Toward a Sustainable Architectural Education: The Case of Jordan

نحو تعليم معماري مستدام في الأردن

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This study was commissioned by the Higher Education Accreditation Commission (HEAC) to assess the quality of the architecture education undergraduate program curriculum in Jordan in response to social, cultural, environmental and technological transformations.

The key questions addressed in this study explore:

Sustainability of the curricula for architectural education towards professional practice.

Learning outcomes: Providing graduates with the knowledge and skills necessary to meet the current professional demands of the market.

Program structure: curricular models for environmental education and digital architecture.

This research examines the present curriculum framework based on certain benchmarks based on the application of several descriptive, qualitative and quantitative methods. The outcome aims at proposing useful orientation that includes more effective educational model to grant access to professional practice as developed by most regulatory bodies around the world.

Keywords: Architectural Education, Curriculum, Higher Education Accreditation Commission, Jordan

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الملخص:

إن هذا البحث جاء بتكليف من ((هيئة اعتماد مؤسسات التعليم العالي))، بهدف تقييم نوعية التعليم المعماري الجامعي في الأردن، في ضوء التطورات التكنولوجية والثقافية والاجتماعية.

ومن بين أهم القضايا التي تناولها هذا البحث:

- تقييم المناهج المعمارية وعلاقتها بالمهنة المعمارية.

- مخرجات التعليم - مؤهلات الخريج بالأسس المعرفية والمهارات اللازمة لتلبية حاجات السوق المحلي والإقليمي.

- هيكلية المناهج وعلاقتها بالمعرفة البيئية والرقمية.

كما يدرس هذا البحث الأطر المعتمدة في المناهج المعمارية، ويحدد عدد من المبادئ الأساسية لفحصها بهدف التوصل إلى توجهات تعليمية جديدة أكثر فاعلية وارتباطاً مع الحقل المهني.

الكلمات المفتاحية: التعليم المعماري، هيئة اعتماد مؤسسات التعليم العالي، المناهج، الأردن

Introduction

Architectural education is a rich, varied and multidisciplinary subject that involves intellectual and practical aspects that deal with historical, social, cultural, economic and environmental constraints. . It must also adapt to climate change, globalization of economy, new knowledge and the new information society demands (QAA, 2010). As such, the study of architecture can be defined on the biases of the "knowledge and skills that are gained from the natural and social sciences, mathematics, humanities and the creative arts, which are employed to deliver solutions that respond to the people needs and to different contexts and challenges (QAA, 2010)."

Consequently, most regulatory bodies around the world believe that educational institutes, quality assurance, and accreditation commissions should assess their architecture education program. This assessment plays a crucial role as an integral part of any education process and enhances the quality of teaching to cope with the latest technological transformation, to respond to the current market and to be in line with the international accreditation standards (Martha, 2001; ARB/RIBA, 2002).

From this perspective, Higher Education Accreditation Commission (HEAC) in Jordan has sensed the thriving urge to improve the quality assurance of all educational programs at

Jordanian higher education institutions through a qualitative assessment of learning outcomes that test and measure current programs' validity, reliability and effectiveness in line with new national HEAC's requirements and international expectations (HEAC, 2016).

In August 2016, HEAC appointed a committee to assess the quality of the Jordanian architecture education program. The broad aim is to gain a deeper insight into the conditions for accreditation of architectural education curricula and for the qualification criteria that are supposed to grant access to an architectural professional practice.

While conducting this study, the researcher encountered limitations such as obtaining more responses from population (educators, practitioners, policy makers, etc.) to the survey. To fulfill this target, the end users' questionnaire was administered in several rounds. Another limitation was that of measuring student achievement to inform educational programs efficiency. Thus, quantitative/statistical analyses of the data such as: Level of Satisfaction Analysis (LSA), Factor Analysis Method (FAM) and Principal Component Method (PCM) were used to assure reliability of results.

