The importance of evaluating the environmental design and performance of student projects as a product of architecture departments: A case study

Khalid Abdul Wahhab[1], Nawfal Joseph Rizko[2]
[1,2]Department of Architecture, Al-Nahrain University, Baghdad, Iraq

Article Info	ABSTRACT
  Keyword: Environmental Education, Environmental Education in Iraq, Al-Nahrain University, NAAB, Labor Market, Assessment Basics, Rubrics	This study investigated the extent to which the requirements and guidelines of environmental education approved by the National Architectural Accrediting Board (NAAB) are met in the academic programs of the Architecture Department of Al-Nahrain University. It also attempted to examine to what extent these guidelines are considered in practical and theoretical parts, and across various stages. To this end, the number of topics given in the field of environment was determined and a review of the importance of this subject was done. Then, the most important studies carried out in this area were extracted and a comparison was made between what must be achieved in the field of environmental education according to the NAAB guidelines and what really exists in educational courses of the Architecture Department of Al-Nahrain University. As a result, the shortcomings that prevented the fulfillment of the NAAB conditions were identified. The findings suggested that, in order to meet the NAAB requirements on environmental education, there is a need to activate applied practical aspects in the environmental education concerning academic projects and the preparation of supporting laboratories for applying the software and calculations on such projects to verify the projects' performance environmentally.

Corresponding Author:

Assist. Prof. Dr. Nawfal Joseph Rizko
Department of Architecture ,Al-Nahrain University, Baghdad, Iraq
Email: al-mudares99@yahoo.com

1. Environmental education

As a result of many movements and attempts by supporters of the environment, the first formal United Nations conference was held in Sweden in 1972 to emphasize the need for new steps in addressing environmental problems. Then, the International Conference on Education and the Environment organized by UNESCO in Tbilisi in 1977 was announced, which emphasized the role of education in facing environmental problems to develop morals and environmental conscience that protects the environment from the effects of human misconduct. This led to the integration of environmental education in formal and non-formal education systems as a continuous lifelong process and linking them to daily life situations based on the empirical study which helps individuals and professionals acquire the knowledge, values, and skills needed to solve environmental problems. Then, the Earth Summit in Rio de Janeiro in 1992 reflected the importance of environmental education; and the New Zealand Natural Heritage Foundation organized the basis of education for the environmental education sector in universities within a conference entitled

"Education for Sustainability" in 1995 emphasizing the need to demonstrate the impact of sustainability on the higher education sector, particularly in relation to the creation of environmental policies and sustainable management practices. Chalkley (2006) points out that environmental education must seek results that include not only knowledge and skills, but also values as the basis for sustainability actions and activities that are practically applied in everyday life. He also points out that environmental education must achieve three main outcomes, which include students' knowledge of the environmental aspects and the ability to implement them in practice. They must also have the personal and emotional attitudes that push them toward this work. But education methods sometimes avoid influencing the students to take such steps [1].

1.1. The importance of environmental education in architectural education

The significant impact of buildings and environment that are built based on climate and climate change led to the need to introduce environmental education topics within the architectural study and part of the special activities [2]. That resulted in the emergence of environmental issues and sustainability in all aspects of daily life since the 1980s leading to the environmental theme being a fundamental and influential factor in the methods and curriculum of higher education, and a new model of environmental education emerged [3]. called for the provision of knowledge of buildings and the built environment that integrate with their natural environment and considered its performance to complement the role of the natural environment and interfere closely and intricately with it. In order for environmental education to be the main focus of the architectural design studio and the focus of researchers and designers [4], the creation of well-trained and efficient architects is needed; accordingly, many universities around the world have included environment and sustainability subjects in their architectural curriculum [5]. This requires the development of a comprehensive environmental education system that is not limited to the performance of the building alone, but extends to include a set of relationships between the built environment and natural environment to reach sustainable environmental performance levels, which helps to improve the environmental performance of the built environment. Therefore, it is necessary to make use of the capabilities of students in higher education to prepare for new environmental solutions that develop the design process to achieve the integrated environmental performance of the built environment as a single unit. To achieve this goal, the integration of environmental education courses in universities is required. Therefore, there is a need for a comprehensive and integrated education system that is different from the traditional one, that is, the new system should add some environmental or sustainable treatments to some parts of the building or the built environment. Although this is not a new claim [6], it depicts how it is applied in practice, how students are trained, and how it is tested.

