The effect of green campus on higher education for sustainable development: The case of Engineering Faculty, Alexandria University

Faten Fares Fouad

Architectural Engineer in Bibliotheca Alexandrina
PhD Student in Architectural Engineering Department, Engineering Faculty, Alexandria University, Egypt

Abstract: The higher education has a key role to play in the move toward a more sustainable world. Through the Curriculum, Research and Operations conducted on campuses to support environmental integrity, economic vitality and social justice for present and future generations. This paper investigates the role of the physical campus environment in embedding sustainable development in Curriculum, research and Campus Community Culture. A questionnaire survey was carried out within the Engineering Faculty at Alexandria University to identify how academic staff, student, administration and graduates perceive sustainable development into the campus through three levels: 1- Curriculum, Teaching and Research; 2- Campus Community culture; 3- Site, Built Environment and Facilities. The findings show the disparity in knowledge between different sectors of the respondents at the university. Finally, the study findings emphasize the need to clear strategies developing approach to sustainability into campus.

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Keywords: Sustainability; Sustainable development; Education for sustainable development; Green campus

1. Introduction

The United Nation's Brundtland Commission Report of 1987 concluded that humanity has the ability to make development sustainable if it meets "*the needs of the present without compromising the ability of future generations to meet their own needs*"[1]. The Brundtland Report was the catalyst that helped focus humanity on our obligations to future generations as well as to the importance of ***developing people***, ***not just protecting the environment***. However, there is a growing consensus among scholars and leaders around the world that we must now build on the Brundtland Report by incorporating a deeper consideration of human well-being into the evolving approach to *sustainable development on local, regional, and global levels* [2]. In Agenda 21 emphasizes that ***education is a 'vital factor'*** in the promotion of sustainable development and, as well, in the development of people's skills when dealing with environmental and development issues [3]. Embedding *sustainability in higher education* is an important engine for societal change. Universities must function as places of research and learning for sustainable development... *Higher education should also provide leadership by practicing what they teach through sustainable purchasing, investments and facilities that are integrated with teaching and learning...* Higher education should emphasize experiential, inquiry-based, problem- solving, interdisciplinary systems approaches and critical thinking. Curricula need to be developed, including content, materials and tools such as case studies and identification of best practices [4].

This paper investigates the effect of green campus 'as an important engine for change' [5] on higher education for sustainable development. Green campuses lead society by example and by directing their intellectual and organizational resources to enhance the environment in local, regional, and global communities. This may take the form of setting an example that others follow, conducting public environmental education or implementing community programs run by students, faculty, and staff that provide direct environmental services [6]. It analyzes the understanding of the role of sustainable campus in the Faculty of Engineering, Alexandria University through three determinants: Curriculum, Teaching and Research; Campus Community culture; and Site, Built Environment and Facilities *[Fig.1]*. *These determinants draw framework to scaling sustainable change for maximum impact.* Finally, The impact of integrating these determinants: best practices in sustainable operations, research and teaching into practice, use the campus to pilot innovative solutions to real-world challenges, campus users become leaders who will use their knowledge to create sustainable impact in service to the world, and sharing replicable models that can be implemented inside and outside the campus[2].

Research Methodology

This research strategy embrace theoretical study investigates the education sustainable development (ESD) in higher education in general and at the campus in particular, it comprises the theoretical analysis of the study issue, and an experimental study

questionnaire. Additionally, the study incorporates two methods of data collection: document analysis and a questionnaire survey. The findings of the questionnaire explain the opportunities and barriers to embedding ESD in the campus.

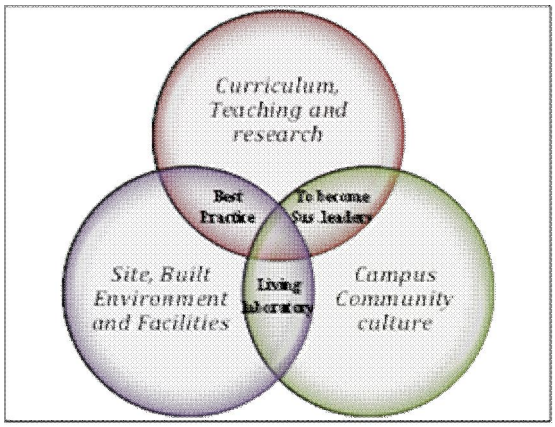

Figure 1: Sustainable campus determinants of the study. (Source: Author)

Education for sustainable development (ESD) in higher education:

Historically, the term "sustainable" arose among those with environmental concerns, and most of the literature and assessment instruments reflect this emphasis. However, it is increasingly recognized that sustainability cannot be achieved without addressing social justice issues. There can be no sustainable communities and institutions without social justice. So too is humane consideration toward the whole community of life an essential part of true sustainability. An academic institution committed to sustainability should help students understand the roots of today's injustices and motivate them to seek justice and humaneness in full integration with understanding the roots of environmental degradation and modeling environmentally sustainable practices [7].

In Agenda 21 at the UN Conference on Environment and Development (UNCED) was incorporating sustainable development in education (Earth Summit, 1992) "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" [8] (cited in Blewitt, 2002, p3)

Education for sustainable development is a dynamic concept that utilizes all aspects of public awareness, education and training to create or enhance an understanding of the linkages among the issues of sustainable development and to develop the knowledge, skills, perspectives and values which will empower people of all ages to assume responsibility for creating and enjoying a sustainable future. (From the UNESCO Decade of Education for Sustainable Development website, 2005) [9]

The concept of sustainability – which, at a minimum, addresses how humans can live on the planet over time in a manner that protects cultural and biological diversity, recognizes and appreciates ecological limits, offers just and accountable governments and economies for all, and draws on the human capacity for adaptive learning and innovation – offers a tremendous challenge for education. It requires educational institutions to rethink their missions and to re-structure their courses, research priorities, community outreach, and campus operations. By preparing students – and the whole campus community – to be more adept decision makers in the increasingly complex, dynamic, and uncertain future that we all face, integrating sustainability into all of the major activities of educational institutions also presents a tremendous opportunity[10].

