

The International JOURNAL

of

ENVIRONMENTAL,
CULTURAL, ECONOMIC
& SOCIAL SUSTAINABILITY

Volume 5

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Amira Elnokaly and Ahmed Elseragy

THE INTERNATIONAL JOURNAL OF ENVIRONMENTAL, CULTURAL, ECONOMIC
AND SOCIAL SUSTAINABILITY
<http://www.Sustainability-Journal.com>

First published in 2009 in Champaign, Illinois, USA by Common Ground Publishing LLC
www.CommonGroundPublishing.com.

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ISSN: 1832-2077
Publisher Site: <http://www.Sustainability-Journal.com>

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Typeset in Common Ground Markup Language using CGCreator multichannel typesetting system
<http://www.commongroundpublishing.com/software/>

Amalgamating Sustainable Design Strategies into Architectural Curricula

Amira Elnokaly, University of Lincoln, UK

Ahmed Elseragy, Arab Academy for Science and Technology, UK

Abstract: In the era of climate change, rising sea levels, the hole in the ozone layer and current food crisis, sustainability is no longer a matter of choice; it is a must. While the term sustainability manages to embed itself in all aspects of contemporary life, sustainability in the built environment requires special attention. Designs created by architects and planners play a fundamental part in shaping the way we live, behave and interact with our surroundings. Smith (2001) argued that instilling sustainable design in curricula at schools of architecture is a significant method of encouraging sustainable architectural design in practice. This is particularly important in non-sustainable societies such as those of the Middle East. For these reasons, this study aims at exploring 'sustainability strategies,' as they may be described, adopted in different schools of architecture. The research surveys architectural curricula at different Royal Institute of British Architects (RIBA) exempted schools of Architecture, at part 1 and 2 levels. Meanwhile, it also observes the contradiction and difficulties of teaching sustainable architectural design in Egyptian and Middle Eastern societies, whose cultural fabric does not encourage environmental awareness. Finally, the study attempts to investigate, in an increased level of detail, how sustainable design education fits into the undergraduate and postgraduate curricula of the Architectural Engineering and Environmental Design Department (AEED) at the Arab Academy for Science, Technology and Maritime Transport (AASTMT) in Alexandria, Egypt. The paper concludes that the proper application of sustainable design strategies at early stages of architecture education has developed architects with sturdy understanding of their environment, climate and local identity, which can never happen if this is addressed in postgraduate studies or at later stages of the Architecture career.

Keywords: Architectural Education, Sustainable Design, Architectural Curricula, Environmental Awareness, Life Projects

Introduction

HIGHER EDUCATION PLAYS a crucial role in shaping the minds of future generations, and the ways they manage to cope with global issues. Sustainability is one such issue, whose importance is rapidly gaining momentum with the onset of climate change, depletion of natural resources and current economic turbulences that have progressed as a result. Architects and planners, who are responsible for shaping the built environment, are held highly accountable for making it sustainable through the designs they create. It is important, therefore, to instill principles of sustainable development in architectural students if they are to create healthy built environments for the future (Smith, 2001 and Elnokaly et al., 2008).

It has now been fifteen years since the UIA Declaration of Interdependence for a Sustainable Future was initially released (Stasinopoulos, 2005). Moreover, it has been almost twelve

years since the UIA/UNESCO Charter for Architectural Education was drawn up, declared and signed (UNESCO/UIA, 2005). In this charter, architectural educators declare that they shall formulate curricula which provide “adequate knowledge of the means of achieving ecologically sustainable design and environmental conservation and rehabilitation” (UNESCO/UIA, 2005). However, architectural institutions world-wide seem to have varying scenarios of how and at what stage the issue of sustainability should be integrated into their curricula (Stasinopoulos, 2005). Many schools have adopted the issue in a superficial manner, without delving deep into its principles, analyzing successful examples and applying knowledge through computer simulation (Kim et. al., 1998). On the other hand, few schools are able to adapt their curricula to establish teaching methods suitable for sustainable design. Others simply have not got the tutors (faculty) able to deliver such issues in design studio. This is as opposed to long-established ones such as the Beaux-Arts traditional methods. But many simple, yet fundamental questions remain unanswered: How and at what stage is ‘sustainable architecture’ taught? What aspects of it can be taught and how? How can physics principles be translated into both a performative and expressive (Yannas, 2005) model of architecture? This paper aims at spreading the general concept of environmental awareness in non-sustainable communities in general. It subsequently aims at focusing on architectural schools’ curricula and instilling sustainable design education in both the minds of tutors and students alike, as well as architectural curricula and syllabuses. In other words it provides a framework for “embracing an ecologically sustainable mindset” in architectural design studio teaching and under the wider umbrella of architectural education.

Sustainability Strategies Followed By Various Institutions

This paper sheds light on the importance of ‘embracing a sustainable mindset’ in architectural education and analyses the approaches of some of the architectural schools attempts in this field. Analysis is carried out of the sustainability strategy adopted at the Architectural Engineering & Environmental Design Department (AEED) at the Arab Academy for Science and Technology (AASTMT), the first RIBA part 1 and 2 validated architecture school in Alexandria, Egypt and the Middle East (Elnokaly, 2007). Successes and failures will both be highlighted, and vehicles for improving ecological literacy will be suggested. Some other approaches conducted by other schools of Architecture validated for both the RIBA part 1 and 2 will also be conducted and presented in this paper.

The methodology followed throughout this research can be divided into three main parts, as displayed in Figure 1.