Architectural Education Program in Jordan

Although there are 19 schools of architecture in Jordan, they deliver the same educational programs because of the Higher Education standards for accreditation of the programme as pertaining to domains of knowledge and the set of required core courses. The program module design has minimum of 165 credit hours delivered through three levels: university requirements of 2127-credit hours, faculty requirements of a 25 credit and the department requirements that are at least 99 credit hours as shown in table (1). Ten Knowledge domains, as shown in table 1, consist of theoretical courses such as basic sciences, history and theory of architecture, projects management and professional ethics, building technologies, engineering systems, and urban sciences. There are also practical courses comprised of many other courses such as design, graduation projects, architectural presentation and training. The following table illustrates the knowledge domains and courses on the present architecture program.

Table 1. General current framework of accreditation architecture program criteria for the bachelor degree (165 credit hours)

Knowledge domain	Minimum CH	
	Theoretical	Practical
A. Basic Compulsory Knowledge Domains		
History & Theory of Architecture: History of Architecture, Modern Architecture, Contemporary Architecture, Islamic Architecture, Vernacular Architecture, Regional Architecture, Art and Architecture Criticism, Behavioral studies, Architecture philosophy & Criticism, Design theories & Styles, Architectural programing & analyses	21	**0**
Building Technologies: Building construction, Advanced Building Technology	9	**0**
Engineering Systems: Mechanical Systems, Environment Control, Surveying and Building Documentation for Architecture, Surveying Lab for Architecture, Mechanics of Materials for Architecture, Structural Analysis for Architecture, Lighting and Acoustics, Structural Design for Architecture, Sustainable and Green Architecture	18	**0**
Urban Studies: urban planning, urban design, landscape, housing, Heritage Conservation	3-6	**3-0**
Projects Management & Professional: Projects Management, Professional practice, Contracts & Regulations	8	**0**
Design: Basic Design, Architectural Design, Interior Design, Workshop Drawings	10	**30**
Architectural Presentation: Architectural Drawing, Freehand sketching, Perspective, Shade & Shadow, CAAD	3	**5**
B. Supportive Knowledge Domains		
Basic Sciences: Math, General Physics	6	**0**
C. Training		
Training : 8 continuous weeks, Candidates should finish successfully 90 CH	0	**3**
D. G **E. raduation Projects**		
Graduation Project- 1: Candidates should finish successfully 120 CH	2	**0**
Graduation Project-2	0	**4**
F. Studios, Workshops & Labs		
Studios: minimum 5 studios should be available		
Workshops: minimum 1 workshop should be available		
Labs: minimum 1 lab should be available		

Research Methodology

The present study focuses on studying the undergraduate program curriculum of Architectural educational in the Jordanian Universities. The research has involved two integrated methods based on several workshops and questionnaire surveys to explore the current conditions of the curricular criteria concerning the current labor market needs. The aim is to improve our knowledge base and the quality of architectural education. The broader aim is to introduce initiatives towards a new model of comprehensive and integrated architectural design education curriculum.

3.1. Workshops on the Current Situation of Architectural Education Program in Jordan

Several workshops were conducted in the period of August to October 2016, with educators, heads of schools and departments, directors of higher education institutions, practitioners, engineering association and other regulatory bodies that deal with program design, development and degrees accreditation. The workshop was a discussion between the members of the committee and the other participants with the goal to gain a deeper insight into the current architectural education curricula. Thus, the current curriculum was analyzed in term of the following benchmarks:

- Mission: Sustainability of the curricula for architectural education towards professional practice.
- Learning outcomes: Providing graduates with the knowledge, skills and professional abilities necessary to meet demands required by the current professional market
- Program structure: curricular models for environmental education, digital architecture, etc.

3.2. Survey on the Current Situation on Architecture Education Program in Jordan

This part of the study involved questionnaire survey sent to 19 universities in Jordan that offered undergraduate degree program in architecture. The surveys were produced in paper and online forms and based on criteria extracted from several conducted workshops. The questionnaire has quantitative and qualitative parts. The quantitative part was structured to seek the educator's views on the current curriculum capacity to see whether it provides graduates with knowledge and skills that are needed to join the international institutions' programs, or to join the current labor market.