'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 [11]. 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, the epistemology of sustainable development literacy builds upon this shift with the addition of an emphasis on the interrelationship between human and natural systems [12].

In Agenda 21 at the UN Conference on Environment and Development Rio 2012 (UNCED)[9] Encouragement to educational institutions to consider adopting good practices in sustainability management on their campuses and in their communities with the active participation of, inter alia, students, teachers and local partners, and teaching sustainable development as an integrated component across disciplines [13].

Sustainable development in campus (Green Campus):

Actually all the world need to do something to protect this planet that is our home. For those of students, faculty, staff, and administrators on campus, could better reflect the principle, "***think globally, act locally***," (Sir Patrick Geddes, 1932) [14] to getting the campus on a greener, more sustainable path [6]. A green campus is a higher education community that is

improving energy efficiency, conserving resources and enhancing environmental quality by educating for sustainability and creating healthy living and learning environments. Universities and colleges are living laboratories. They develop the tools and techniques needed to implement innovative green technology and methodology. Through comprehensive sustainability plans that integrate curriculum offerings, research initiatives, student engagement opportunities, and collaborative partnerships, educational institutions can realize the concept of "campus as teacher." In the process, green campuses provide students opportunities to develop green job skills that prepare them to be top candidates in an increasingly competitive job market. [15]

A sustainable campus is one that develops process or management systems that help create a vibrant campus economy & high quality of life while respecting the need to sustain natural resources and protect the environment [16].

There is cause for hope, however. Increasingly, more and more people have come to accept the observation David Orr made in 1992: "The [sustainability] crisis cannot be solved by the same kind of education that helped create the problems." Today, students, faculty, staff, and administrators have embraced sustainability as a key part of the mission of higher education, and are working to make our campuses more sustainable and our curriculum better geared to helping students acquire the background and skills they will need to meet to make our future more sustainable [17].

Campus operations at the college or university would be fundamentally oriented toward reducing the institution's "ecological footprint." Thus one would see examples of water and energy conservation, carbon dioxide reduction practices, sustainable building construction and renovation, environmentally responsible purchasing of food, paper, and other products, etc. Furthermore, these operational practices would be integrated into the educational and scholarly activities of the school. Student opportunities and engagement on campus would reflect a deep commitment to sustainability through such institutional practices as new student orientation, scholarships, internships and job placement counseling related to community service, sustainability, and/or justice issues [18].

The Sustainable Campus Charter has been developed and is disseminated in collaboration between the International Sustainable Campus Network (ISCN) and the Global University Leader Forum (GULF) convened by the World Economic Forum. It provides universities and corporations a common framework to formalize their commitments and goals on campus sustainability, and a platform to publicly share achievements within a group of peer and leading organizations around the globe.

To address sustainability holistically, the Charter structures campus commitments about sustainability into a nested hierarchy encompassing individual buildings, campus-wide planning and target setting, and integration of research, teaching, outreach and facilities for sustainability. Three corresponding principles *[Fig.2]* [19]:

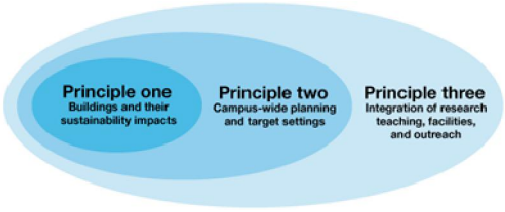

Figure 2: The Sustainable Campus Charter principles (ISCN(

1. ***Sustainability performance of buildings on campus***

To demonstrate respect for nature and society, sustainability considerations should be an integral part of planning, construction, renovation, and operation of buildings on campus.

2. ***Campus-wide master planning and target setting***

To ensure long-term sustainable campus development, campus-wide master planning and target-setting should include environmental and social goals.

3. ***Integration of facilities, research, education, and outreach as a "living laboratory" for sustainability***

To align the organization's core mission with sustainable development, facilities, research, and education should be linked to create a "living laboratory" for sustainability.

The Sustainability Tracking, Assessment & Rating System ™ (STARS) is a voluntary, self-reporting framework for helping colleges and universities track and measure their sustainability progress. An institution's STARS score is based on the percentage of applicable points it earns across four categories [28]:

1. Academics (AC)
Curriculum, Research

2. Engagement (EN)
Campus, Public Engagement

3. Operations (OP)
Air & Climate, Buildings, Dining Services, Energy, Grounds, Purchasing, Transportation, Waste, Water

4. Planning & Administration (PA)

Coordination, Planning & Governance, Diversity & Affordability, Health, Wellbeing & Work. Investment

Review Campus Improvement Plans (Harvard):

"Harvard must model an institutional pathway toward a more sustainable future." (President Drew Gilpin, 2015)[2] The Harvard Sustainability Plan builds off of this framework and is the next step in the University's evolving commitment to sustainability. It is roadmap for building and operating a healthier, more sustainable campus community. Aim to transform the University into a sustainable community that contributes positive

social, economic, and environmental benefits. They dedicated to institutionalizing best practices in sustainable operations and translating research and teaching into practice by using the campus to pilot innovative solutions that can be widely replicated. Plus have a deeper mandate that goes to the heart of Harvard's research and teaching mission: to educate and empower its students while on campus to become leaders who will use their knowledge to create sustainable impact in service to the world *[Fig.3]*.