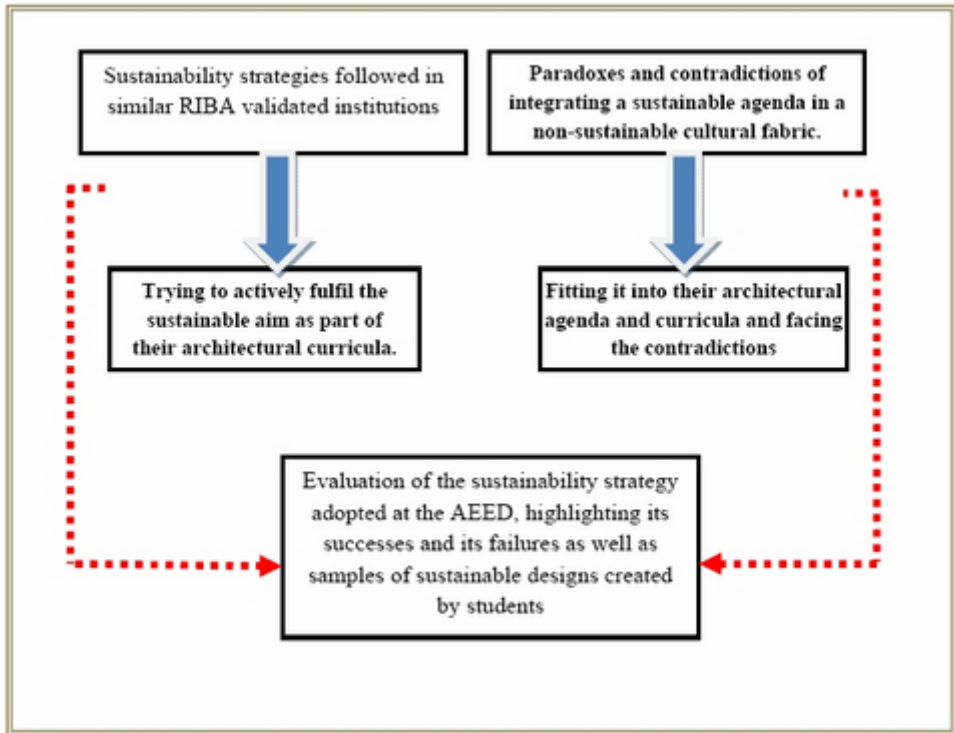


Figure 1: Research Methodology Diagram

This section looks at the techniques embraced in different architectural schools in an analytical approach to evaluate their implemented sustainability strategies. These schools have actively tried to integrate the issue, principles and ideas of sustainable design into their curricula's. Most of the trials discussed in this paper evolved around group projects addressing certain ideas and strategies of sustainability and/or live projects. The aims of the live projects undertaken in Architecture Education and in the Schools of Architecture programs presented in this paper are summarized in Figure 2.



Live Projects are an opportunity to take risks

Live Projects usually do not know where they are going

Live projects are usually political and that's the only way they can be political

Live projects have challenging means of marking and grading system, and should not be marked by traditional means project

Live Projects should be something that could not be done by typical projects

Live Projects should create opportunities for action with the profession, the city and the school

Live Projects should give students academic license



Live Projects should empower all participants

Live Projects should value failure within the live project

Live Projects have the possibility to be students

Live Projects should be something that is not typical

The University of Sheffield's School of Architecture

Issues of sustainability are introduced immediately in the second year design studio at the University of Sheffield's School of Architecture (TUS_SA -4, 2007/08). Objectives of the second year design studio include, "to explore a range of issues that emerge from the consideration of architecture and sustainability, particularly those related to the social, material

and servicing aspects of this debate” (TUS_SA -4, 2007/08). The third year studio continues to expand students’ understanding of the environment.

Issues of the environment and sustainability are focused on in greater detail during the *March* programme. Students must pass courses entitled ‘ARC552 Environment and Technology 1’ and ‘ARC584 Environment and Technology 2’ for RIBA Part 2 exemptions (TUS_SA -3). These run parallel to ‘Design’ modules which are also meant to increase student’s awareness of sustainability in relation to architecture. Meanwhile, all students are required to participate in the university’s ‘Live Projects’. These are offered in a wide range, but are all related to the community and entail working with a real client (TUS_SA -3). The following section 1.1.1 presents some of the projects undertaken by the students at Sheffield University.

The ‘Why Waste’ Live Project

The ‘Why Waste’ project was one of such live projects that received a great deal of media attention in 2007 (Live in Sheffield, 2007 and SWRA). Coordinated by Jeremy Till, (TUS_SA -3) the project was run as part of an online business and construction waste exchange. The project, labeled by the University as ‘Space of Waste,’ reveals an interesting method for the integration of sustainable design into the curriculum. The building created by fifth and sixth year students was constructed entirely of recyclable materials, enforcing concepts of recycling and reuse in the minds of students and public awareness simultaneously. Meanwhile, the building was intended as part of an awareness-raising campaign to imply the message of ‘one person’s waste is another’s resource’ (TUS_SA -3).



Figure 3: (Left) Birchwood wall Panels and (right) Polystyrene bag wall Fillings Photo Courtesy (SWRA) (Kolb, 2008, SWRA)



Figure 4: Upturned Carpet Tiles are used as a Substitute Roofing Material, Thus Creating a Colourful Composition to be seen from afar, Photo Courtesy (SWRA)



Figure 5: Samples of Construction Photos throughout Different Stages of the Project. (Photo courtesy: (SWRA))

The Architectural Association School of Architecture

The Architectural Association School of Architecture (AA) is a highly-renowned school, and one that is well known for the variety of programmes provided at graduate level. At undergraduate level, the AA offers a Foundation course as well as a five year course leading to AA Intermediate (RIBA Part 1), AA Finals (RIBA Part 2) and AA Diploma (AA-1 and 2, 2007). The school also offers a wide range of postgraduate programmes, such as the March Design Research Laboratory, MA Landscape Urbanism, MSc/March Sustainable Environmental Design and several more (AA-2, 2007).

The Foundation course at AA places a special focus on the ‘atmosphere,’ and its accompanying connotations. This is inclusive of the gaseous atmosphere that surrounds us, and which is becoming less ‘breathable’ as the undergraduate prospectus describes, as a result of climate change, global warming and increased air pollution (AA-2, 2007). On the other hand, the term ‘atmosphere’ researched in the Foundation course also describes “layers of location, time, space, material and culture” (AA-2, 2007).