The qualitative part aimed at identifying obstacles in the current program circular with regard to knowledge domains, courses within these domains and whether these domains and courses are enough and up to date to provide students with knowledge and skills that are required to join the current labor market.

Quantitative data was analyzed using statistical analysis software "SPSS". Of the 200 questionnaires sent, 102 academic (response rate of 51%) replied, and all 19 schools of architecture were represented by at least 5 respondents. The assessment framework has linked the student learning outcomes with the prerequisites of the labor market, the international education and accreditation. Therefore, the Student Performance Survey was designed to measure these cores respectively. Then, the quality of teaching and the knowledge domains' assessment was evaluated through an individual survey circulated to deans of architecture faculty. This survey was designed to measure the quality of teaching obtained by using the present infrastructure and comparing it with the international education assessment criteria. The integration of the findings extracted from the two surveys is believed to draft a new proposal of the future Architecture Undergraduate Program by extending the knowledge domain of the existing program and enhancing its integration. The present study is generally conducted based on mixed methods research of which both qualitative and quantitative data were analyzed. Two surveys were being circulated as the followings:

A. Student Performance Evaluation Survey circulated to School of Architecture academic staff. The purpose of which is to evaluate the general performance of students and their preparedness to enter the labor market.

B. Architecture Undergraduate Program Evaluation Survey circulated to School of architecture faculty deans, on the purpose of evaluating the quality of a present undergraduate program.

The following figure illustrates the Curricular Assessment Approach Framework used throughout this research.