The Harvard Office for Sustainability led the development of the Plan with extensive feedback from hundreds of faculty, students, and facilities and operational experts across the University. The Harvard Sustainability Plan is organized around the five core topics of Emissions and Energy, Campus Operations, Nature and Ecosystems, Health and Well-Being, and Culture and Learning (Harvard Sustainability Plan year 2015-2020 p7) [2]. *[Fig.4]*

Figure 3: Harvard Sustainability Vision (Plan year 2015)

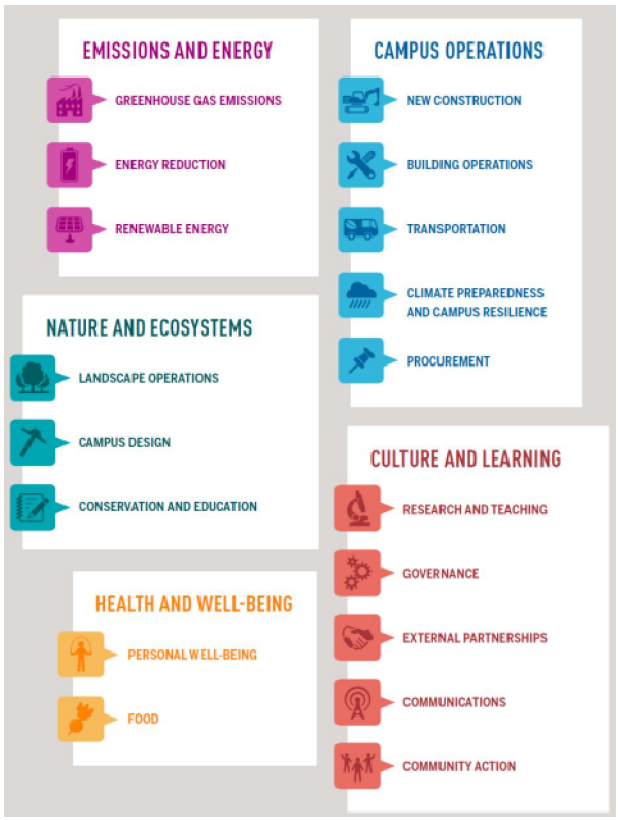

Figure 4: Harvard Sustainability Roadmap (Plan year 2015)

The Green Campus and higher education for sustainable development

Case study: Engineering Faculty Alexandria University

Figure 5: Main façade of Engineering Faculty Alexandria University and its slogan

At the beginning of the academic year 1941 - 1942, the Faculty of Engineering of King Fuad I University established a branch in Alexandria for the preparatory year study. In 1942, Farouk I University was established in Alexandria, and the branch of the

faculty of Engineering became the Faculty of Engineering in King Farouk I University [20]. *[Fig.5]*

- In 1941 The Faculty of Engineering – Cairo University established its branch in Alexandria.
- 1942 The emanation of law ordinance No. 32 for the year 1942 for founding Alexandria University.
- 1942 The inception of the education in of the preparatory year and the first year (Architecture, Civil Engineering, Electrical and Mechanical Engineering)
- 1946 Establishing the department of Sanitary Engineering and Municipalities.
- 1953 Establishing the department of Chemical Engineering
- 1960 Establishing the departments of Mechanical Power Engineering, and Weaving & Textile Engineering.
- 1961 Establishing the department of Marine Engineering.
- 1963 Establishing the department of Production Engineering.
- 1964 Establishing the department of Nuclear Engineering.

- 1974 Establishing the department of Computer Science and Automatic Control.
- 2006 Adopting Specialized Scientific Programs (S.S.P) using Credit hours system.

The Engineering Faculty Site

The Faculty site is located in Shatby district, on the north is Fakher Fakher street separating it the Industrial Institute, on the east is Ahmed Kamha street, from the south Abu kir street (formally known as Liberty road), & finally from the west Ahmed Lotfy Elsayed street. The Faculty is located in the middle of the city of Alexandria (Author). It has an area of average 109600.9 m² consists of 10 buildings 6 of them are famous for their Pharaonic Style. The buildings are:

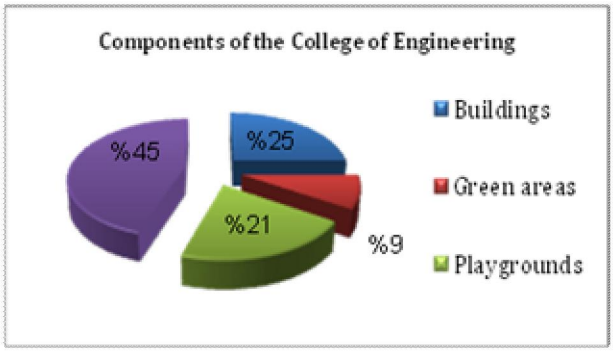

Chart 1: Ratios and components of the College of Engineering

Table 1: Total area of the Faculty of Engineering buildings in m^2

No	Building	Area / m^2
1	Administration Building	2598
2	Electricity Building	5227
3	Preparatory Building	5737
4	Mechanics Building	6780
5	Textile Engineering building	1059
6	Production Building	4363
7	Carpentry workshops Building	957.4
8	Union Building	631
	Total Area	**27352.4**

Built up Area: 27352.4 m2, Total built up area: 109600.9 m2 Percentage of Occupation: 25%.

