the entire faculty to the exploration of the subject and requires a complete revision of the curriculum, which is practically not easy to achieve.

The actual challenge at the pedagogical level is how to develop design projects to promote an interdisciplinary setting regarding the traditional cultural misunderstandings and sometimes confrontations. This needs a comprehensive organization and commitments at different levels (Fleming, 2002: 152). Esmail Baniassad (2001) asserts that, the challenge is deep and that the change it necessitates will be fundamental. It is not going to be met by the addition of information on top of existing programs of architecture, nor will it be met by general statements of intention. Among these operational challenges, a number of obstacles stand against achieving more advances. On the one hand, many architectural faculties do not care enough about the issues or cannot find ways to integrate a new pedagogical focus into the traditional design studio settings (Fleming, 2002: 146). On the other hand, shallow interventions in the already existing curricula by adding more information to already overburdened studio pedagogy bring about another obstacle. One more important obstacle is the long-established thoughts of

studio professors about the dominance of a building's form and aesthetics over the more technically demanding and postmodern goal of designing a sustainable building.

Design Studio and Education for Sustainable Development: Beirut Arab University (BAU) as a Case Study

The undergraduate program offered by the Faculty of Architectural Engineering was launched in 1962 as the fourth faculty at Beirut Arab University (BAU). This was one of the early programs in architectural education in Lebanon. Since its launch, the program has been revised on several occasions to accommodate feedback from students, industry and, lately, from the accrediting bodies (especially the RIBA). The program was upgraded from the extended academic year system to a two-term scheme in 1993. More recently, in 2005, the faculty implemented the Credit Hour system, which spreads over a 10-semester period (minimum). The faculty in its mission highlights the main features of its education perspective, which were consequently reflected in its curriculum. The main aspects could be seen as focusing on the core areas of the profession, providing the proper educational atmosphere, embedding the sense of responsibility towards society, culture and the environment, and, finally, advancing architectural knowledge.

The program encompasses a total of 180 credit hours, 36 credits in each of the five study areas. These credits are taken as follows:
- 132 Credit of mandatory courses, consisting of the fundamental structure of the program, which include Design Studios, Execution Design, the essential theoretical and technical requirements, and courses in Civil Engineering.
- 32 Credit of faculty elective courses, divided into two levels; 16 Credit In the preliminary & intermediate levels, and 16 Credit In the advanced level (with a total percentage of 17.8% of total taken credits).
- 16 Credit as general university requirements divided into 5 Credit Mandatory university courses and 11 Credit In elective university courses (with a total percentage of 8.9% of total taken credits).

The design studio takes up 10 Credit at each level (from the first to the fourth) and 15 Credit at the fifth level (of these credits, 10 Credit are for the graduation project), representing the largest share among all the studied courses (about 30.6%). The subjects related to the engineering program (Civil and Mechanical Engineering) take up 12 Credit, studied along the five levels of the program, with a percentage of about 6.7%. The program in its elective division imparts a number of courses that provide a basis for an understanding of sustainable development. However, the role that these courses play varies widely according to their type and the level at which they are taken. These courses are distributed along three levels: preliminary, intermediate, and advanced. The preliminary level contains Environmental Studies, Environmental Sustainability in Architecture, and Social Studies in Architecture, the intermediate level contains Architectural Landscape and Urban Landscape, and the advanced level contains Vernacular Architecture, Design and Building Economics, Building Reuse, Conservation of Historic Buildings, and Environmental Assessment.