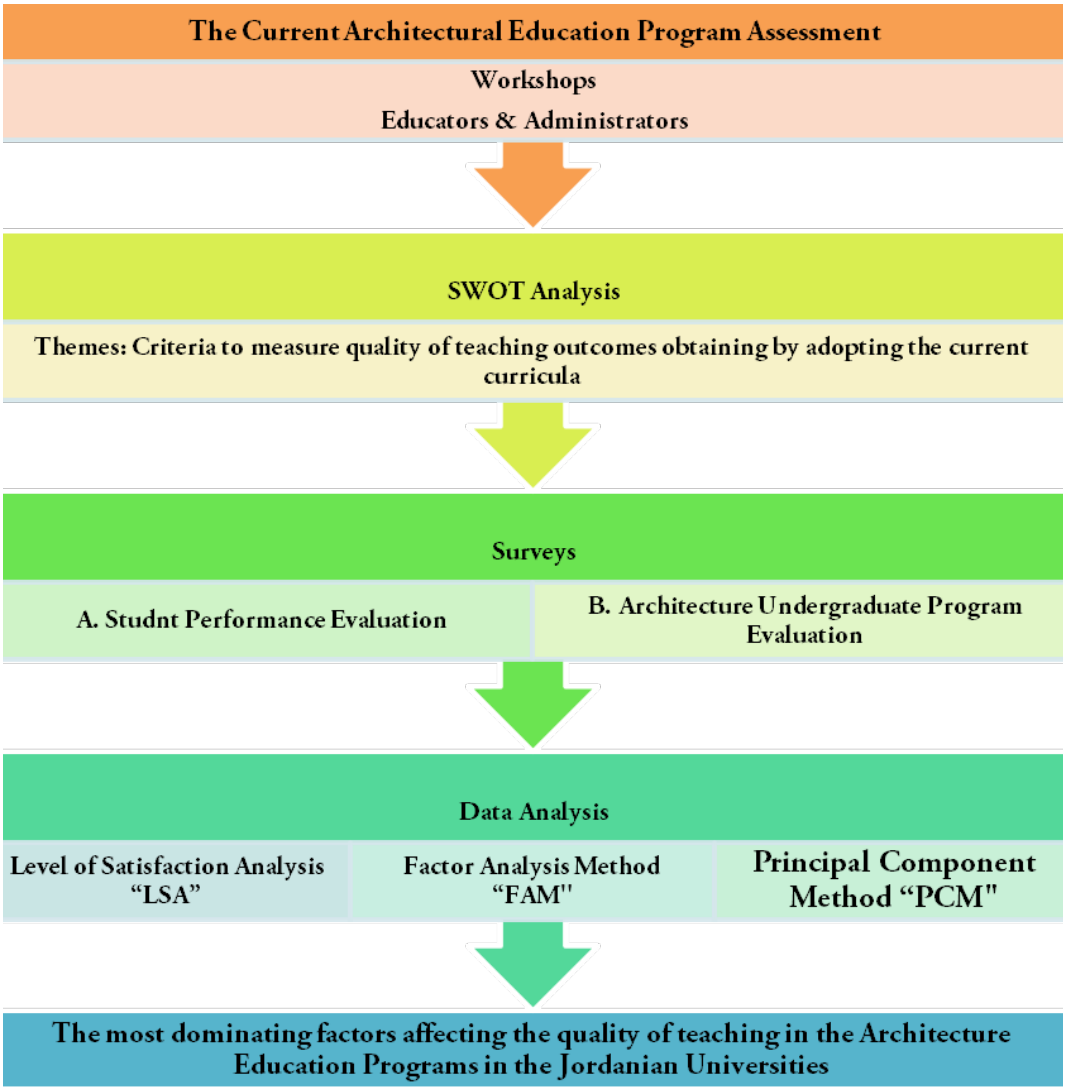

Figure 1. Curricular Assessment Approach Framework

Data Analysis Methodology

Workshops Findings

Workshops were divided into 5-focus-groups; the task of each was to conduct a "SWOT" analysis to examine the effectiveness and capacity of the present architectural education program curricula based on the defined benchmarks in 3.1. The outcomes of which are summarized as follows in figure 1:

Top 5 Strengths	Top 5 Weaknesses
- Architectural current curriculum covers an extremely broad range of theoretical / technical and non-technical areas. - Excellent academic staff with impressive skills & experiences. - Excellent infrastructure (labs, workshops, library, etc.). - Financial resources are available. - Affordability in term of cost.	- A basic curricular split between theoretical and practical teaching. - Marginal balance between creative and technical courses. - Split between architecture courses and other multi- and inter-disciplinary disciplines. - Disintegration between environmental design and green architecture courses. - Disintegration between architectural education and the digital world.
Top 5 Opportunities	**Top 5 Threats**
- Establish/strengthen partnerships. - Effective balance between creative and technical courses. - Integration between environmental design and sustainability courses with architectural design. - Integration between digital design and creative design with other architectural courses and studios. - New ICTs skills may improve students' learning outcomes. - Integration between architecture courses and other multi- and inter-disciplinary disciplines.	- A gap between architectural education and the profession - A gap between architectural education program accreditation and the international standards. - Impairing students' eligibility to join international programs. - Graduates are not fully prepared with the knowledge, skills and professional abilities necessary to meet demands required by the current professional market.

Figure 2. SWOT Analysis overall result (Top 5)

"SWOT" overall results show that the current program curriculum has crucial issues regarding integration between practical and theoretical courses; integration between architecture courses and other multi- and inter-disciplinary courses (e.g., split between architecture and the building industry, digital architectural courses, and environmental design and sustainability courses). Units and lecture courses were often separated (physically and temporally) from the applied coursework; so the students are not able to engage with an integrated design process. Furthermore, environmental design and green architecture are "elective lecture-courses" that are rarely integrated in any meaningful manner within a design studio. Thus, their share

is very marginal in the current curricula and there is no measurable indicator for quantifying and qualifying these aspects of education. Nor are there principles defining the environmental skills that students should have at each stage in their education. Nevertheless, world boards and professional bodies (e.g., NAAB, RIBA, ARB, etc.) as well as national ones such as the Jordanian Engineering Association (JEA) insist on the importance of developing environmental design to be introduced at every stage of the architectural curricula.

JEA is considered as one of key leaders in the development of engineering practice that is advocated to the sustainable development in Jordan and the Arabic region. Thus, as a professional national body, it focused on bridging any gap between academia and market through providing educational and training programs, exchanging knowledge in various engineering topics, and qualifying Jordanian engineers to lead the development process in Jordan and the Arabic region. JEA major goal is "to maintain the progress and development of engineering and consultancy sectors to meet the international standards and best engineering practice" (Taba, 2015).