Meanwhile, the AA’s First Year and Intermediate courses follow a slightly philosophical approach leading to a diverse range of projects, with labels such as ‘Narrative Architecture,’ ‘Titanic Utopia’ and ‘Ghost in the Machine: the Architecture of the Uncommon’ (AA-2, 2007). Ultimately, these seemingly exciting design units assist students in following an innovative path towards form-finding, spatial perception and examining potentials of various materials. The Undergraduate Prospectus is continually peppered with phrases related to environmental performance (AA-2, 2007), implying that awareness of issues related to global warming and sustainability does exist among students, and that their designs may be broadly responsive.

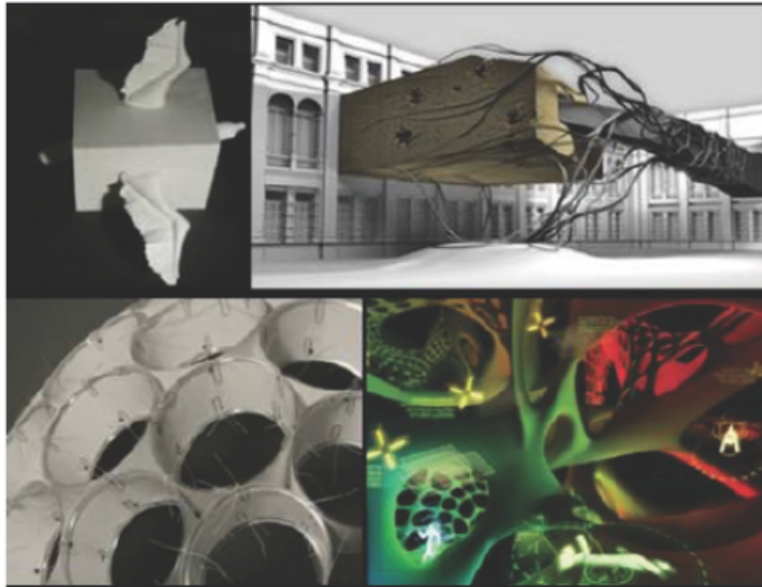


Figure 6: Samples of the Design Work Produced at the Architectural Association Undergraduate Level Courses, Photo Courtesy AA, (AA-1, and 2, 2007, AA-3, 2008)

However, it is the M.Sc./March Environment and Energy Studies Programme (AA E+E) at the school that provides deep insight into the relationship between architectural design, environmental performance and sustainability, through research, experimental design projects and dissertations (AA-3, 2008 / Yannas, 2004). The postgraduate AA E+E programme focuses on real-life applications in both design projects and research (AA-4, 2008), as opposed to the broad philosophical approaches adopted at junior levels. Principles of sustainable design and its theories are taught through lecture courses and workshops. Case studies by of? exemplar models of environmentally-performative architecture are reviewed and students are trained in the use of computer simulation tools for the assessment of their architectural designs (Yannas, 2005 / AA-4, 2007). Additionally, teaching staff at the school are brought in from various countries world-wide (AA-2, 2007 / AA-4, 2007). This exposes students to highly diverse international areas of knowledge, particularly when studying various contexts and different climatic conditions.

The school further enhances students' perception of various climatic and environmental aspects through two main features. Students are given the chance to, a) Model physical large-scale constructions of their designs and b) Perform computer simulation tests on their designs in different world regions, such as Santorini in Greece and the Lulu Island in the Emirates. (AA-3, 2008/Yannas, 2004). Sections (1.2.1) and (1.2.2) presents selected projects undertaken by the AA (E+E) students, in different climatic locations.

The Heliotropic Bench

The Heliotropic Bench was a term project assigned in 2005, where students were meant to create an outdoor bench which incorporates an adjustable sky dome-shaped covering that can be used in hot climates (AA-5, 2007). In addition, the adjustability of the bench was intended to allow manipulation of environmental conditions, particularly solar exposure and wind (Yannas, 2005 / AA-5, 2007). Repositioning the ribs of the bench allow modification of the sky dome's proportions. Obstruction or exposure that comes as a result of this adjustment allows different openings in several directions, thus altering environmental conditions (Yannas, 2005). Prior to design and construction, which took place at one of the school's park facilities; the bench was tested at the PLANEC International Conference in Fira, Santorini in Greece, and finally displayed on the square of Oia (Yannas, 2005 / AA-5, 2007). The final bench design incorporated an interesting deployable structure that can be easily manipulated to respond to alterations in climatic conditions, shown in Figure 7.



Figure 7: Construction and Assembly of the Helotropic Bench throughout Different Phases.
(Photo Courtesy From: AA-5, 2007)

Dynamic Structures for Extreme Climates, Lulu Island, Abu Dhabi 2006-07

The Dynamic Structures for Extreme Climates project for 2006-07 is another example where students were subjected to a context and climatic conditions that are very different to the ones they may have been accustomed to working with in the UK. The project involved sustainable development proposals on Lulu Island, a man-made island near Abu-Dhabi's coastline, and one that has been exposed to extreme climatic conditions in the past (AA-5, 2007). A structure was initially designed and tested at one of the school's workshops, before students travelled to the United Arab Emirates to test their design in context. The project was re-assembled and tested at the American University of Sharjah (AUS) Campus, before being further developed for different sites on Lulu Island itself (AA-5, 2007) depicted in Figure 8.



Figure 8: Design Drawings and Assembly of the Structure at AUS for Testing Using Data Loggers and Computer Simulation Tools. (From: AA-5, 2007)

Integrating Sustainable Design Education in a Non-Sustainable Cultural Fabric

Integrating the sustainable agenda in the design studio proves to be a challenge for any school of architecture. While many schools feel the importance of integrating sustainability issues within their curricula, many obstacles are faced during the process. The following figure displays a classification of these obstacles as seen by Thanos N. Stasinopoulos (Stasinopoulos, 2005), an academic at the Architectural Association School of Architecture, whose research interests are strongly related to sustainable design education.