The site is surrounded by 3 main roads, from the east, south & north, its most famous is the Liberty road connected to the site by main entrance, making it easily accessible from main points such as the Sidi Gaber Station. Also several south roads branched from it to connect the site to several districts such as Elhadra & Smouha. This all is done through public transportation (microbuses, buses & taxis) & private cars. West side (Ahmed Lofty Elsayed street) has another car entrance & a pedestrian one. There are some closed entrances & the two east & west streets are connected to the Tram road & the Korniche road north. The streets surrounding the building, which facilitates access to the site. The site is open and allows access of air from the north or north-west and moves around the buildings easily. *[Fig.6]*

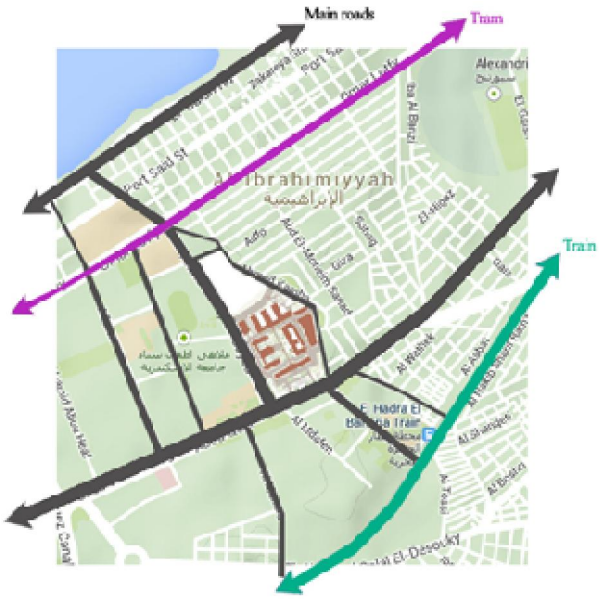

Figure 6: The Faculty Site and its relationship with the surrounding transportation Network

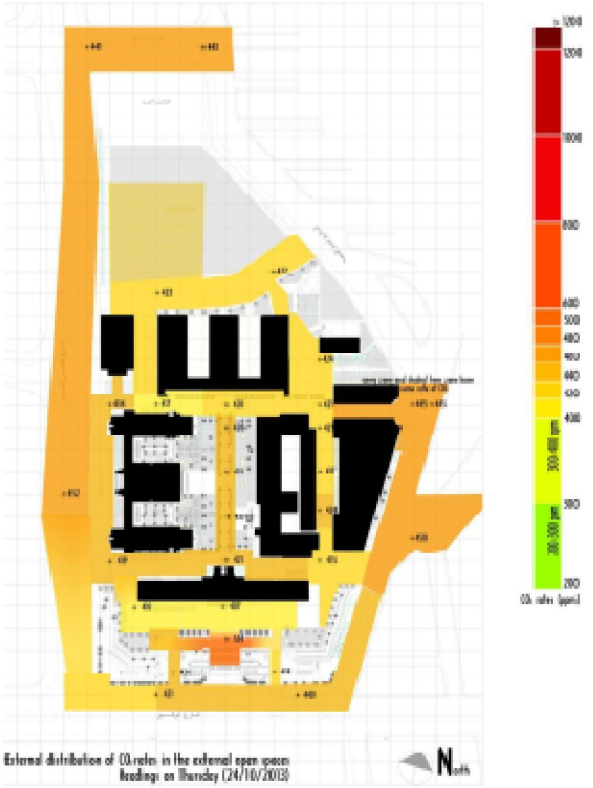

Figure 7: External Distribution of CO2 rates in the open spaces- October

The carbon dioxide on the site average in the faculty 554.08, and outside 417.8 and a rise in temperatures, the average temperature on the inside more than abroad, in addition to the presence of plankton in the air inside and outside the building because of poor ventilation, and car exhaust, and directing the building [22]. *[Fig.7]*

Cars entering to college daily estimated at 500 cars on different places in campus plus, passing cars in the streets surrounding the faculty. *[Fig.9]*

The Faculty of Engineering Information (2012-2013)

1-Number of students 15755 students; 11203 male and 4522 female

2-Number of post graduate 3767 students; 2654 male and 1113 female

3-Number of PhD 358 students

Number of Ms 2674 students,

Number of Diploma 735 students *[Chart 2]*

4- Number of Staff + assistants: 1049

Number of actual Academic Staff 567

Number of administrative staff in the Faculty: 679

-The proportion of the total number of students to Academic staff 1:27

-The Percentage of obtaining the scientific degrees from academic staff and assistants members at the last three years, about 31%. On the other hand The Percentage of Foreign students enrolled in postgraduate is shallow, about 3.4% [21]

- Consumption of electrical energy used in the buildings are estimated at 1162866 kilowatts during the six months of this year, an average of 193 811 kWh per month.

-Consumption of water used is estimated at 21107 m^3 during the first six months of this year, with an average 3517.8 m^3 per month.

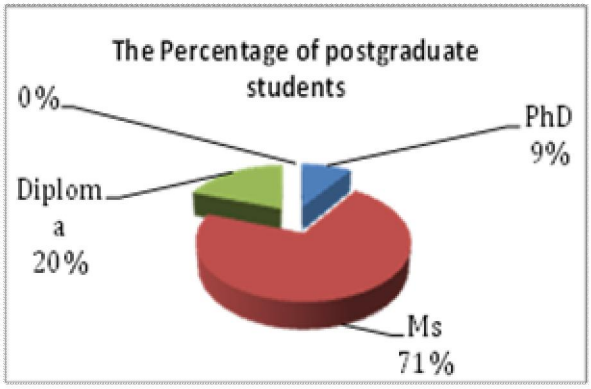

Chart 2: The Percentage of postgraduate students

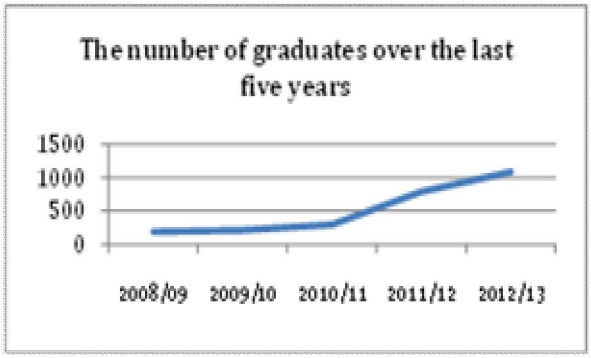

Chart 3: The number of graduates over the last five years

-There are wastes and materials consumed in the buildings, workshops and cafes of paper, cans, glass and others not reused or separate it. *[Fig.8]*