Therefore, the testing of environmental systems and designs using computer programs for this purpose has become an additional judgment and assessment method to prove the efficiency of design in competition. There are calls for change of teaching and scientific research on sustainability from the level of the single building and its passive systems, and a shift to a larger scale to include the fully built environment [7], through which specific sustainability characteristics and dynamic features can be identified to determine the environmental requirements of a large area; and thus environmental treatment is more efficient. Higher education and universities can play a major role in this regard, which contribute to the development of the society. Legislation and building codes can help in this area by imposing them on the community compulsorily. Sustainability has become an important part of the construction industry and has significantly affected the design of buildings [8], giving priority to energy-efficient buildings and environmentally friendly materials through which the efficiency of the buildings and the level of pollution resulting from it can be determined. In addition, environmental computer programs have been used as a means of competition and judgment between architects to determine the best project, as it will represent excellence in sustainability and environmental standards. This led to a focus on the design and implementation of the buildings in a sustainable manner considering the building part of the natural environment. Thus, a new type of knowledge about sustainable environmental solutions has been developed, combined with new interpretations of traditional solutions. Therefore, a large body of such information is made available on the internet which are easy to access. But this does not mean that they can be used directly [9], since the

availability of this information will not enable the architects to use it directly unless they receive education and training. If this is not fulfilled properly, it will make architects adhere to traditional methods. As a result, their dealing with new projects will be without awareness and without a clear path of environmental treatments, which will constitute a negative aspect of the inability to look at the project as a whole, but seen as scattered parts.

2. Requirements of NAAB in the field of environmental education

The NAAB emphasized the importance of the study of integrated critical thinking for the consideration of high complexity architectural problems [10]. Therefore, the relationship between the design process and the implementation of correlation and integration with the architectural design approach is one of the most important problems facing the architectural study. However, by relying on global institutions that grant accreditation such as NAAB and the Royal Institute of British Architects (RIBA), this dilemma can be solved by drawing on case studies from research and design terms (theoretical and practical sides) [11] in a similar manner to the study of medicine as the students cannot learn the theoretical side without a real case study [12]; and this is what RIBA calls "Live Studio" [13]. Therefore, the general characteristics of architectural education are based on the architectural studios in large because it represents the place where the practical aspect of the architectural study is applied. Therefore, RIBA [14] has imposed 50% of the study modules of the architectural study designated for the practical side in the studios. Moreover, NAAB [15] considered that the philosophy of architectural learning and its policy should be directly related to the development of a special policy for the students' work curriculum in the architectural design studio with mechanisms that take into account the verification of the application of environmental requirements according to the regulations of these two institutions. Global environmental standards by preparing lists of assessment of the product design that include and emphasize global environmental standards. Therefore, this organization stipulated that the architecture graduates should have acquired a range of intellectual and technical skills, as well as the ability to deal with others and understand the environmental and cultural context of the architecture to solve architectural problems in general, and the environmental problems in particular. These indicators have made educational institutions aware of the importance of developing and implementing accreditation procedures and quality assurance methods to ensure graduates with high qualifications, to keep abreast of the architectural profession, to have the ability to apply theoretical knowledge in the field of work, to be able to absorb the intellectual and technical changes and how to deal with them, to be aware of the environmental characteristics and nature, and to produce environmental architectural designs that reflect the nature of his environment and society during the years of study and beyond. In its 2004 regulations, NAAB stipulates that the inclusion of sustainable environmental designs in the curriculum of architectural departments should be considered as a prerequisite; therefore, in its paragraph 15, NAAB noted that "understanding environmental principles is the basis for guiding urban design and planning decisions to provide more healthy buildings and complexes. In terms of the requirements of the same body within its controls for the year 2009, more precise conditions have been determined by the following phrase: "the ability to design projects that use resources optimally, conservation of natural resources and reuse of building materials to reduce environmental impacts through several methods such as carbon equal buildings, designing Bio-climatic buildings, and energy-efficient buildings". This change indicates that the standards of NAAB have become more accurate and focus on the environment with limited energy sources and natural materials. Therefore, there is a need for a more comprehensive method of architectural teaching that seeks to clarify and establish the importance of the environment to contribute to the production of a successful architect, which requires the students to study curricula and topics in the form of lectures and seminars related to the sustainability and environment during university years [15].

The architectural approach must be multi-subject in order to enable the student to develop various knowledge and skills of the environment and for different stages of study, as well as practical practice to apply this information in architectural design lessons to give him the opportunity to present his ideas and concepts in practice after knowing them theoretically, which will contribute to the establishment of Environment Language that enables the student from the beginning properly to be an architect or urban

designer who deals clearly with the environment. Therefore, NAAB encourages its students to develop competencies for renewable energy technologies and their own systems to be applied in practice, which will preserve the environment and its sources [16].