Design Studio

The study in the Faculty of Architectural Engineering at BAU depends mainly on

the design studio as the backbone for the architectural education. The weight and time it takes reflects its importance. However, it takes up about 27.8% (5/18) of the total credit hours studied each term and about 35.7% (10/28) of all teaching hours. The importance the design studio has is consistent along the five levels of the study - two modules in each level, and succeeding in each of these levels is a prerequisite to move to the higher one. This guarantees attaining the needed cumulative knowledge while upgrading through these levels. The first level - in both of its two modules, the first and second term - is directed towards the study of the architectural design fundamentals. Starting from the second level, the studio-based design education places an emphasis on analysis, research and experimentation as an important part of the design process, which pave the way to coming to a proper design. At this level, the design studio represents a basis for the understanding of architectural design as a response to the increasing complexity of ethical, social, conceptual and formal conditions, such as sustainability, identity, cultural imperatives, and modes of realizing architectural designs. Students are asked to make designs in response to specific aims including modular design, architectural space grouping, articulation of space and functional relationships. In the second module of this level, the design studio draws a number of constraints as a problem-based study approach regarding the building and site relationship, environmental aspects and site planning. The third level builds upon the previous two levels. The students are asked to develop design projects based on the disciplinary or interdisciplinary theme of the design studio. Detailed knowledge of a specialist or interdisciplinary aspect of design is required, as are its oral and graphic presentation and demonstration. In addition, a set of aims are to be fulfilled regarding the process of site analysis, space organization (interior and exterior), structural systems, forms, the advanced study of building context, the development and creation of architectural character and identity in the design of spaces and buildings. The fourth level comprises the study of more complicated patterns of space, form, functional relationships, and circulation. In its second module, the design studio-based study draws a more comprehensive approach, as it links all the physical, social and economic aspects of more complicated projects. In addition, land use, circulation, densities, and structural systems are deeply studied. The fifth level emphasizes design studio topics requiring theoretically informed and viable architectural solutions. The studio work is coupled with extensive analysis, research and experimentation. In addition, it focuses on giving general training to handle large architectural problems with special emphasis on all the professional and technical problems through research work, the formulation of concepts, and design processes. The graduation project represents the second module of this level. It encompasses a comprehensive design project that shows the formulation of all the previously studied skills.

The previously addressed studio-based levels for design education show that embedding sustainability understandings, concepts, applications, and methods is not placed at the heart of the curriculum's objectives. However, the importance given to some related concepts along the five levels draws the main contributors to promote sustainability foundations during the study. In addition, the

flexibility of the curriculum and the wide range of its interpretation perspective enable the professors and instructors to have an important impact on the education process within the studio.

Questionnaire Results and Discussion

Questionnaire design

A questionnaire survey was designed and issued at the beginning of the semester to all students enrolled in the design studios at the third, fourth, and fifth levels. Students were asked to complete the questionnaire during the design studio, which helped to ensure a good response. There was no participation of studio professors or teaching assistances while completing the questionnaire to eradicate their impacts. A sample of 103 students (31 in the third level, 43 in the fourth level, and 29 in the fifth level) out of 177 students completed the questionnaire.

The questionnaire design contained five main related aspects to investigate the role of design studio in conducting concepts and understanding concerning the sustainability. These aspects include the place, the curriculum, the external aspects (outside the studio), the internal aspects (inside the studio) and the evaluation process. In addition, the students were asked to rank different sustainability dimensions - environmental, social, and economic - regarding three criteria (the design proposal, the guidance presented at the studio, and the previously studied courses). However, the comments given at the end part of the questionnaire (48 out of 104 respondents) show the interest of respondents in integrating sustainability aspects in architectural education and its related aspects.

The five aspects selected for investigating the role of design studio in embedding ESD in architectural pedagogy were concluded mainly from the literature review. The place of the study comes as the first of these aspects. It asks about the impact of the surrounding environment on the attainment of sustainability practices and concepts. However, it identifies different levels of enclosure for the study; the site, the building, and the studio. The second aspect is the curriculum. In this regard, the respondents are asked to rate the impact of studying mandatory architecture and engineering courses and the elective courses of both the faculty and the university. The last question in this part tries to link the cumulative knowledge of sustainability developed along the hierarchical levels of design studios. It asks respondents to rate the contribution of the previously enrolled design studios in attaining an understanding of sustainability. The third part asks about the impact of the external but related aspects of the design studio. It investigates the role of students' own research about different sustainability concepts, its aspects, the site visit and the impacts of both physical and social contexts. The fourth part - as the core of this research - asks about different characteristics inside the studio. It asks the respondents to rate the role of the following items: the theoretical lectures (about aspects of sustainability and the resulting understanding) given at the studio, the instruction given by both the teaching staff and teaching assistances, the teaching techniques used in the design studio, the discussions within the studio with respondent's colleagues and the collaborative (oral) discussion of design proposals. This part also asks two rating questions about modeling (either mathematical or computer-based) to evaluate

the design proposal regarding its sustainability aspects, and the other one concerns discussing design proposal with specialists regarding any of the aspects of sustainability. Finally, the last part asks about evaluation as a final part of the educational process.