SWOT shows very important issues about curricular rigidity through marginal balance between creative and technical courses. These twenty issues were taken as data basis and main criteria to design the questionnaires of Student Performance Evaluation Survey and Architecture Undergraduate Program Evaluation Survey that were circulated to School of Architecture academic staff and deans respectively.

Data Analysis Methodology

The data analysis conducted for this report is based on the Level of Satisfaction Analysis "LSA" and Factor Analysis Method "FAM". FAM implemented the Principal Component Method "PCM". Whereas, LSA was conducted on Student Performance Evaluation Survey and Architecture Undergraduate Program Evaluation Survey by giving the answers scoring scale as follows: 1 for Very Satisfied, 2 for Somewhat satisfied, 3 for Neither satisfied nor dissatisfied, 4 for Somewhat dissatisfied and finally 5 for Very Dissatisfied. For measuring the level of satisfactions for both surveys, the following assumptions were considered:

- If the score is less than the value (3); the level of satisfaction is deemed to be high;
- If the score is greater than the value (3); the level of satisfaction is deemed to be low; and
- If the score is equal the value (3), Then the view of surveyees on the level of satisfaction is deemed to be neutral.

Student Performance Evaluation Survey - Level of satisfaction Analysis

The student Performance Evaluation Survey has been conducted to study whether or not the present student academic achievement is up to the estimated benchmarks from architectural educators' perspective. Moreover, it highlights some topics relevant to assess the degree to which the quality of the undergraduate program in an architecture faculty is acceptable and achieves its academic objectives. The survey was circulated to over 200 persons. However, the sample considers only 102, thus eliminating the remaining persons to achieve a higher degree of data reliability (table 2).

Table 2. Criteria affect student performance in the architecture Undergraduate Program

Criteria affect the architecture undergraduate program				
No	Criteria/Score	Satisfied	Neutral	Dissatisfied
Cr.1	Student Academic achievement	32%	26%	41%
Cr.2	Student ability to analyze, assess and handle environmental design	16%	28%	56%
Cr.3	Technical performance- ICTs skills	16%	25%	60%
Cr.4	Student ability to employ the architectural courses with the other scientific and engineering disciplines	24%	25%	52%
Cr.5	Students' performance in terms of using the best sustainable practices and site management Performance	12%	25%	63%
Cr.6	Environmental orientation and sustainability	23%	17%	61%
Cr.7	Creativity and problem-solving	11%	23%	67%
Cr.8	Communication method & media to present design proposal effectively	19%	38%	43%
Cr.9	Students' performance in terms of dealing with the digital architecture tools	24%	11%	66%
Cr.10	Preparedness of the graduating students to enter the profession	19%	29%	52%

*** Criteria listed above represents the questions asked in the survey.**

As shown above, there was a general dissatisfaction with the performance of students of the Architecture Undergraduate Program. The highest level of dissatisfaction was listed for the creativity and problem solving of 67%, then the Students' performance in terms of dealing with the Digital architecture tools of 66% and finally the Students' performance in terms of using the best sustainable practices and site management Performance of 63% respectively.

The following diagram shows level of satisfaction on Student Performance at the Architecture Undergraduate Program:

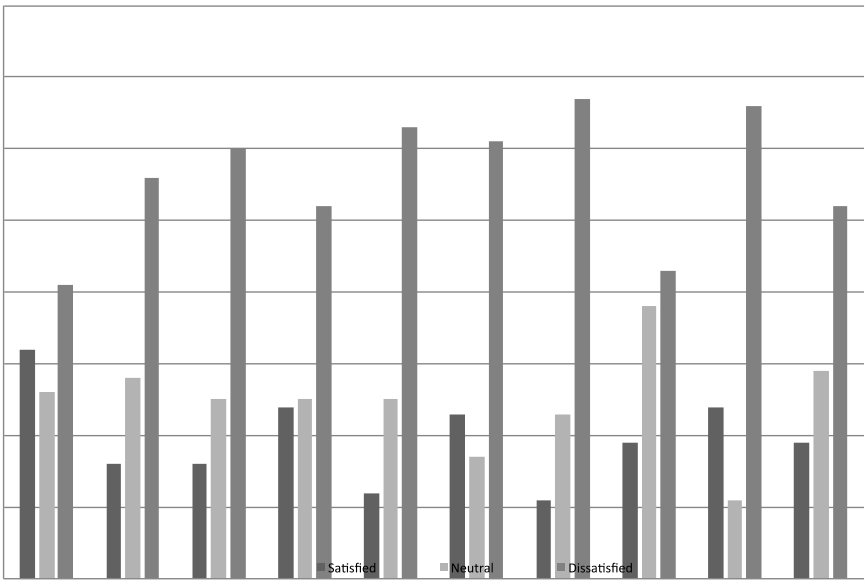

Figure 3. Level of satisfaction on Student Performance at the Architecture Program

Figure 3 shows the selected criteria affect student performance in the architecture, which are the criteria or question in the survey, that was used as "principal components to analyze level of satisfaction on Student Performance (see A.1, Appendix A). Then, "Total Variance Explained Test" was conducted for determining the number of variables that are most relevant to the low level of satisfaction on Student Performance at the Architecture Undergraduate Program (see A.2, Appendix A). According to this test, the number and weight of each component was calculated. Furthermore, the test suggests retaining only two factors that are relatively responsible for generating high dissatisfaction over the student performance. The" Initial Eigenvalue" for the two selected variables (which are student academic achievement and student ability to analyze, assess and handle environmental design) was 56.447% and 10.789% respectively. However, to determine the actual factor that shall be retained the following matrix displays the correlation factor per each criterion:

Table 3. Component Matrix a		
Criteria/ components	**Component**	
	1	**2**
Student ability to employ the architectural courses with the other scientific & engineering disciplines	.884	**-.179-**
Preparedness of the graduating students to enter the profession	.875	**-.169-**
Creativity & problem-solving	.849	**-.012-**
Communication method & media to present design proposal effectively	.822	**-.116-**
Student ability to analyze, assess & h&le environmental design	.803	**-.032-**
Technical performance- ICTs skills	.786	**.130**
Using the best sustainable practices & site management performance	.745	**.155**
Environmental orientation & sustainability	.658	**.383**
Student Academic achievement	.597	**-.457-**
Students' performance in terms of dealing with the digital architecture tools?	.308	**.779**

Extraction Method: Principal Component Analysis.

a. components extracted.

The above matrix suggests extraction of two components of very high correlation and that are:

Student ability to employ the architectural courses with the other scientific and engineering disciplines at correlation amounted (0.884).

Students' performance in terms of dealing with the digital architecture tools at correlation amounted (0. 779).

The final findings of running the Factor Analysis were emphasized through considering the above-extracted components as a determining factor that has a high correlation with the subject matter as well as with each other.

Architecture Undergraduate Program Evaluation Survey- Level of satisfaction Analysis

The Architecture Undergraduate Program Evaluation Survey was conducted to study whether or not the present academic curricular in the Jordanian Universities is satisfactory from the perspective of deans of Architecture Faculty. The survey was circulated to over 25 persons (current deans and previous deans; however, the sample considers only 21, eliminating the remaining persons to achieve a higher degree of data reliability.

Figure 4 shows general dissatisfaction of the present curricular at the Architecture Undergraduate Program. The highest levels of dissatisfaction were listed for the integration of environmental studies with design studios of 76%, and the Architecture curricula in terms of providing innovation and creativity opportunities of 71% and

Table 4*. Curricular Assessment based on ten selected criteria as follows
Criteria affect the architecture undergraduate program