3. Environmental education and the labor market

The architectural education in the countries of the developed world is considered as a key element in guiding the process of technical development in that country as well as being an important basis for knowledge building. Universities should work hard to develop this subject to meet the demands of the labor market. However, the multiplicity of universities that are working to have large numbers of graduated architects, who do not match the needs of the labor market, created a big problem related to the basis of architectural education, even though most of these universities consider the quality and reliability of their architectural programs a first priority. The profession of architecture is characterized by exclusivity, as is the case with its educational curricula and the reason that architecture is a free profession, its study and the specifications of its graduates must be linked to the requirements of the labor market and the conditions of practicing the profession. Therefore, accreditation is one of the important indicators for measuring the quality of the academic programs, as well as determining the quality of education compared to education in other universities that do not meet this requirements, which makes graduates of the first universities more qualified to work because they meet the requirements of the market. Due to globalization, the profession of architecture is not limited to certain countries, but has become a profession with global and international application possibilities, which increases the importance of accreditation in architectural study. Therefore, the American NAAB and British RIBA programs, which are bodies that provide accreditation to the Architecture University Study, have become two bodies that determine the level of universities and the level of their graduates, and their recommendations have become one of the major bases for employment, work, and practicing the profession. The NAAB uses the word "accreditation", which can generally be defined as a voluntary quality determination process conducted by a third evaluator based on a set of input criteria and then evaluated by peer reviewers in the same jurisdiction; this model is based on the values set by independent decision-making institutions to increase the ability of educational institutions to develop and upgrade curricula and courses (NAAB 2014a). While the RIBA uses the term "validity" on the product, including the general form of the educational product (students portfolio), which includes not only the aspects and design possibilities, but the tests and special possibilities of students on the number of texts and course work; and these are evaluated according to the RIBA specification and not within the specifications and standard requirements. Therefore, this standard seeks to describe the RIBA trends of the universities and architectural schools product and evaluate the methods of study without focusing on the quality of the study inputs only and this entity also believes that validity is based on a number of criteria that can include the nature of the curriculum, the number and quality of staff and technical resources, and that the scale of these inputs will be the basis of this validity. Therefore, most of the architectural departments are currently facing increasing pressure from the students, as well as the labor market, to make a radical change in the subjects and methods of teaching architecture and to emphasize on environmental issue and its relation to the built environment. Research around the world indicates that the construction sector, and the society at large, have placed the issue of environment, energy, and natural resources at the center of architecture, which makes the continuation of work as in the past a natural state, which requires the introduction of this subject in the core of the architectural profession. Thus, teaching the environmental topics in architectural schools in the primary and higher studies [17] revealed that after careful consideration of the architectural approach, we will notice a difference in the weight of these environmental subjects within the general curriculum. and what is the method of study? And what is the desired goal? And will this issue be distributed at all stages? And how the theoretical and practical aspects will be linked? And will this be verified? Many questions pose itself, as well as whether expanding environmental education will overshadow other topics.

One study in Norway indicated that a number of specialists see sustainability and the environment are linked to the concept of energy economy, which can be achieved through specific determinants and

controls, or can be seen as a purely technical subject that can be added to buildings. Consequently, [18]. This requires the architect not only to think in a sustainable way, but to make sustainability an integral part of architecture [19], which necessitates updating the environmental education curriculum. This is what actually happens in many departments and architectural schools around the world [20], such as in the architectural schools of the United States, from the direction towards carbon equal buildings and projects, which aims to motivate teachers and students to deal with environmental and ecological issues [21]. Therefore, the American Institute of Architects (AIA) has introduced a 2030 toolkit to promote sustainable architecture, which is an important part of the built environment and encourages its introduction as part of the standards of accreditation in architectural schools [19].

[22] classifies the process of restructuring of sustainability curriculum as a change from adding a topic to the curriculum to a state of integration with the curriculum in its theoretical and practical part. Therefore, there is a need for exposure to a new type of environmental skills and knowledge and to identify the steps that must be taken by the architectural departments to train today's students and tomorrow's engineers to deal with climate change and global warming issues, or in other words, the need to design an integrated architectural curriculum that makes sustainability a primary goal [23]. Thaler and Sunstein point out that the way people make decisions depends on how the topic is presented and how it is framed. Therefore, it is mentioned that people choose traditional models and ideas when presenting projects because what is presented to them is traditional [24]. Therefore, there is a need for new ideas, including sustainability, to identify their vocabulary, methods, and features to be presented to people or external entities to introduce them. It should also be noted that sustainability is a fundamental pillar in its composition and a clear goal that the built environment seeks to achieve. And this is called Quo BIAS. Therefore, specialists do not demand increased environmental performance in the curriculum, but rather give the subject importance and priority in the architectural design [25], to be the culmination of the theoretical study and thus show the projects in the form of abyss and urban designs that take the sustainability role of the foundation [19]. It is also possible to take advantage of the large numbers of students who are present during the study stage and in various stages to develop sustainable architectural designs that can be tested in the laboratories of the department, so that it is possible to find the best environmental solutions for each project and at different stages of study, thus building a theoretical knowledge base applied in practice, during computer tests [26]. Therefore, the researchers believe that there is a difference between curriculum allocated to sustainability and curriculum in which sustainability is accidental [27]. Furthermore, the architectural departments have a great responsibility to teach sustainability and the environment through organized practices that vary from theoretical lectures that provide students with understanding and between the architectural studios with the greatest weight for their long hours. This theoretical knowledge is applied in practical terms, thus developing the abilities of both students and professors in a similar way.