Results and Discussion

This part of the study follows a methodology that correlates the numerical findings of the questionnaire to the respondents' comments. It interprets the questionnaire findings horizontally and vertically, as it links between the three levels of the study in addition to comparing different aspects at the same level. However, the general reading of the questionnaire's findings shows the high score of the fourth level respondents towards almost all of the asked questions compared with those of the third and fifth levels; this reflects the importance given to promoting the understanding of sustainability in the design studio. Another important note is that the respondents were interested in answering the questionnaire, and their feedback shows a positive attitude towards the educational process. One respondent in the third level comments that "…I encourage such researches and questionnaires in order to have scientific records of the critical problems according to sustainability relative to architecture."

Sustainability dimensions

The findings of the questionnaire show the unbalanced importance given to different sustainability dimensions. The environmental dimension scores the highest compared with both social (the second) and economic (the third). This is consistent through all study levels and all architectural studio-related elements - the previously studied courses, the guidance presented at the studio, and the design proposal (see table 2). The respondents' comments cover these areas and point to evaluation as another important aspect. The comments come to show the need for more

To what extents do the following items give importance to ?	3rd Level	4th Level	5th Level	AV
Your design proposal				
Environmental sustainability	3.84	4.23	4.21	4.09
Social sustainability	3.55	3.70	3.34	3.53
Economic sustainability	2.58	3.16	2.83	2.86
The guidance presented in design studio (by teaching staff and assistants)				
Environmental sustainability	3.71	4.28	3.03	3.67
Social sustainability	2.87	2.72	2.72	2.77
Economic sustainability	2.71	2.81	2.69	2.74
The previous studied courses				
Environmental sustainability	3.68	3.79	3.55	3.67
Social sustainability	2.81	2.49	2.83	2.71
Economic sustainability	2.84	2.98	2.62	2.81

Table 2: Findings of the questionnaire regarding sustainability dimensions. (Source: Author).

To what extent do the following items affect your sustainability understandings?			3rd Level	4th Level	5th Level	AV
1.	**Place**					
	1.1	The layout of BAU Campus in Debbieh and its natural features	3.35	3.44	3.34	3.38
	1.2	The building of the Faculty of Architectural Engineering	3.10	3.44	3.14	3.23
	1.3	The Studio Layout	3.00	3.09	2.72	2.94
2.	**Curriculum**					
	2.1	The previous studied mandatory courses (Architectural courses)	3.45	2.81	3.59	3.28
	2.2	The previous studied mandatory courses (Engineering courses)	1.87	1.95	2.10	1.98
	2.3	The previous studied faculty elective courses	3.00	2.67	3.21	2.96
	2.4	The previous studied university elective courses	1.55	1.98	1.72	1.75
	2.5	The previous studied programs of architectural design (in previous levels)				
		2.5.1. Second Level	2.90	2.51	2.17	
		2.5.2. Third Level		2.72	2.86	
		2.5.3. Fourth Level			4.34	
3.	**External Aspects (outside the studio)**					
	3.1	Your own search about sustainability and its related aspects	3.19	4.05	3.97	3.74
	3.2	The site visit (project location)	2.94	3.14	3.10	3.06
	3.3	The physical context of the project	3.29	3.28	3.28	3.28
	3.4	The social context of the project	2.71	3.09	2.72	2.84
4.	**Internal Aspects (inside the studio)**					
	4.1.	The theoretical lectures (about sustainability aspects and understandings)	3.10	4.44	3.59	3.71
	4.2.	Guidance presented by teaching staff	3.19	3.88	2.69	3.26
	4.3.	Guidance presented by teaching assistances	3.16	3.35	2.66	3.06
	4.4.	Teaching technique in the design studio	2.71	3.16	2.41	2.76
	4.5.	Discussion with your colleagues	2.74	3.44	3.21	3.13
	4.6.	Collaborative (oral) discussion about design proposals	3.10	3.23	2.66	2.99
	4.7.	Were you encouraged to use any model (mathematical, computer, etc.) to evaluate your design proposal regarding sustainability aspects?	2.58	2.77	2.97	2.77
	4.8.	Discussing your design proposal with any specialist regarding any of sustainability aspects	2.23	2.77	2.93	2.64
5.	**Evaluation**					
	5.1.	The evaluation of your design proposal in its different preparation stages	2.58	3.56	2.66	2.93
	5.2.	The evaluation of your final design proposal	2.87	3.42	2.72	3.00
	5.3.	The jury discussion and evaluation of your final design proposal	2.35	2.72	2.24	2.44
Do you think that the previously mentioned sustainability aspects and indicators were taken in consideration during evaluation process?			2.55	3.33	2.62	2.83