- The overall condition of the buildings and facilities are not satisfactory. As well as the weak of maintenance and it appears evident in the external facades, sanitation and finishing materials. *[Figs.9, 10]*

Community participation and development environment in the faculty:

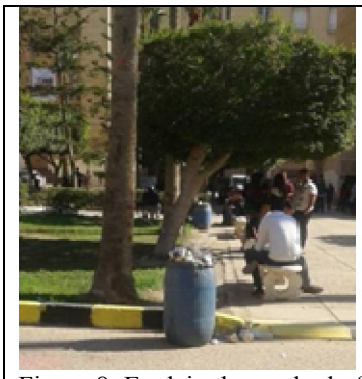

Figure 8: Explain the method of assembling waste

Figures 9, 10: Explain the condition of buildings and one parking places

The faculty established Engineering Center for Public Service and Serve Community Office In order to implement outreach programs of community service and development (Academic staff and their assistants / students / workers / relevant community parties' environment…) by issuing booklets, flyers, faculty website, and workshops about environmental problems and community issues (Alexandria city problems) workshops as, " Towards stopping the irregularities of buildings in Alexandria" & " The development of transportation and traffic systems in Alexandria" [23]. However these programs are extremely limited hence, have limited effect.

In addition, the faculty organized patrol international conference every two years "Role of Engineering Towards Better Environment". On 22nd December 2012, decision makers, stakeholders, members of the society, government officials, educators, and project managers in Egypt were invited by the faculty of Engineering, Alexandria university, to meet to participate in the "RETBE'12 and RIO+20" workshop to discuss and assess the challenges and vision for the sustainable development goals implementation. They acknowledged the establishment of ARWA (Alexandria –Rio+20 Workshop-Agenda), a networking base "Alexandria Declaration" affirm some principles concerning the environment and development last points contain [24]:

-Science and technology must be used to improve the environment.

-Awareness at all levels, (Public, Schools, Universities, Media, Etc.) must be implemented.

-Environmental education (Engineering, water, energy, …etc) is essential.

-Teaching sustainable development concepts, ensuring that they form a part of the core curriculum across all disciplines.

-Encourage research on sustainable development issues.

-Green our campuses *by reducing the environmental footprint through energy, recycling, water and material resource efficiencies in our buildings and facilities…...*

Sustainability Assessment Questionnaire for Engineering Faculty- AU

Questionnaire

Sustainability Assessment Questionnaire is designed to assessing the extent to which Engineering Faculty- AU is sustainable in its teaching, research, operations and outreach. Additionally, generate both statistical and qualitative data; this would yield explanations concerning the opportunities for and barriers to embedding Sustainable development in our universities.

A questionnaire survey was carried out within the Faculty of Architectural Engineering at Alexandria University to assess extent achieving sustainable campus in the faculty of engineering at levels: ***1- Curriculum, Teaching and research; 2- Campus Community culture; 3-Site, Built Environment and Facilities.*** The questionnaire was designed to identify how Staff, student, administration perceive sustainable development into campus and education.

The Three parts selected for investigating the role of sustainable campus in embedding sustainable development in Curriculum, pedagogy, research plus, in leading society by example and by directing their intellectual and organizational resources to enhance the environment in local. The Curriculum, Teaching and research comes as the first of these parts. It asks about the opportunities which introduce by university to enhance understanding, teaching and research in sustainability. The second part is the campus community culture. In this regard, asks about the role of the faculty in its social, ecological and economical systems and attempts to teach and emphasize its students. Finally, the last part Site, Built Environment and Facilities - as the core of this research- represents evaluation to what extent the faculty of engineering by operational practices emphasized moving toward sustainability and integrated into the educational and scholarly activities of the university.

A questionnaire survey was issued at autumn 2014 with the beginning of the semester to random sample included male and female and encompassed Students, Academic staff, Administrative staff and Engineers (Faculty graduates).

Questionnaire Results

The findings of the questionnaire show the high percentage of academic staff and students have a good knowledge about sustainability compared with faculty graduates. In contrast, the sustainability literacy to administrative staff almost non-existent *[Chart 4]* on the other hand, many Engineering departments haven't enough idea about the sustainability issues as the architecture department**.**

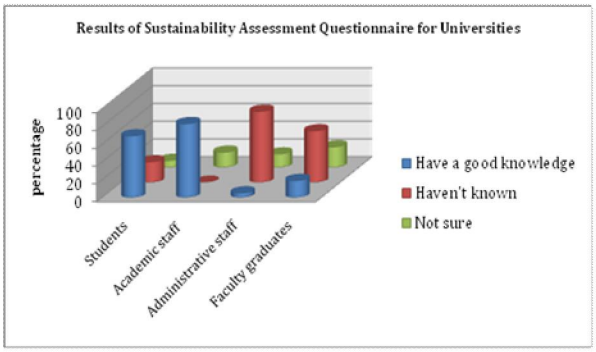

Chart 4: Show the extent of knowledge about the term "sustainability" and the concept of "green thinking"

1- *Curriculum, Teaching and research*

This part of the survey shows the samples opinions in first level of achieving sustainable campus in the faculty of engineering: Curriculum, Teaching and research. *[Tab. 2]*

Table 2: A rating system was developed based on a Likert-scale from 1 to 4, in which 4 is a great deal. (-A great deal [4] -Quite a bit [3] -Little [2] -None [1]). [25]