4. Assessment as the basis for completion of the educational process

Lemkowitz *et al.* (1996) point out that higher education and universities provide an opportunity for students to study pure engineering sciences that can be an incentive for students to develop new ideas about the environment and sustainability through creative thinking. However, these agencies offer no opportunity to evaluate these products and students' values and attitudes [28]. The process of education is an ongoing process. However, learning skills and knowledge in any field requires a strong academic base and to achieve this goal, assessment and its mechanism have become an important tool for understanding the level of the students' understanding of the curriculum, and it is also considered a way to help identify the type of educational steps to come. Therefore, all educational schools rely on a kind of formal tests for the purpose of evaluating the students and to know the extent to which the student benefited during the years of study. Accordingly, universities seek to make the assessment process more effective to increase the student's ability to learn. However, the assessment process for students in the large-scale architecture studios requires a double amount of attention and scrutiny because measuring the student's success in addressing design problems and translating them into success levels or grades is more difficult than testing the students in purely theoretical lessons with clear and specific answers. The architectural study includes putting the

students in a specific design test, the level and details of which vary according to the stage of study and the extent of which depends on the presentation of the final project of the final stage of the study. The student's product is subjected to criticism and observation from his/her colleagues and professors and the final grade of the student shall be given after the discussions, which is often unconvincing to the students because they are not present for discussion at the time of putting the grade and they believe that the result was due to the lack of defense of their projects or misunderstanding during the evaluation stage, leaving the students with an impression of dissatisfaction with the grade. And this requires research in the methods of architectural assessment to develop this subject and to establish clear rules and criteria for this purpose. The assessment process in the United States differs from that in the United Kingdom, which depends on the student's reports of the project and the number and type of research provided away from traditional exams.

Therefore, we will consider the assessment as a process of forming a judgment on the quality of the student's achievement and on what has been drawn from a product to solve a particular problem of what has been submitted to the professors or the jury. This calls for the determination of certain criteria for assessment, where the students must be aware of it, as they represent the intended learning outcomes of the project as a completed design with special specifications. This will help the student to develop his/her work to achieve these products supported by their appropriate assessment criteria and it will also form the basis for rational assessment.

One of the methods of architectural assessment is the holistic view of projects and the assessment of grade for all final designs of students. But this method overlooks a number of criteria such as the extent of student creativity and ability to solve design problems regardless of their designations (like environmental problems). So, this method will reduce the ability of students to develop their own capabilities and can be adopted for a limited number of projects, though it will be difficult to apply to a large number of projects. The subjective aspect in this method will have a major role in the assessment process away from the substantive side. Also, this method will be more complicated if external arbitrators are invited to evaluate the projects who do not have the assessment criteria and basis of that entity. Thus, there is a need to establish a clear basis for the assessment based on the identification of certain requirements that must be met by the student and each requirement shall have a rate of the total grade of the assessment; this falls within the Rubrics mechanism for assessment so that the grades will be based objectively on the quality of the product and the extent of the presentation include a number of schemes, sections, interfaces and details including environmental treatments that will represent the practical application of theoretical environmental lessons given to the student and took a wide range of study during his previous years.

4.1 The role of the Rubrics method in architectural assessment

Assessment is a key issue in the field of higher education and architectural education [29]. However, the assessment of creativity, architectural effort, or architectural product is difficult [30]. But this is what we need in architectural design lessons. The Rubrics method is a descriptive method of assessment [31]. It is also an effective and varied way to assess the extent of knowledge and the level of development of technical skills [32], and it can be the basis for the use of academic judgment on student performance [33]. Therefore, there is a great tendency in higher education to use this method for its positive role in learning and education [34] because this method clearly and explicitly explains how the process of learning and education should proceed and what results are required of the student so this method can be used to assess different levels of achievement [35]. This researcher points out that following this method will reduce the assessment burden on teachers and its use will also eliminate confusion in the vision between education and assessment, which will enhance their role significantly. Andrade (2000) also points out that this system will increase the speed and development of work in the large studios [36]. Rust (2002) notes that students prefer to use this method because it is an effective and useful method based on clearly defined assessment criteria [37]. Hudson (2005) states that assessment criteria must be based on specific determinants and outputs of education as these will be the reference for teachers and students. In addition, the participation of students in the development of the standards of this system will encourage them to develop their skills and improve