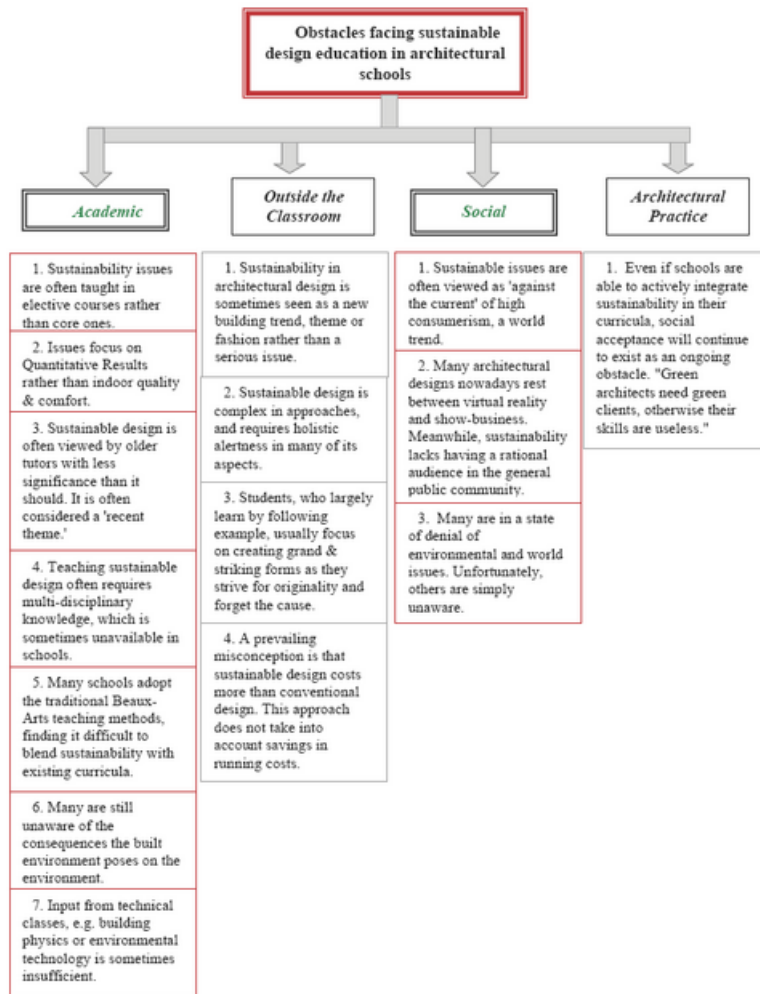


Figure 9: Obstacles Facing Sustainable Design Education in Schools of Architecture. After: Stasinopolous (Stasinopoulos, 2005)

The Problem That Lies Within the Egyptian Cultural Fabric

It is arguable that, in Egypt and the Middle East, some of the greatest obstacles facing sustainable design education alongside the above-mentioned ones, are largely social, and related to awareness issues. It is unfortunate that, in a cultural fabric such as that of Egyptian societies, the whirlwind of life has caused many to ignore global issues of climate change, the greenhouse effect and pollution. Additionally, many people are seemingly unaware of such issues, and few feel that they can truly contribute to 'saving the planet' by playing their minimal roles (E3OP, 2007 and Elnokaly et al, 2008). Members of poorer socio-economic groups are likely to worry about getting through one day at a time, instead of worrying about the hole in the ozone layer, increased levels of carbon dioxide and other global warming-

related issues. The result is that few people are conscious of such issues, and even those who do have awareness have a very weak belief in their ability to participate in the global initiative and make a change.

Young students at university level are an intrinsic part of this social and cultural fabric. It therefore does not come across as a surprise that few of them show an interest in such significant issues. Instilling sustainable strategies poses a great difficulty in a society whose practices are largely unsustainable, and whose members are either unaware, uninterested or both. Introducing simple environmental vocabularies to architectural students whose largest concern is to create striking and outstanding designs is, in itself, a paradox and contradiction. As asserted by Salama and Amir (2005) introducing sustainability and issues related to it in any society rely significantly on a “change in culture,” support of the local economy and availability and use of appropriate technologies (Salama and Amir, 2005).

Evaluation of the ‘Sustainability Strategy’ Adopted at the AEED Department, Alexandria, Egypt

The Architectural Engineering and Environmental Design Department was established in 1997, as part of an initiative to cope with local and international market needs (AASTMT-1, B.Sc., 2008). The programme title reveals the strong interest the department holds in ‘Environmental Design’. Students at the AEED are tutored to become architects and designers who are insightful in dealing with the natural and built environments. For this reason, students are required to undertake design studio courses complemented with courses in history and theory of architecture, human sciences, building technology, environmental controls and structural engineering (AASTMT-1, B.Sc., 2008). The objectives of the undergraduate programme include preparing young graduates in dealing with ‘livable environments’ on all its scales, while acquiring professional competency. Young graduates are intended to reach a coherent understanding of ‘the environment’ as a whole, as well as its internal contextual relationships, whether between people and buildings, or between buildings and their surrounding context. One of the obstacles faced by the AEED is finding faculty members with multidisciplinary knowledge, which is usually difficult to allocate.

The programme’s five year curriculum leads to a B.Sc. degree in Architectural Engineering and Environmental Design, validated from the Egyptian Supreme Council of Universities (SCU). Furthermore, studies conducted during the curriculum’s first eight semesters provides exemption from RIBA Part I, which is equal to three years of architectural education in RIBA-validated schools in the UK, leading to a B.Sc. degree (Elseragy and Elnokaly, 2007). Meanwhile, a postgraduate research programme, leading to an MSc degree in Architectural Engineering and Environmental Design is also available at the AEED department (AASTMT-2, M.Sc., 2008). While the research conducted during the programs preparatory pre-thesis courses are diverse, a large proportion of these courses deal directly with environmental issues, thus enhancing graduate students’ perception of sustainability in natural and built environments. The AEED department’s undergraduate curriculum, as well as eight postgraduate preparatory courses allow RIBA Part II exemption (Elseragy and Elnokaly, 2007), thus making the program comparable to curricula provided by schools of architecture in the United Kingdom, such as the ones mentioned above in section 2. The correlation between the courses run at the AEED department at the AASTMT and the RIBA course is depicted in Table 1.