Curriculum, Teaching and research survey	Students	Academic staff	Admin. staff	Graduates	AV
To what extent the university provide faculty and staff development opportunities to enhance understanding, teaching and research in sustainability	2.1	2.8	1	2.16	2.02
To what extent the faculty offers courses which address topics related to sustainability. (Such topics could include globalization and sustainable development; urban ecology and social justice; population....)	1.85	2	1	1.89	1.69
To what extent undergraduates required to take a course on issues related to the environment or sustainability	3.4	3.17	3	3.15	3.18

Moreover, a small percentage of the sample are accessed their information about sustainability in Engineering faculty campus from all available methods; Subjects, Research programs, Conference and Workshops. *[Chart 5]*

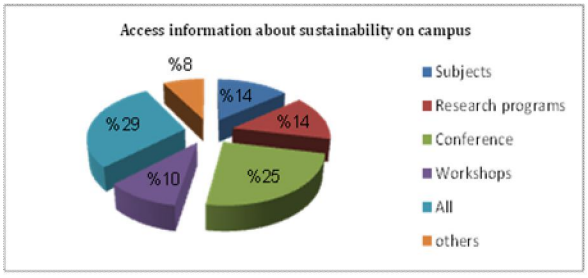

Chart 5: Show the percentage of different resources to access information about sustainability on campus

2- *Campus Community culture*

The findings of the questionnaire show in this level that the most of sample agreed dramatically on the achievement sustainable development is considered the responsibility of all; Researchers and universities, Society and Government. Additionally, the academic staff and students emphasize significantly that the obstacles to achieving sustainable development are all; lack of awareness, material cost and long time to achieve. At the same time, the administrative staff and engineers (faculty graduates) their point of view the main obstacle is lack of awareness.

Regarding the role of the faculty in its social, ecological and economical systems (sustainability dimensions), the respondents' answers cover these areas and point to integrate sustainability into attempts to teach the natural features and culture of the region. From a different angle, the faculty ignores the contribution to a sustainable economy, sustainable local communities and the campus functions in the ecosystem (e.g. water, energy, waste and garbage....). The comments come to show the need for more application regarding all sustainability dimensions.

Thereby according to the sample's answers, refer to the academic staff only agreement of the Individual efforts can achieve the effect of a difference in the

issues of sustainable development (Waste, Water Use, Resource Consumption and Health and Wellness) and achieving sustainable development in Alexandria University Faculty of Engineering. *[Tab.3]*

Table 3: Campus Community culture survey, a rating system was developed based on a Likert-scale from 1 to 4, and in which 4 is a great deal. (-I agree and support [4] -I agree [3] -Disagree [2] –Not Interested [1])

Campus Community culture survey	Students	Academic staff	Admin. staff	Graduates	AV
Individual efforts can achieve the effect of a difference in the issues of sustainable development (Waste, Water Use, Resource Consumption and Health and Wellness)	2.1	3.7	1.7	1.6	2.75
Achieving sustainable development in Alexandria University Faculty of Engineering	3.7	4	4	3.2	3.73

3-Site, Built Environment and Facilities

Lastly, the third level represents evaluation to what extent the faculty of engineering by operational practices emphasized moving toward sustainability.

The reading of this part of the questionnaire findings showed the most of sample agreed unanimously that when they walk around the campus can't find the faculty by operational practices committed to sustainability especially Transportations, Parking, Exterior facade, Energy conservation (Finishing materials - ventilation), Water conservation, Waste Management Site, and Indoor environmental quality*[Table 4]*. To add to that, although the faculty site is open and surrounding by different public transportations, only average 50% used public transit *[Chart 6]*.

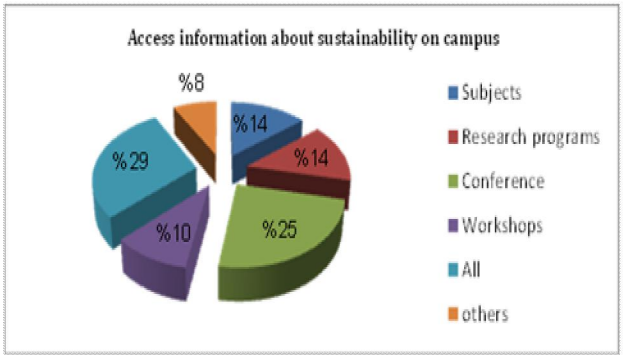

Chart 6: Show the percentage of Users commuting by means of transportation to the university

At the end of the questionnaire the respondents' comments explain the statistic findings, most of them didn't find any committed to sustainability on the campus. To put it into different perspective, some comments find only green spaces of the manifestations of sustainability. One respondent from post- graduate student comments that "... Green spaces, passive design in building to save energy like the thickness of walls, materials, the size of windows, and use day-lighting..."

Regarding, integrated operations practices campus into the educational and scholarly activities, the comments show that no sustainable educational activities into the campus, some of them just studied courses about "sustainable environment". Additionally, the factors that support achieve sustainability on the campus; the respondents' comments come to ensure this fact "I think we should raise awareness among the pioneers of the university students and staff, place a greater focus on more courses about sustainable development, and more of interests in save the campus environment…"

Sustainable AUC:

Affirming its commitment to sustainability, AUC has taken several measures to foster a "clean and green" campus environment, from developing a sustainable trash management system and building the University's first extensive green roof to offering new degree programs in sustainable development, reducing overall energy use on the New Cairo campus and establishing an Office of Sustainability, the Research Institute for a Sustainable Environment and the Center for Sustainable Development. In addition, a Sustainable Campus Committee – established in 2010 and comprised of students, faculty and staff – creates a forum for sharing knowledge, exchanging ideas, advancing research and raising awareness in order to promote environmentally friendly practices on campus. [26].