their output [38]. Dornisch and Mcloughlin (2006) expressed that this system is credible, effective, and applicable and helps to reduce the problems of product evaluation and creative performance, which will reduce dissatisfaction and satisfaction with evaluation or unfairness [34]. Ehmann (2005) points to the need to use this technique inside the studio, which will help to develop the student's abilities, improve his/her creative output; it will also accurately determine the expected products to be obtained from the student [39] which are accepted by the professor [40]. The subject of evaluation and accreditation has become an essential part of higher education [41] and the Rubrics method has become one of the methods in this field. The term can be defined as a collection of documents based on the expectations of student assessment and by the installation of specific criteria [42] according to certain subjects and levels that are required to be considered as assessment criteria; they also determine the required quality of work and the degree of determination strategy [43] and this system also has the potential to help students understand the desired objectives of education and the level and type of performance required. It also provides the basis for fair judgment of students' adaptable and development outcomes. Studies conducted on graduate and postgraduate students indicate that thanks to this method of assessment, students can work to achieve these goals and the required level of assessment [44]. This method not only develops students' abilities but can also develop and improve the entire learning process (the source [45]) ; It is also a vital means of finding an efficient assessment system that helps to develop curriculum and increase access to accreditation [46].

5. Experience of environmental education at Al-Nahrain University

The share of environmental education in the academic curriculum of the Department of Architecture at Al-Nahrain University in its five stages covering tow academic stages (the third and fourth) where the subject of (sustainability) of the third stage, which aims to (The subject of the environment and sustainability aims to teach students What are the natural environment and the man made environment, the relationship between them, and what are the limits of thermal comfort and how the man made environment affected the natural one and vice versa and the role of the built environment on energy consumption and its impact on climate change. Renewable energies and how we can take advantage of them, passive cooling and how it was used in traditional and contemporary architecture. According to table (1), the study of the subject extends over a whole semester (15 weeks). In the fourth stage, the term "architecture and the environment", which aims to specify the concepts of exchanging of the permanent act among these factors and man's physiological requirements illustrates the positive and negative climatic effects, and the methods of protection are clarified to the student in order to reach designing and planning values that might be the basis in determining the architectural local climate level and micro climate in enclosed spaces. In addition, studying sun shading devices and patches along with its calculations illustrate the importance of sustainable concepts in conservation our natural environment and climatic system balance, Studying and illustrate sustainable architecture and its importance in provide healthy environment for human and conservation natural environment) according to table (2), where the study extends over a whole semester (15 weeks).

Table 1. Study Plan for Al-Nahrain University – Architecture Department- Topic Title \ Sustainability Stage: Third year Architectural Department at Al-Nahrain University Baghdad, Iraq (source\The study Plan for Architectural department)

Topic Title \ Sustainability Stage : Third year Architectural Department at Al-Nahrain University Baghdad, Iraq	Type of Skill	
Subject	understanding	ability
Introduction	U	
Man and climate	U	
Psychometric chart for Iraq	U	

Sustainability and sustainable development history and meanings	**U**	
Energy and built environment and fossil fuel	**U**	
Climate change	**U**	
Traditional building and environment	**U**	
Renewable energy part 1	**U**	
Exam		
Renewable energy part 2	**U**	
Passive cooling part 1	**U**	
Passive cooling part 2	**U**	
Sustainable city part 1	**U**	
Sustainable city part 2	**U**	
General discussion (all subjects)	**U**	

Table 2. Study Plan for Al-Nahrain University – Architecture Department- Topic Title \ Environment and Architecture. Stage: Fourth year Architecture Department at Al-Nahrain **University Baghdad, Iraq.(source\The study Plan for Architectural department)**

Topic Title \ Environment and Architecture **Stage : Fourth year** **Architectural Department at Al-Nahrain University Baghdad, Iraq**	**Type of Skill**	
Subject	**understanding**	**ability**
Introduction	U	
Green architecture standards	U	
Natural lighting in architecture	U	
Solar radiation and architecture	U	
Solar angle, shades and spot lights	U	
The advantages of solar lighting and its codes	U	
Exam	U	
Power consumption in buildings	U	
Exam		
Thermal insulation in buildings	U	
Natural ventilation in buildings	U	
Methods of natural ventilation in buildings and cities	U	
Papers submission	U	
Discussions	U	
Exam	U	

Table 3. Actual Criteria for Design Project in Architecture Department – AL-Nahrain University.
(source\The study Plan for Architectural department).