'Sustainability Strategy Adopted As Part of the B.Sc. Undergraduate Programme

Courses taught during the undergraduate programme focus on various aspects related to architectural education, namely increasing student creativity and visual perception, enhancing basic drawing skills and introducing students to the fundamentals of architectural design. These courses are supplemented with additional history and theory courses and, at a later stage, town planning courses. Students are also required to take ten elective courses, choosing between several alternatives.

While sustainability-related issues are sometimes introduced during Architectural Design 1 & 2, (semesters four and five) these issues are explored in greater depth during the Environmental Studies 1 course in the sixth semester. This course offers a thorough examination and deep understanding of theories of passive sustainable design (AASMT-1, B.Sc., 2008). The subsequent design course, Architectural Design 4, taught during the seventh semester therefore focuses on applying sustainable design issues highlighted in the previous semester to students' design products. Execution Design 3 taught in the 9th semester looks at sustainable materials and construction techniques. Students are further expected to demonstrate their understanding during subsequent semesters eight, nine and the final graduation project. Courses which provide knowledge of sustainable design and instruct students on how to apply acquired knowledge onto their design projects are highlighted below. The following sections provide a detailed outline of each of the aforementioned courses, highlighting course objectives and projects produced as a result.

Table 1: Comparison between AEED & RIBA course structure (Elnokaly et al, 1-2008). Student Groups on Which the Student Survey was Conducted are Highlighted

	AAST M.Sc. Arch. (Min. 7 Years - 216 CR)							
	AAST B.Sc. Arch. (Min. 5 Years-180 CR)							
	RIBA PART 2 (Min. 7 Years-204 CR)							
	RIBA PART 1 (Min. 4 Years-144 CR)							
AAST Course Structure	Semester 1	Semester 3	Semester 5	Semester 7	Semester 9	Year 6	Year 7	Dissertation
	Semester 2	Semester 4	Semester 6	Semester 8	Semester 10	Year Out - Practical Training		
RIBA Course Structure		Year 1	Year 2	Year 3	Year Out - Practical Training	Year 5	Year 6	

AR 362 Environmental Studies 1

The Environmental Studies 1 course is taught during the sixth semester of the undergraduate B.Sc. curriculum, which is equivalent to the third year as shown in Table 1. The course presents theoretical background on environmental design concepts and philosophies, and

points out different tools, methods and techniques that can be used to make building designs increasingly environmentally-friendly (AASMT-3, Elseragy, 2007/08). It focuses on passive techniques which, through simple manipulation of natural aspects, can help improve indoor quality dramatically. These techniques are inclusive of traditional passive cooling, natural ventilation, the stack effect, etc. In addition, the course also sheds light on modern and active techniques, utilization of renewable energy sources and elimination of waste (AASMT-3, Elseragy, 2007/08).

In addition to theoretical knowledge, students are required to immediately apply their knowledge in the form of individual and group research, and conceptual and experimental design projects. These projects are usually abstract and low in detail. Students proceed to construct physical models of their designs, which are then tested in the department's Environmental Design Laboratory (EDL) (Elseragy, 2007). The EDL is periodically supplemented with student-built equipment such as a helioden and wind-tunnel; exercises which help enhance their understanding of monitoring and simulation tools and techniques (Elseragy, 2007). Furthermore, virtual models of these designs are created using basic computer-modeling software. This allows students to compare and contrast results of both the physical and virtual models of the designs they initially created.

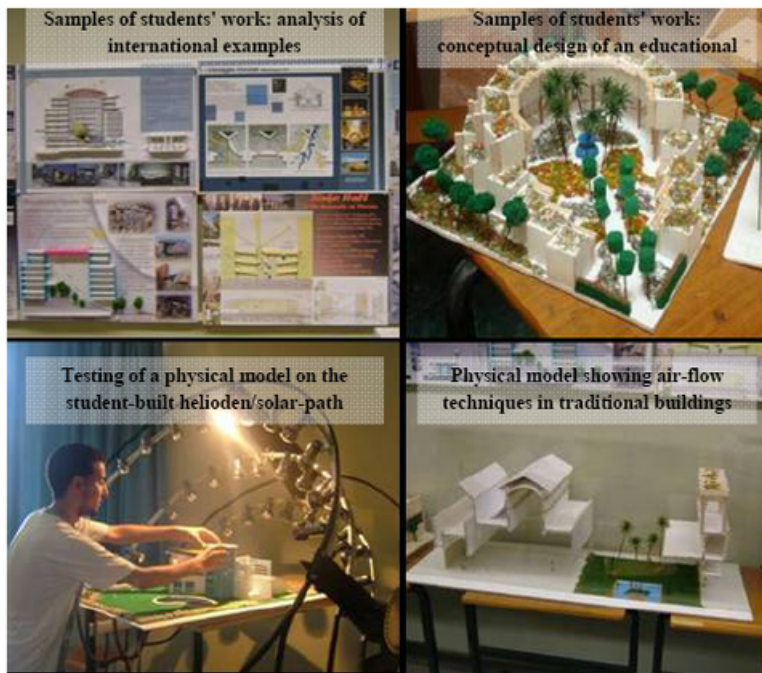


Figure 10: Samples of Student Work Created during the 15-week Period of the Environmental Studies I Course

AR414 Architectural Design 4

The Architectural Design 4 module is taught immediately following the Environmental Studies I course and, therefore, students are expected to apply their knowledge on sophisticated building designs. As stated in the course description, “(this) course is a practical application of the environmental design elements the students studied in the Environmental Studies I course” (AASTMT-4, Elnokaly, 2007/08). Hence, the main objectives of the course are to address sustainability issues within the built environment as well as applying environmental design elements well-suited to local contextual and climatic conditions (AASTMT-4, Elnokaly, 2007/08). This is usually achieved through two architectural design projects of varying complexity. While one project may be complicated in terms of functional relationships, the other is often simpler in nature, allowing students to focus on details of sustainable design features which their buildings are intended to accommodate. In both cases, buildings designed throughout the fifteen-week duration of the course are required to address issues of sustainability throughout their design and substitute non-renewable energy sources, through installation of alternative elements such as photovoltaic cells, wind turbines and more. Meanwhile, the course file summary and outline place a high amount of stress on the importance of preservation of the local identity and architectural character (AASTMT-4, Elnokaly, 2007/08).