The same questionnaire was carried out within AUC in contrast, the results was a completely different compare with EFAU campus. The random sample included academic staff and student from different disciplines; they have a good knowledge about sustainability and green thinking. In the first part (Curriculum, Teaching and research), the answers of samples show that the university provide staff development opportunities to enhance understanding, teaching and research in sustainability and they accessed their information about sustainability in campus from all available methods; Subjects,

Research programs, Conference and Workshops and most of them choose others and wrote "RISE"[27].

Table 4: Questionnaire findings regarding the faculty committing to sustainability (Source: Author)

To what extent the faculty by operational practices committed to sustainability.	A great deal	Quite a bit	A little	None	Don't know
Outdoor environmental					
A landscaping	●	○	○	○	○
Parking	○	○	○	●	○
Exterior facade	○	○	●	○	○
Energy conservation					
Energy conservation (lighting)	○	●	○	○	○
Energy conservation (ventilation)	○	○	●	○	○
Energy conservation (Finishing materials)	○	○	○	●	○
Water conservation					
Water conservation (Efficient toilets)	○	○	●	○	○
Water conservation (Minimal irrigation)	○	○	●	○	○
Water conservation (Harvested rainwater)	○	○	○	●	○
Recycling of solid waste					
Waste Management Site	○	○	○	●	○
Recycling of solid waste (Paper- plastic- metal...)	○	○	○	●	○
Indoor environmental quality	○	●	○	○	○
Indoor environmental quality (Thermal comfort)	○	○	○	●	○
Indoor environmental quality (Facilities)	○	●	○	○	○
Indoor environmental quality (Overcrowding)					
To what extent you see when you walk around campus that tells you this is faculty committed to sustainability	○	○	○	●	○

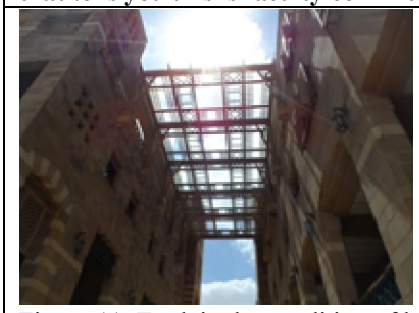

Figure 11: Explain the condition of buildings materials and passive design in AUC

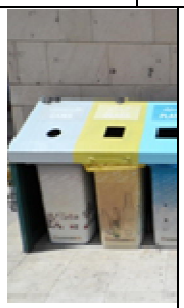

Figure 12: Explain the method of assembling waste in AUC

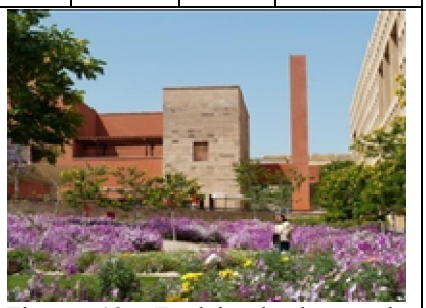

Figure 13: Explain landscape in AUC

Regarding the second part (Campus Community culture) the sample's answers, refer to the agreement of the Individual efforts can achieve the effect of a difference in the issues of sustainable development (Waste, Water Use, Resource Consumption and Health and Wellness) *[Table 5]*. Finally, in the third part findings showed the most of sample use privet cars to arrive the university while, about 25% of sample uses the bus and walk (University Residences). In the overall analysis of findings the most of sample agreed unanimously that when they walk around the campus can find the campus by operational practices committed to sustainability especially Parking, Exterior facade, Energy conservation (Finishing materials - ventilation), Water conservation , Waste Management Site, and Indoor environmental quality. *[Figs.11, 13]*

Table 5: Questionnaire findings regarding the faculty committing to sustainability in AUC (Source: Author)

To what extent the faculty by operational practices committed to sustainability.	A great deal	Quite a bit	A little	None	Don't know
Outdoor environmental					
A landscaping	●	○	○	○	○
Parking	○	●	○	○	○
Exterior facade	○	●	○	○	○
Energy conservation					
Energy conservation (lighting)	○	●	○	○	○
Energy conservation (ventilation)	○	●	○	○	○
Energy conservation (Finishing materials)	○	●	○	○	○
Water conservation					
Water conservation (Efficient toilets)	○	●	○	○	○
Water conservation (Minimal irrigation)	○	●	○	○	○
Water conservation (Harvested rainwater)	○	●	○	○	○
Recycling of solid waste					
Waste Management Site	●	○	○	○	○
Recycling of solid waste (Paper- plastic- metal...)	○	●	○	○	○
Indoor environmental quality					
Indoor environmental quality (Thermal comfort)	○	●	○	○	○
Indoor environmental quality (Facilities)	●	○	○	○	○
Indoor environmental quality (Overcrowding)	●	○	○	○	○
To what extent you see when you walk around campus that tells you this is faculty committed to sustainability	○	●	○	○	○

Conclusion:

The sustainable campus promote the concept of sustainability and its dimensions, within a wide scope the Higher education for sustainable development (ESD) through integrating determinants; Curriculum, Teaching and Research; Campus Community culture; and Site, Built Environment and Facilities. However, the deeper challenge is transforming the different university disciplines to teach integrated thinking for sustainability, in accordance with harnessing the power of collaboration and integrated knowledge across disciplines leads to more powerful and effective solutions to the most pressing problems. This requires change strategies which depend on develop innovative and creative initiatives to engage the university community in discussions about the role the university can play in creating a sustainable future.

This mission need to structure, planning and communicate to promote sustainability in campus. In this regard, the findings of questionnaire which carried out in the Engineering Faculty- Alexandria University (EFAU) part one apparently lack of courses about the sustainability issues in different university discipline expect architecture department. While the sustainability literacy to administrative staff almost non-existent. The questionnaire's findings also show the difficult to access information about sustainability on campus from all available methods compare with AUC.