No.	Required Project Items	Fail Less than 50%	Pass 50-59%	Mid. 60-59%	Good 70-79%	V. Good 80-89%	Excellent 90-100%
Existing Project Scoring Table							
1	Concept Design						
2	Site plan						
3	Plans						
4	Sections						
5	Elevations						
6	Model						
7	Perspective						
Final Project Degree (100%)							

Table 4. Proposed Criteria for Designing the Project in Architecture Department – AL-Nahrain University

No.	Required Project Items	Fail Less than 50%	Pass 50-59%	Mid. 60-59%	Good 70-79%	V. Good 80-89%	Excellent 90-100%
Suggested Project Scoring Table							
1	Concept Design						
2	Site plan						
3	Plans						
4	Sections						
5	Elevations						
6	Model						
7	Perspective						
Required Project Applied Environmental Treatments							
8	Site Environmental						
9	Plans Environmental						
10	Sections Environmental						
11	Elevations Environmental						
12	Passive Systems Treatments						
Required Project Applied Environmental Treatments Calculations							
13	Environmental Computer Software Checked Project Treatments Calculations and Results						
Final Project Degree (100%)							

6. Practical study

Analysis of the results of the practical study and the above tables shows:

1. Focus shall only be on the theoretical aspects of the subject and the lack of activation of the practical aspect (ability), i.e., the possibility of application of the theoretical subjects and then the assessment is (Not Available). This requires an assessment system that investigates the results of the application of environmental theoretical subjects with a share of the proportion of this investigation being drawn from the final degree of the general assessment.

2. This information shall not be applied in the architectural design lesson due to:

−The students are not obliged to introduce environmental treatments within the architectural design. There is no orientation towards adopting the environmental design as a basic and integral part of the architectural design of the student projects. Assessment is done according to Table 3, which does not include environmental design or practical application of environmental treatments. In addition, there is the lack of a requirement or assessment standard regarding this subject.

−The non-application of a weight on architectural design in the design of student projects and the lack of an evaluation system needed to investigate the application of environmental treatments.

−The non-verification of the efficiency and effectiveness of the performance of treatments and environmental systems in student projects, if any, in a documented manner, because students do not know such programs and they have not been taught the curricula of architectural education which must be included in the curriculum of teaching computer uses in architecture through environmental software Which is not taught in the curriculum of the Department of computer use courses, which focuses only on software for drawing and architectural show only.

7. Conclusion:

1) There is a gap in environmental education between the two aspects of (Understanding) and the possibility of application (Ability) among the students. This is illustrated in Table (1) due to the inconsistency of the applied aspects in the architectural studios which have a great effect in the architectural study and its extension of long study hours within the curriculum of the department.

2) Failure to include the assessment criteria of architectural designs of the student projects on the environmental standards, which weakened the importance of this subject until it was neglected in full. This is not consistent with the NAAB requirements which state that students must have the ability to Understand and the Ability to deal theoretically and practically with environmental issues. This represents an obstacle to obtaining accreditation from the international accreditation bodies.

3) There are no special methods for assessing environmental architectural designs for student projects, if any, because there is no environmental computer software to verify the efficiency of the submitted designs, and to be the basis for judgment and assessment for the purpose of making a comparison among these projects.

8. Recommendations

1) Encourage the adoption of environmental design with all the systems, strategies, and specifications as a key part of the students' projects in the Department of Architecture with the development of assessment criteria for this subject to be added to the traditional assessment criteria. Moreover, it is recommended that the subject of environmental design shall take its share in the final assessment of the projects for each student, and for all academic stages as a product increases the performance of the architecture department.

2) The process of setting the assessment criteria proposed in Table (4) will oblige students and teachers to adopt environmental trends when designing ideas and architectural designs for student projects. This will enable the creation of innovative ideas in this field based on the reality of the climate and the dry and hot environment in Iraq, which gives the product its special environmental and architectural Iraqi identity. It is possible to propose a prize for the best environmental architectural design for postgraduate and undergraduate studies.

3) Prepare laboratories and teaching staff qualified to operate and teach environment related computer software. This specialization should be added as an essential part of the computer program for the purpose of assessing the environmental performance of the student projects, especially the finished projects as the final product of the Department of Architecture.

4) Integration of theoretical and practical environmental studies supported by the results of the environmental computer programs leading to the production of comprehensive and integrated environmental education, which is in line with the requirements of the environmental education of the NAAB, thus facilitating the accreditation of specialized international bodies in this field. This can fill the gap in environmental education between students' Understanding and Ability.

5) Encourage graduate students to adopt applied environmental research as subjects for master's thesis in the Department to solve the local problems of reality and to reduce energy consumption and the implement environmentally friendly projects to address the effects of climate change.

6) The possibility of presenting the results of the research and the postgraduate and undergraduate studies as design proposals to the state departments concerned with the production of energy-efficient buildings. These results can also be presented as an integral part of Iraqi building codes for green architecture or to the parties concerned with the construction to control future building requirements.

7) The development of the criteria for environmental assessment that are added to the previous standards leading to the production of a balanced objective assessment system that goes beyond the self-determining aspects of the ability to achieve real environmental treatment in the ideas and designs of student projects.