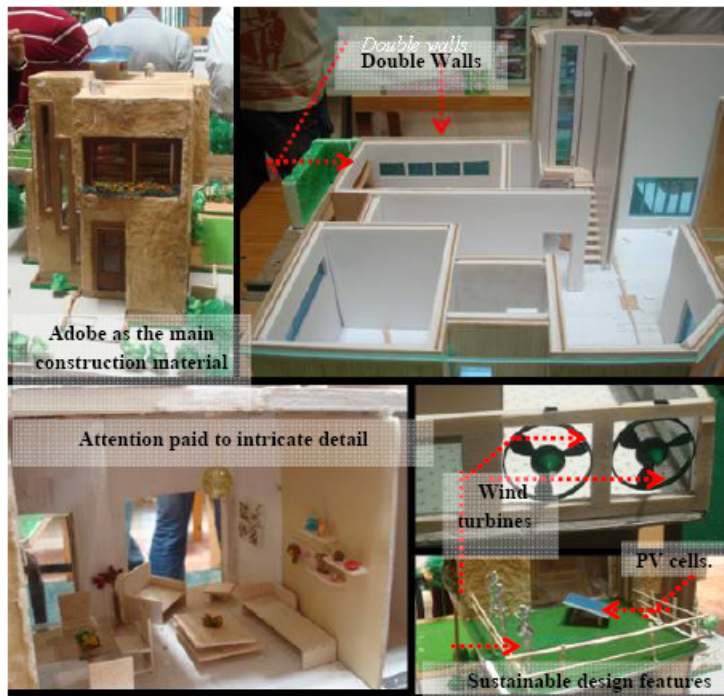


Figure 11: Some of the Work Produced as Part of the Architectural Design 4 Studio. A Clear Understanding and Application of Sustainable Design Feature is Displayed

AR415 Architectural Design 5

The Architectural Design 5 studio is taught during the penultimate year of architectural students' B.Sc. degree programme and RIBA part 1 module. By this stage of their architectural education, students are expected to have a diverse understanding and capability of dealing with various architectural vocabularies, to increasing levels of detail and rising maturity. As a result, Architectural Design 5 students are usually specified with complex projects, and are expected to deal with complicated functional relationships and detailed design considerations. Naturally, environmental considerations and the incorporation of sustainable design features are aspects which instructors expect to clearly distinguish in students' design projects, though this has been recently applied to this module.








The experience of the 2007-08 Architectural Design 5 studio was particularly different from the preceding studios. A 'Summer House' model competition was assigned to the students, whose aim was to design and manufacture a housing project that adapts to "current economic, climatic and social changes of our society" (AASMT-5, 2008). The main objectives of the project included the following (AASMT-5, 2008):

1. To construct the housing prototypes of recycled or recyclable materials, thus ensuring its affordability and durability. The prototypes were therefore expected to display some level of sustainability.
2. To minimise internal temperatures, by studying airflow patterns, and using materials of low embodied energy that are well-suited to local contextual and climatic conditions.
3. Adopt a relatively light-weight construction system, which requires only basic skills to construct. The models could therefore be built by local inhabitants.

The group of thirty-five students was divided into two, and each was expected to create a scale 1:2 model of their 4m x 4m x 4m prototype. The design tutors expected that working with such a scale would help students focus on intricate details, which they could easily relate with in terms of human scale. The two groups initially formulated a conceptual blueprint, before working on detailed working drawings and execution details. This gave the students the chance to experiment with working in semi-real-life and practical conditions, facing unexpected obstacles and learning to take imperative decisions.

"The Cube"

The first group (group A) decided to focus primarily on the aspect of adopting a "light-weight construction system," by creating a model that was fairly easy to assemble and de-assemble, with speed and efficiency. 'The Cube,' as the group decided to name it, was comprised mainly of a PVC piping structural system. This PVC skeleton was filled in using modular Styrofoam panels, which were modified in different areas around the facade for the sake of variation and composition. The main flooring material used was cylindrical cardboard tubes around which large rolls of paper, used in large-scale plotters, are wrapped around. Openings, once again fabricated of foam panels and plexi-glass, were also fixed in accordance with the modular skeleton.

RECS TABLE	ITEM	PHOTO	QUANTITY	COST
	PVC		105M	440LE
	PVC CONNECTIONS			
	L-SHAPE		20	392LC 146LEUNT
	T-SHAPE		64	720LC 186LEUNT
	CROSS		45	1800LC 405LEUNT
	CARDBOARD TUBES		216X50CM	—
	STYREFOAM PANELS		5M ²	45LE 90CM ²
	REFLECTORS ALUMINIUM		—	25LE/1M

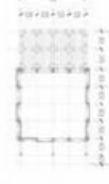



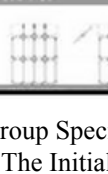
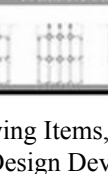
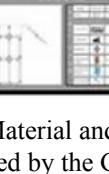

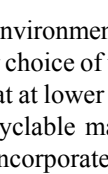
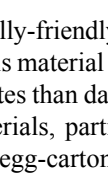
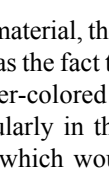
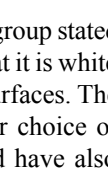
ENVIRONMENTALLY FRIENDLY SUMMER CUBE			
			
			
			

Figure 12: Left- A Table Devised by a Group Specifying Items, Material and Equipment Needed to Erect the Cube. Right- The Initial Design Devised by the Group

While PVC can hardly be described as an environmentally-friendly material, the group stated that one of the aspects that influenced their choice of this material was the fact that it is white in color. Light-colored surfaces absorb heat at lower rates than darker-colored surfaces. The group also made an attempt at using recyclable materials, particularly in their choice of flooring. Some of the wall-panels used incorporated egg-cartons which would have also otherwise gone to waste. It is important to note, however that creating a sustainable ‘cube’ was not the primary objective of this group despite explicit specification of this aim in the original project program. However, their innovative solution displays an appealing perception of the original project program.