No	Criteria/Score	Satisfied	Neutral	Dissatisfied
Cr.1	Integration of environmental studies with design studios	5%	76%	19%
Cr.2	Students' abilities to join international institutions	29%	38%	33%
Cr.3	Curricular international accreditation	29%	52%	19%
Cr.4	The quality of the architectural infrastructure; such as laboratory, library, etc.	5%	62%	33%
Cr.5	Curricular outcomes -Preparedness to enter the labor market	14%	48%	38%
Cr.6	Integration of the construction courses with architectural design	14%	48%	38%
Cr.7	Sustainability integration into the present curricular	57%	5%	38%
Cr.8	Students' Professional Ethics	71%	19%	10%
Cr.9	Technology and technical integration with the present architecture curricula	19%	43%	38%
Cr.10	Architecture curricula in terms of providing Innovation and creativity opportunities	0%	71%	29%

*Criteria listed above represents the questions asked in the survey

finally the quality of the architectural infrastructure; such as laboratory, library, etc. of 63% respectively.

The Principal Component Analysis (PCA) was used to determine the most dominating factor affecting quality of the architectural undergraduate program. This method of analysis involves finding the linear combination of set of variables that has maximum variance and removing its effect, repeating this successively. Ten different variables (i.e. the criteria or question of the survey) were entered as principal components. The variance of which was analyzed through the correlation Matrix (see A.3, Appendix A).

According to the Total Variance Explained test, the number and weight of each component was calculated. The test suggests retaining only two factors that are relatively responsible for generating high dissatisfaction on the program curricular (see A.4, Appendix A). The first two variable Initial Eigenvalues were respectively 54.873% and 13.527%. However, to determine the actual factor that shall be retained the following matrix will display the correlation factor per each factor upon which the factors will be retained.

The above matrix suggests extraction of two components, which has the highest correlation listed as follows: -

Sustainability integration into the present curricular with the other engineering disciplines at correlation amounted (0.869).

Integration of environmental studies and design studios with correlation

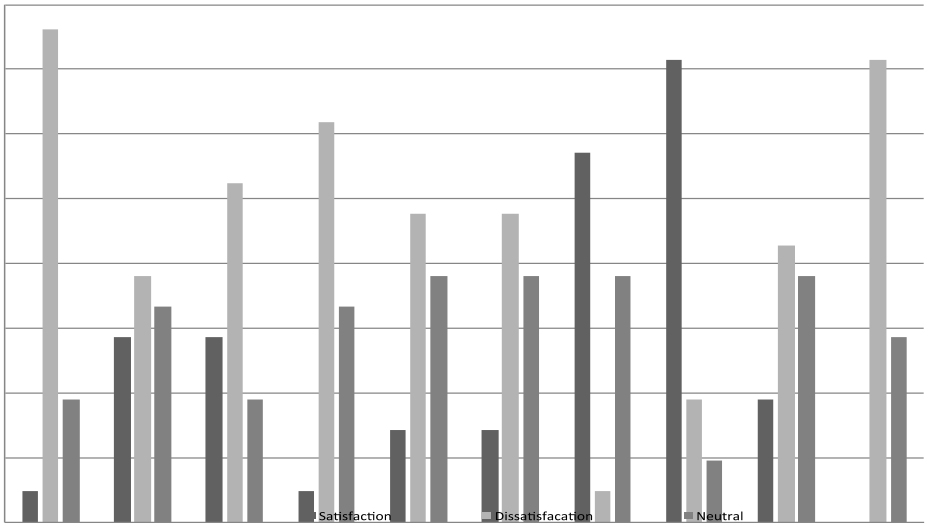

Figure 4. level of satisfaction on the curricular of the Architecture Undergraduate Program

amounted (.561).

The final findings of studying the most significant extracted factors that affect the performance of both the student and quality of curricular are summarized as follows:-

Sustainability integration into the present curricular with the other engineering disciplines.

Integration of environmental studies and design studios with correlation amounted.

Student ability to employ the architectural courses with the other engineering disciplines.

Students' performance in terms of dealing with the digital architecture tools.

Action plan

Firstly, committee decided both to improve the present curricular by recommending an integration of subjects relating to 'History and Theory of Architecture' into Architectural Design Studios as a part of studio learning. Of special significance, here are the design studio educators who need to shed the light on the theoretical courses, which give a context to the design process where a range of themes in Architectural Theory is explored to enhance innovation and productivity in the design studio.