Note

• There is no conflict of interest regarding the publication of this paper.

• The topics tiles and the study plan of architecture department of Al-Nahrain university data used to support the findings of this study. All data is available upon request.

References

[1] E. C. W. Lou, A. Lee and A. Welfle, "Greenhouse gases (GHG) performance of refurbishment projects – Lessons from UK higher education student accommodation case studies," Journal of Cleaner Production, vol. 154, pp. 309-317, 2017.

[2] K. A. Saeed, M. K. Malhotra and S. Abdinnour, "How supply chain architecture and product architecture impact firm performance: An empirical examination," Journal of Purchasing and Supply Management, vol. 25, (1), pp. 40-52, 2019.

[3] L. M. Khodeir, "Blended learning methods as an approach to teaching project management to architecture students," Alexandria Engineering Journal, vol. 57, (4), pp. 3899-3905, 2018.

[4] C. Moreno, S. Olbina and R. R. Issa, "BIM Use by Architecture, Engineering, and Construction (AEC) Industry in Educational Facility Projects," Advances in Civil Engineering, vol. 2019, pp. 1-19, 2019.

[5] Y. Arayici, P. Coates, L. Koskela, M. Kagioglou, C. Usher, and K. O'Reilly, "Technology adoption in the BIM implementation for lean architectural practice," Automation in Construction, vol. 20, no. 2, pp. 189–195, 2011.

[6] D. B. Arensman and M. E. Ozbek, "Building information modeling and potential legal issues," International Journal of Construction Education and Research, vol. 8, no. 2, pp. 146– 156, 2012.

[7] D. K. Smith, "+e USC school of cinematic arts: the arrival of spring in the facilities industry," Journal of Building Information Modeling, vol. 2009, pp. 16-17, 2009.

[8] O. Hamdi and F. Leite, "Conflicting side of building information modeling implementation in the construction industry," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, vol. 6, no. 3, article 03013004, 2014.

[9] T. Korman and N. Lu, "Innovations and improvements of MEP systems for modular construction using building information modeling," in Proceedings of the Architectural Engineering Conference (AEI), pp. 448–455, Oakland, CA, USA, April 2011.

[10] K. Barlish and K. Sullivan, "How to measure the benefits of BIM—a case study approach," Automation in Construction, vol. 24, pp. 149–159, 2012.

[11] T. Nath, M. Attarzadeh, R. L. K. Tiong, C. Chidambaram, and Z. Yu, "Productivity improvement of precast shop drawings generation through BIM-based process re-engineering," Automation in Construction, vol. 54, pp. 54–68, 2015.

[12] P. Bynum, R. R. A. Issa, and S. Olbina, "Building information modeling in support of sustainable design and construction," Journal of Construction Engineering and Management, vol. 139, no. 1, pp. 24–34, 2013.

[13] K. Lee and S. Choo, "A hierarchy of architectural design elements for energy saving of tower buildings in Korea using green BIM simulation," Advances in Civil Engineering, vol. 2018, Article ID 7139196, 13 pages, 2018.

[14] K. Tu and D. Vernatha, "Application of Building Information Modeling in energy management of individual departments occupying university facilities," World Academy of Science, Engineering and Technology International Journal of Architectural and Environmental Engineering, vol. 10, no. 2, 2016.

[15] H. Gocke and K. Gocke, "Integrated system platform for energy efficient building operations," Journal of Computing in Civil Engineering, vol. 28, no. 6, article 05014005, 2014.

[16] J. J. McArthur, "A building information management (BIM) framework and supporting case study for existing building operations, maintenance and sustainability," Procedia Engineering, vol. 118, pp. 1104–1111, 2015, https://www. sciencedirect.com/science/article/pii/S1877705815021050.10.10 16/j.proeng.2015.08.450.

[17] S. Lockley, BIM for Facilities Management—University Campus, OpenBIM, Newcastle-upon-Tyne, UK, 2013.

[18] Y. Ahn, H. Kwak, and J. Suk, "Contractors' transformation strategies for adopting building information modeling," Journal of Management in Engineering, vol. 32, no. 1, article 05015005, 2016.

[19] C. Eastman, P. Teicholz, R. Sacks, and K. Liston, BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, and Contractors, John Wiley and Sons, Hoboken, NJ, USA, 2nd edition, 2011.

[20] Y. Lu, L. Yongkui, M. Skibnievski, Z. Wu, R. Wang, and Y. Le, "Information and communication technology applications in architecture, engineering, and construction organizations: a 15-year review," Journal of Management in Engineering, vol. 31, no. 1, article A4014010, 2015.

[21] C. Botton and D. Forgues, "Practices and processes in BIM projects: an exploratory case study," Advances in Civil Engineering, vol. 2018, Article ID 7259659, 12 pages, 2018.