Figure 13: 'Raw' Materials Used for the Construction of "The Cube."



Figure 14: Various Phases throughout Construction of “The Cube”, and the Final Product

“The Newspaper House”

The second group (group B) adopted a dissimilar approach to their peers in group A. Instead of focusing on one of the aims mentioned above in section 5.4.1, the “Newspaper House,” as the group decided to name it, was successful in merging the aforementioned aims into one model. This success can be traced back to background knowledge which the students managed to apply in their “Newspaper House,” the materials they chose and the intricate levels of detail which they managed to reach.

While group A used recyclable materials to fulfill only few of the building requirements, all the materials used in construction of the “Newspaper House” were recyclable, thus ensuring the affordability of the model. These materials, which are all local and very easy to locate, also guarantee ease in construction, particularly for locals who do not necessarily have an architectural background.



Figure 15: Different Views of ‘The Newspaper House’ after Completion

The main structural skeleton comprised of cardboard tubes, used in “The Cube” as the main flooring material for the strength and durability it displays. These cardboard structural members were wrapped round entirely in rope. The students of group B then proceeded in an innovative attempt to create ‘newspaper tiles’ used as the main filling material between the structural elements, hence the name “Newspaper House.” These tiles were made up of newspaper and glue mixture, which were left to be sun-dried. It is interesting to note that, after this mixture had dried fully, they formed extremely strong and highly-durable tiles that could be sure to offer adequate protection for the interior space. Before the tiles had dried up completely, the students managed to create circular-shaped openings in the wet mix. These were later filled with conical shaped plastic bottles, a form chosen for the comfort they provide as a result of the airflow patterns they create. These bottles were painted in different colors on all facades. Not only did this help create a sense of variety in the facades, the colors helped light up the interior space whilst dark, with colorful impressive lights.



Figure 16: Cardboard Tubes as Structural Members, Wrapped Entirely Round in Roping Material

The “Newspaper House” also incorporated a ‘malqaf’ or ‘wind catcher’ in the design; the traditional wind tower, whose openings allow airflow, and therefore cooling, into the interior of the building. While some may argue that the malqaf was slightly out of proportion in comparison to the 2m x 2m x 2m space, it can be viewed as a positive attempt to introduce

sustainable solutions for natural ventilation and cooling, along with the conical shaped plastic bottles, mentioned in the paragraph above. Another sustainable design solution can be seen in the cardboard louvers fitted into the southern facade of the building.

One of the strikingly impressive facts of the “Newspaper House” is the amount of intricate detail focused on by the group in creating the design. Intricately thought-out solutions can be seen in the pivot and wheels on which the house rests, providing ease of movement from one place to another. This is depicted in figures 17 & 18 below.



Figure 17: Fabrication and Fixation of the Newspaper Tiles



AR557 Execution Design 3

Execution Design 3 is a course taught during architectural students' penultimate semester, which translates into the fifth and final year of their architectural studies. The course focuses on mastering execution documents, while concentrating and producing detailed design of structural elements, interior design elements and sustainable design technologies (AASTMT-6, Elseragy, 2007). Through projects, research, workshops and one-day projects, students are given the chance to explore a variety of execution-design related topics. However, environmental awareness and sustainability are issues that are heavily emphasized throughout.

Workshops conducted during the Execution Design 3 module give students the ultimate opportunity to explore environmental awareness and sustainability issues, while simultaneously examining their designs with a high level of detail and scrutiny. During these workshops, students are usually asked to design and execute a piece of furniture, using innovative approaches. Stability is one of the ultimate goals of such models, which are constructed at a scale of 1:1. After completion, the models are usually displayed as part of a public exhibition at the AEED department tested for stability and assessed for innovation, stability and the level of environmental awareness they portray. Some of these examples are shown in Figure 19.



Figure 19: Samples of Work Produced During the Execution Design 3 Workshops

Postgraduate M.Sc. Curriculum at AEED Department Highlighting Courses which Focus on Sustainability-Related Issues (Part of RIBA part 2)

As mentioned in section 5 above, the AEED department offers a postgraduate programme leading to an MSc Degree in Architectural Engineering and Environmental Design. This programme is comprised of eight preparatory courses, three of which are core and therefore mandatory, and five elective courses. Over a two-year part time period, students are required to fulfill the requirements of these eight courses, out of a range of twenty-seven. Choice is usually based on the area at which they would like to gain greater expertise. These include areas such as urban design, environmental design and sustainability and construction management. Subsequent to the completion of five of these courses, students are permitted to register for the final research conducted in Thesis Part 1 and later, Thesis Part 2. As a result, the knowledge acquired during the preparatory courses help shape students' decisions into what field of research they may wish to undertake. Nevertheless, it is important to note that not all twenty-seven courses are available each semester and, very often, students' choices are limited to the few available ones.

Similar to other international M.Sc. courses, the M.Sc. course at the AEED department consist largely of open discussions, presentations and workshops between members of the

group. Discussions and debates usually take place both in parallel with and as a part of on-going research conducted by the students. Areas of research vary depending on the courses undertaken and the tutors approach, and according to areas of expertise students would like to specialize in, as elaborated on the previous paragraph.

AR737 Research Topics in Environmental Design

The Research Topics in Environmental Design module is one of the elective modules that address sustainability and environmental issues offered to students' during their M.Sc. degree programme an RIBA part 2 module. As stated in the course outline "This module focuses on how architectural graduates should be committed with the rationales of environmental and sustainable design, their significance in architectural design and their different approaches and means". It defines environmental design and sustainability in its broader sense, and justifies the urging need of its application generally in our built environment and in the developing countries in particular.