Table 3: Questionnaire findings regarding different aspects that shape the role of the design studio in embedding the understanding of sustainability in the architectural education process. (Source: Author).

guidance regarding social and economic dimensions "The design studio makes emphasis on environmental sustainability and forgets all about the social and economic aspects. More guidance in studio according to social, economical, and environmental sustainability must be taken in consideration". The previously studied courses (mandatory and electives) do not help students to build a comprehensive understanding of the integrated typology of the different sustainability dimensions. The respondents' comments come to ensure this fact "I think we should have more courses about sustainability not only environmental one but give some importance for social and economic, we should study about the three parts of sustainability equally to produce a better project. Instead of Human Rights, Arabic, and English -university mandatory courses, Sustainability courses (Social, Environmental, and Economical) should be given". Additionally, the comments show evaluation as an added element that should place a greater focus on the environmental sustainability dimension and the evaluation make more emphasize on environmental sustainability, than social sustainability, and hardly any emphasize on economic sustainability aspects.

Design Studio

Table 3 shows the questionnaire findings and the score of each of the five mentioned aspects and their subdivisions. The first of these aspects is the place. The results show the positive impacts of the place of the study on attaining sustainability understandings. The natural features of BAU's new campus at Debbieh scored the highest compared with the Faculty building (the second) and the studio layout (the third). While there is a consensus between the respondents of the three levels on the vital role that the natural features of the site play (as indicated by the high rating score), there are differences in their perspectives towards the layout of the studio. This could be seen as the result of different studio layouts and the potential of each layout to facilitate communication and interaction within the design studio.

In spite of being one of the most important aspects, as indicated in respondents' comments, in attaining an understanding of sustainability, the 'Curriculum' and its related sub-items show the lowest scores compared with other items. The detailed results, while showing a relative appreciation for the previously studied Architectural mandatory courses, show both the previously studied mandatory engineering courses and the university's elective courses as having very minor impacts. This reflects a major deficiency in creating transdisciplinary and interdisciplinary channels as mandatory features to attaining a deep understanding of sustainability.

A respondent commented, "...I think there should be elective & mandatory courses that would guide students towards better sustainable designs...." However, the fifth level respondents show higher scores compared with both fourth and third level respondents when it comes to ensuring the impacts of the greater emphasis made at the fourth level to the understanding of sustainability. The results show a gap in the cumulative understanding of sustainability between different consecutive levels. Respondents noted that "...the study in the previous years doesn't give good sustainability background.... We need more organized system, in order to pass from level to another". While the results scored in table 3

show a consecutive increase in the cumulative understanding of sustainability between different consecutive levels (from the second to the fourth level), the comments come to show a gap in this cumulative experience between the fourth and fifth level. A respondent noted that "in fifth level there is no importance for sustainability, the most important is only for architectural drawings while during fourth level the most analyzed sustainable studies where developed". In addition, the respondents' scores and comments show a lack of a comprehensive vision for embedding sustainability understandings in architectural education distributed along different levels of the study. Respondents commented, "There must be more progress and new ideas and methods to incorporate sustainability within our design studio moving from one level to another.... We want from the faculty to begin the sustainable studies from the second level and to give a big part of the grade to the sustainable in the final evaluation and jury".