[22] S. Lee, J. Yu, and D. Jeong, "BIM acceptance model in construction organizations," Journal of Management in Engineering, vol. 31, no. 3, article 04014048, 2015.

[23] M. Gheisari and J. Irizarry, "Investigating human and technological requirements for successful implementation of a BIM-based mobile augmented reality environment in facility management practices," Facilities, vol. 34, no. 1/2, pp. 69–84, 2016.

[24] L. Hero and E. Lindfors, "Students' learning experience in a multidisciplinary innovation project," Education + Training, vol. 61, (4), pp. 500-522, 2019.

[25] Y. S. Hegzi and N. A. Abdel-Fatah, "Quantifying students' perception for deconstruction architecture," Ain Shams Engineering Journal, vol. 9, (4), pp. 2745-2754, 2018.

[26] C. Lima et al, "Product line architecture recovery with outlier filtering in software families: the Apo-Games case study," Journal of the Brazilian Computer Society, vol. 25, (1), pp. 1-17, 2019.

[27] H. D. Arslan, G. Özer and A. Özkiş, "Evaluation of Final Product Integrated with Intelligent Systems in Architectural Education Studios," Online Journal of Art and Design, vol. 5, (3), pp. 119, 2017.

[28] H. D. Arslan, G. Özer and A. Özkiş, "Evaluation of Final Product Integrated with Intelligent Systems in Architectural Education Studios," Online Journal of Art and Design, vol. 5, (3), pp. 119, 2017.

[29] R. Chen et al, "ArchME: A Systems Modeling Language extension for mechatronic system architecture modeling," Artificial Intelligence for Engineering Design, Analysis and Manufacturing, vol. 32, (1), pp. 75-91, 2018.

[30] M. E. Spencer and S. B. Watstein, "Academic Library Spaces: Advancing Student Success and Helping Students Thrive," Portal: Libraries and the Academy, vol. 17, (2), pp. 389-402, 2017.

[31] T. Bruckner, "Design of the technological architecture for PUMPIT project," Journal of Systems Integration, vol. 10, (2), pp. 34, 2019.

[32] L. Sapto Pamungkas, C. Meytasari and H. Trieddiantoro, "Virtual Reality As A Spatial Experience For Architecture Design: A Study of Effectiveness for Architecture Students," SHS Web of Conferences, vol. 41, pp. 5005, 2018.

[33] C. Hein and E. van Dooren, "Teaching history for design at TU Delft: exploring types of student learning and perceived relevance of history for the architecture profession," International Journal of Technology and Design Education, 2019.

[34] T. Tong et al, "Functional density and edge maps: Characterizing functional architecture in individuals and improving cross-subject registration," Neuroimage, vol. 158, pp. 346-355, 2017.

[35] C. Sousa, A. P. Tereso and A. G. G. Fernandes, "Improving project management practices in architecture & design offices," 2017. . DOI: 10.1007/978-3-319-56538-5_6.

[36] L. Ulmane-ozolina, A. Jansone, I. Magazeina, and D. Barute, "Technology enhanced learning in teachers ' professional development," Period. Eng. Nat. Sci., vol. 7, no. 1, pp. 216–221, 2019.

[37] I. J. Ramaji and A. M. Memari, "Product Architecture Model for Multistory Modular Buildings," Journal of Construction Engineering and Management, vol. 142, (10), pp. 4016047, 2016.

[38] S. Kim and S. K. Moon, "Eco-modular product architecture identification and assessment for product recovery," Journal of Intelligent Manufacturing, vol. 30, (1), pp. 383-403, 2019.

[39] C. Liu et al, "Product architecture design of multi-modal products," Research in Engineering Design, vol. 27, (4), pp. 331-346, 2016.

[40] P. Zheng et al, "Smart, connected open architecture product: an IT-driven co-creation paradigm with lifecycle personalization concerns," International Journal of Production Research, vol. 57, (8), pp. 2571-2584, 2019.

[41] N. Burton, "When do product architectures mirror organisational architectures?: the combined role of product complexity and the rate of technological change," Technology Analysis & Strategic Management, vol. 30, (9), pp. 1057-1069, 2018.

[42] S. Pashaei, "The impact of global operations on product architecture: an exploratory study," International Journal of Operations & Production Management, vol. 37, (10), pp. 1304-1326, 2017.

[43] D. Williamsson, U. Sellgren and A. Söderberg, "Product Architecture Transition in a Modular Cyber-Physical Truck," Journal of Computing and Information Science in Engineering, vol. 19, (3), pp. 31002, 2019.

[44] Y. Malini Reddya* and Heidi Andradeb, "A review of rubric use in higher education, Assessment & Evaluation in Higher Education", vol. 35, no. 4, pp 435–448, 2010.