Despite some efforts to integrate the concept of sustainability on EFAU campus through curriculum and events (conferences, workshops…), but there are obstacles in the questionnaire's findings and comments (Part two), one of most effective obstacles is lack of awareness, plus material cost and long time to achieve sustainability. Thereby according to the sample's answers, refer to the Individual efforts can't achieve the effect of a difference in the issues of sustainable development (Waste, Water Use, Resource Consumption and Health and Wellness) on the contrary of AUC questionnaire findings. The comments come to show the need for more application regarding all sustainability dimensions.

In the overall analysis of findings of part three the most of sample agreed unanimously that when they walk around the campus can't find the campus by operational practices committed to sustainability especially Parking, Exterior facade, Energy conservation (Finishing materials - ventilation), Water conservation , Waste Management Site, and Indoor environmental quality on the contrary of AUC questionnaire findings.

Concluding, this paper analyzes the understanding of the role of sustainable campus in the Faculty of Engineering, Alexandria University through three determinants which draw framework to scaling sustainable change for maximum impact could be the case in similar campus in Egypt. The approach used represents a roadmap:

-promote a deeper understanding of sustainability amongst students, staff, admin as a societal leaders.

-Promote the development of university-wide undergraduate academic programs that allow students to learn for a sustainable future.

-Promote the development of active and empowering curriculum focused on creating change for a sustainable future.

-EFAU campus begin to redesign their operations based on eco-efficiency, waste reduction, and recycling

-establishing programs, or offices would express prominent and explicit concern for sustainability. That commitment would be further

Develop regional networks of researchers engaging in research in the field of sustainability further develop the list of research priorities for the field.

Eidenced through administrative positions and committees, e.g., environmental programs, sustainability task force, etc., and practices, e.g., orientation programs, socially responsible, investment policies, annual environmental audits, etc like Office of Sustainability, RISE, and the Center for Sustainable Development at AUC

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29. Author) Faten Fares Fouad, is an architect, has a master degree in sustainable architecture (2012), Alexandria University, Alexandria - Egypt. Now student in PhD and work as maintenance architecture engineer in Bibliotheca Alexandrina. Her research interests in Sustainability, sustainable architecture, the future of architecture with green new technologies.

Appendix
Sustainability Assessment Questionnaire AU [29]
"The Green thinking and the future of Architecture"
Green Campus
Job/---------- Institution/---------- age/---------- Gender/----------

1- Have you heard the term "sustainability" used at Alexandria University?
-Yes -No -Not sure

2- Do you know what the concept of "green thinking" is?
-Yes -No -Not sure

Curriculum, Teaching and research

3- To what extent does your university provide faculty and staff development opportunities to enhance understanding, teaching and research in sustainability?
-A great deal [4] -Quite a bit [3] -Little [2] -None [1]

4- Which your faculty offers courses which address topics related to sustainability. (Such topics could include globalization and sustainable development; environmental policy and management; environmental philosophy; urban ecology and social justice; population, sustainable production and consumption; and many others.)
-A great deal [4] -Quite a bit [3] -Little [2] -None [1]

5- Are undergraduates required to take a course on issues related to the environment or sustainability?
-A great deal [4] -Quite a bit [3] -Little [2] -None [1]

6- How do you currently access information about sustainability on campus?
-Subjects -Research programs -Conference -Workshops -others

Campus Community culture

7- In your opinion, is the achievement of sustainable development is the responsibility of?
-Researchers and universities -Society -Government -All

8- What are the obstacles to achieving sustainable development?
-Lack of awareness -Material cost -long time to achieve -others

9- The shift to sustainability requires critical thinking about the role of the institution in its social, ecological and economical systems. Which of the following your institution attempts to teach and emphasize its students?

-The campus functions in the ecosystem (e.g. water, energy, waste and garbage....)
-A sense of place: the natural features and culture of the region
-the institution's contribution to a sustainable economy and sustainable local communities
-Staff and faculty involvement in decision-making, their status and benefits
-The content and methods of the academic disciplines

10- Are individual efforts can achieve the effect of a difference in the issues of sustainable development (Waste, Water Use, Resource Consumption and Health and Wellness. and many others?)

-I agree and support [4] -I agree [3] -Disagree [2] -Not Interested [1]

11- What do you think of achieving sustainable development in AUC?

-I agree and support [4] -I agree [3] -Disagree [2] -Not Interested [1]

Site, Built Environment and Facilities

12- Some of the operational practices emphasized by institutions moving toward sustainability. Adding a check (√) to practices which your institution has implemented

	A great deal	Quite a bit	A little	None	Don't know
Outdoor environmental					
A landscaping	○	○	○	○	○
Parking	○	○	○	○	○
Exterior facade	○	○	○	○	○
Energy conservation					
Energy conservation (lighting)	○	○	○	○	○
Energy conservation (ventilation)	○	○	○	○	○
Energy conservation (Finishing materials)	○	○	○	○	○
Water conservation					
Water conservation (Efficient toilets)	○	○	○	○	○
Water conservation (Minimal irrigation)	○	○	○	○	○
Water conservation (Harvested rainwater)	○	○	○	○	○
Recycling of solid waste					
Waste Management Site	○	○	○	○	○
Recycling of solid waste (Paper- plastic- metal...)	○	○	○	○	○
Indoor environmental quality					
Indoor environmental quality (Thermal comfort)	○	○	○	○	○
Indoor environmental quality (Facilities)	○	○	○	○	○
Indoor environmental quality (Overcrowding)	○	○	○	○	○

13- Which of the following choices describe your lifestyle in University? Transportation to University

- Bike/walk
- Public transit
- Tramway
- Private car

14- To what extent are your operations practices integrated into the educational and scholarly activities of the university?

15- In your opinion, what are the factors that support achieve sustainability on AU?

5/26/2015