The questionnaire's findings show the important role that the external aspects (outside the studio design) play in attaining sustainability understandings. The respondents rank their own research work -as a part of the design process- the highest among all other external aspects. One respondent noted that "the doctor talks about sustainability but it is not enough in my research I find more things that need elaboration". This growing interest in embedding research work into the design studio is faced by two obstacles, as mentioned by the respondents: teaching techniques and evaluation criteria. Respondents noted that "...the staff is not giving the student chance in making any research or opinion about sustainable architecture (I think this is a major problem why we are not up to date).... Efforts done on research for sustainability aspects are not appreciated in evaluation". Among other external aspects are the awareness and analysis of the social context of the projects. This item scores the lowest among all of external aspects, which is consistent with the low importance given to the social dimension of the understanding of sustainability compared with the environmental one, as indicated in table 3.

The internal aspects come to the heart of the role that the design studio plays in engendering an understanding of sustainability. Table 3 shows a high score of the fourth level regarding different items compared with the other two levels (third and fifth), which are consistent with the previously discussed items. Among all the internal aspects, the theoretical lectures (about sustainability aspects and understandings) given within the design studio are the most important driver of attaining an understanding of sustainability. In addition, the collaborative (oral) discussion within the design studio and with the colleagues has a considerable contribute on. The two aspects that reflect a more scientific approach to dealing with the understanding of sustainability (modeling and consulting expertise) score the lowest among all the aspects, which reflect a more traditional problem-based approach to deal with the design studio. One important aspect to be considered is the impact of teaching techniques used in the design studio on attaining an understanding of sustainability concepts. This is apparent while comparing the score of this item between the third, fourth, and fifth levels (see table 3). The respondents' comments shed light on more detailed aspects. They address a number of in-studio obstacles that negatively

affect attaining extensive understanding for sustainability. The first of these obstacles is the theoretical typology of the concept that needs a lot of elaboration to be physically embedded in design projects. Respondents note that "…there is a Lack of visual application for the theoretical ideas studied within lecture halls…. The courses we study about sustainability aren't enough and their being theoretical without real testing and ways of using sustainable architecture in studio. They always talk to us about sustainability but they don't show us some good examples that can help us" "We have reached a good understanding for sustainability techniques but not for sustainability design". The last comment shows the need for more in-depth guidance that goes beyond the cliché embedding of sustainability techniques in the design process. Another important obstacle is apparent from reading the respondents' comments regarding the type of guidance they get in the design studio. This item, type of guidance, is correlated to a number of sub-items. The first of these is the difference between teaching staff in their evaluation and acceptance of sustainability concepts. These changing perspectives negatively affect the students' educational outcomes. They note that "here whenever you talk or use any questionable ideas in our design, the doctors under estimate it, they are divided about the importance of sustainability itself… some professors give a high importance for sustainable design and aspects while teaching assistances don't give the same importance for the sustainability issues." The second is the lack of coordination between different levels of design studios. This makes the knowledge of sustainability not rooted in the design process. In this regard, fulfilling sustainability requirements is treated as a prerequisite to move to a higher level, which negatively affects the cumulative experience developed along the design studios.