Secondly, two new knowledge domains were introduced: "Sustainable Architecture" and "digital Architecture" with a number of compulsory subjects that were outlined to integrate computation and digital design and environmental sustainable subjects into design teaching.

Table 5. Component matrixa		
	Component	
	1	2
Students' Moral Development	.540	**-.673-**
Curricular international accreditation	.810	**-.356-**
Sustainability integration into the present curricular	.869	**-.204-**
The quality of the architectural infrastructure; such as laboratory, library, etc.	.841	**-.141-**
Curricular outcomes -Preparedness to enter the labor market	.824	**-.077-**
Students' abilities to join international institutions	.752	**.024**
Technology and technical integration with the present architecture curricula	.700	**.159**
Integration of the construction courses in architecture design	.733	**.358**
Architecture curricula in terms of providing Innovation and creativity opportunities	.701	**.368**
Integration of environmental studies and design studios	.561	**.644**

Extraction Method: Principal Component Analysis.a

Finally, Table 14 shows a new model that focuses on integrating theoretical and practical subjects, technical and non-technical areas, architectural and engineering, sustainability-related architectural sciences, digital design and creative design. The wider aim is to graduate professionals capable of handling the different aspects of contemporary design, from structural components and engineering and services to tools and techniques of the "integrated design"; and to provide the labor market with responsible architects and ethical designers who could deliver solutions that deal with environments' constrains and problems, since there can be no responsible design without a responsible designer (Findeli, 2001; Fry, 1993).

Conclusions

Based on the final findings of the curricular structure, it is clear that there are apparent gaps in the conditions for accreditation of curricula and in the qualification criteria path. Architecture practice is changing radically in response to the changing world around. This change is driven by social, economic, environmental and technological drivers that bring us new realities, new

Table 6. General modified framework of accreditation architecture program criteria for the bachelor degree (165 credit hours)		
A. Basic Compulsory Knowledge Domains		
Knowledge domain	**Minimum CH**	
	Theoretical	**Practical**
History of Architecture: History of Architecture, Modern Architecture, Contemporary Architecture, Islamic Architecture, Vernacular Architecture, Regional Architecture	9	**9**
Architecture Theory: Behavioral studies, Architecture philosophy & Criticism, Design theories & Styles, Architectural programing & analyses	**6**	**0**
Building Technologies & Systems: Building Materials, Building construction, Construction systems , Mechanics systems, Survey, Acoustics & Lighting	6-9	**3-6**
Urban Studies: urban planning, urban design, landscape, housing, Heritage Conservation	3-6	**0-3**
Sustainable & Green Architecture: Environmental Control (Architecture & Energy), Sustainability, Green Buildings	4	**2**
Digital Architecture: CAAD, Design Generation, Building Modeling (BIM)	2	**4**
Projects Management & Professional: Projects Management, Professional practice, Contracts & Regulations	8	**0**
Design: Basic Design, Architectural Design, Interior Design, Workshop Drawings	10	**30**
Architectural Presentation: Architectural Drawing, Freehand sketching, Perspective, Shade & Shadow	3	**5**
B. Supportive Knowledge Domains		
Basic Sciences: Math, General Physics	6	**0**
C. Training		
Training : 8 continuous weeks, Candidates should finish successfully 90 CH	0	**3**
D. Graduation Projects		
Graduation Project- 1: Candidates should finish successfully 120 CH	2	**0**
Graduation Project-2	0	**4**
E. Studios, Workshops & Labs		
Studios: minimum 5 studios should be available		
Workshops: minimum 1 workshop should be available		
Labs: minimum 1 lab should be available		

knowledge and new information society. It is clear that the rising awareness of "environmental sustainability" and "technological innovation" requires some changes in higher education to equip students with the knowledge, skills and competence needed to access professional labor markets. As a consequence, schools of architecture has to work with technology and has to get the benefit of its great potential through integrating it with the creative design, environmental design, urban design and other architectural subjects (Gross, 1999).

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