Evaluation comes as the final step in drawing a comprehensive vision of embedding sustainability understandings in studio-based architectural education. Table 3 shows the evaluation process as one of the weakest points among the aspects of design studio. However, part of these results is due to the usual disappointment architectural students have after any evaluation process, but linking these numerical indicators to respondents' comments sheds more lights on the negligible role that evaluation plays in intensifying the understanding of sustainability. The problem could be addressed in two areas: the evaluation during the design process and the final evaluation - jury. The results (see table 3) show the high score that the fourth level respondents gave to the evaluation process compared with both the third and the fifth level respondents. In addition, all levels show a slight change in score between the regular evaluations and the final evaluation within the design studio, which reflects a consistent use of the same evaluation criteria. This is not the case when comparing the regular design studio evaluations to the jury discussion and evaluation (especially in the case of the score given by the fourth level respondents). The respondents' comments come to cover both types of evaluation. They comment that "At the beginning, of any project we are guided to use sustainability understandings and concepts, but the evaluation come completely against these ideas this leads us to work not seriously and reflects to our non serious thinking about sustainability…. I don't think that it is taken into consideration while evaluating

our work." In addition, the respondents show their disappointment regarding the jury "The jury discussion was extremely disappointing.... I mainly used sustainable studies in my design project in fourth year. I was evaluated and discussed about it in the studio. But in jury it was not the case...the jury doesn't give importance to sustainability analysis and the importance is directed mainly to function and structural aspects."

Conclusion

While the design studio has the potential to manipulate a large portion of the factors that affect embedding sustainability understandings in the architectural pedagogy, its role has to be addressed within a wider scope of the education for sustainable development (ESD) in higher education. The shift towards more interdisciplinary and transdisciplinary practices in architectural education -needed as prerequisites to attain an understanding of sustainability - has to be managed within a wider context that connects different university disciplines. This comprehensive vision implies a participatory epistemology that seeks wholeness and reflects intrinsic and transformative values. This requires a shift from facts-based skills to processed-based skills. This implies a shift from individual learning dominated by theory and a focus on accumulating knowledge and familiarity with the content, to collaborative, praxis-oriented learning that links theory and experience and focuses on self-regulative learning and real orientation with issues.

This holistic vision required orchestrating different interlocking disciplines and majors at the macro level (university scale), seems to be lacking in the Faculty of Architectural Engineering at Beirut Arab University. The questionnaire's findings show the weak contribution of courses taken from disciplines outside of the Faculty of Architectural Engineering in attaining a proper understanding of sustainability. Both the mandatory and elective university courses and the courses taken from other disciplines (mainly from the Engineering Faculty) scored the weakest as drivers of understanding. The questionnaire's findings also show the lack of coordination between different levels of study within the Faculty. This micro-scale analysis shows the individualism in design studio teaching and a more traditionally unreceptive design studio culture that negatively affects the student's cumulative experience, which has to be developed while moving from one level to a higher one.

Parallel to the initial efforts made to integrate a sustainable pedagogy through collaborative / interdisciplinary project-based learning within the Faculty of Architectural Engineering, a number of obstacles stand against these efforts. As stated in the questionnaire's findings and comments, one of the leading and most influential obstacles is the traditional vision of design studio professors regarding changing their mindsets to integrate sustainable principles into their studios. The highest share of their attention is driven toward a typical mindset involving aesthetics and poetic form at the expense of issues such as energy efficiency, air quality and green materials. This limited vision has to be expanded to incorporate these issues as inspiration for sustainable building design in addition to building aesthetic foundation, which will always remain in the domain of architects' interest. This traditional vision of design studio professors is directly reflected to projects' evaluation within

design studios and at the final juries, which has profound negative effects on students.

Finally, this paper comes to conclude that, while the Faculty of Architectural Engineering aims to incorporate an understanding of sustainability to its educational processes, the approach it follows lacks the needed wholeness - that could be the case in many similar schools of architecture. The approach used represents a minor intervention for the curriculum by increasing the importance of environmental topics in related courses, which is not enough as it is narrowing the responsibility of promoting the understanding of sustainability to very few professors, which may not be in a position to fully integrate the subject into the design studio. A wide-ranging integration of sustainable design into the entire coursework is needed. This requires the commitment of the entire faculty to the exploration of the subject and to the complete revision of the curriculum. This draws a roadmap for all schools of architecture that shift towards more integration of sustainability understandings in their architectural pedagogy.

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