The course runs through discussions and workshops on a range of different environmental design processes and case studies. The students are to design and present a final project titled the "Eco-house", by the end of the course. Individual and group researches on chosen prosperous topics on environmental and sustainable design are undertaken.

In an attempt to instill the importance of environment, and the role each individual can play in saving it, the Environmental Design Research Group (EDRG) at the AEED department introduced an awareness campaign under the motto 'Save our Planet Earth' supervised and instructed by Dr. Amira Elnokaly. Members of this research group are all involved in architectural education, and have a noteworthy belief in spreading environmental awareness in members of the younger generation, before they advance into further education. The novelty of this project lays in engaging architecture design students both on the undergraduate and postgraduates' level and fitting this project within the academic context of their architecture programme. The campaign that was titled "The Green Day Campaign; Save Our Planet Earth" (Elnokaly et al., 2-2008) carried out on a two year stage is presented in this paper. Starting in May 2007 with the International Deutsche School (Deutsche Schule der Borromaeinnen) followed the next year 2008 with five more national and international schools in Alexandria, Egypt. This campaign was therefore aimed at school-age children of various grades, at primary, preparatory (junior-high schools) and secondary schools. The campaign involved circling a number of schools in Alexandria, Egypt, whose curricula operate under a number of international institutions, namely the German educational system, the English GCSE and the American Diploma educational system (Elnokaly et al. 1, 2-2008). The campaign consisted mainly of lectures, seminars and workshops. In a further attempt to reach a larger audience of students, brochures and checklists were sent out during recess. Scrutinizing the campaign that ran the first year, some modifications were carried out on the 2nd year in order to involve more of those who are concerned from the NGO's and to have more leaflets and brochures to spread out. Thus, for the latter year the campaign was set in co-operation with Rotaract Club of Alexandria El-Nozha and with the Environment Friends Association (EFA) an NGO in Alexandria concerned with environmental issues. In running the first year campaign it seemed that networking with other organization can be useful for the promotion of this project. This was also out of a deep belief in the importance of incorporating and simulating Non-Governmental Organizations (NGO's) in taking a major role in combating

global warming and raising awareness of effects of increasing carbon emissions (UN-ESCO/UIA, 2005).



Figure 20: Preparations, Lectures and Workshops during Visits to Several Schools in Alexandria, Egypt

It is unfortunate, however that the prevailing attitudes witnessed through the 2nd year of the campaign in two of the International American Schools, and which spanned a 6 weeks time, was fairly negative. It was noticed that the younger the students, the more interest they displayed in the lectures and seminars being given. They also demonstrated greater excitement about participating in the workshop. It was noticeable, on the other hand that, the older the students, the less care they seemed to display. While younger students, particularly those who studied under the German curriculum, seemed interested, asked questions and actively suggested innovative methods by which they could play their parts in improving environmental conditions, the elder students displayed an air of indifference. It is possible to assume that the older children have been infiltrated to a great extent by society's misconceptions, problems, lack of concern and unresponsiveness. It therefore comes as no surprise that when these young students pursue further education with no sustainable background whatsoever, teaching sustainable architectural design in the design studio becomes an arduous task; a tough challenge (Elnokaly et al, 2-2008).



Figure 21: Images Depicting the Negative Attitude and Response of some of the Students to the EDRG's Environmental Awareness Campaign at Some of Alexandria's Schools

This campaign was awarded an honoree award by the E3OP (United Nations) in December 2007, and the founder of the group Dr. Elnokaly was awarded an honoree award for the effective role undertaken in spreading 'environmental awareness and global warming effects' in the Schools of Alexandria, Egypt (E3OP, 2008).

Meanwhile, it is important to note that most postgraduate students are mature and working members of society, that's why all carry out the M.Sc. course on part time basis. While the postgraduate programme is ultimately a part-time one, students find it difficult balancing their professional life with their postgraduate education, and the three courses they are expected to accomplish every semester. Regrettably, a lot of the research produced is often not up to the expected level of detail. While students may suggest proposals, concepts and ideas in their research and sustainable designs, few have the time and energy to test them either using software or physical models. This is as opposed to the undergraduate courses, whose students are all full-timers and are obliged to test their results at several stages of their undergraduate architectural education.

Conclusions and Recommendations

From the examples investigated in this paper it is obvious that the life projects undertaken by students of Architecture plays a vital role in shaping their understanding of sustainable design techniques and its application in architectural design on different levels. These projects increase their understanding of sustainable and environmental design at later stages of their architecture practice. The examples analyzed in the first section of this paper at the British universities are very much comparable to their counterpart projects undertaken at the AEED department at the AASTMT and presented in the second part of the paper.

Instilling sustainable design education in societies where environmental awareness is minimal is an arduous task. One of the main obstacles faced by design tutors who attempt to spread concepts of sustainable design among their students is the lack of general environmental awareness of students entering higher education. However, it is imperative if we are to improve the quality and future of our built environments. The undergraduate B.Sc. curriculum at the AEED department does manage to integrate sustainable design principles and theories through several of the undergraduate courses, spanning between the fourth semester (third year) and up until the ninth semester (fifth semester.) It is clear from the design products shown in the above figures (Figures 9-21) that a large amount of effort is exerted on the parts of students and instructors alike, to improve students' understanding of sustainable design and its role in architecture. Rising levels of interest, moreover, may be considered an indicator of the success of this aspect of the undergraduate architectural programme. However, while students excel in creating models of their sustainable designs, few have advanced to test them, with exception to a few mandatory tests undertaken during the AR362 Environmental Studies 1 course. It seems that the undergraduate course is somewhat lacking in this area, in both the form of physical and virtual testing.

In comparison to the undergraduate programme at the AEED department, the M.Sc. postgraduate programme does not seem to reveal the same amount of enthusiasm and success shown by undergraduates. While postgraduate students may have similar, if not greater amounts of interest in sustainable design, the fact that the M.Sc. programme is a part-time one causes difficulties. Students are usually left with little time to suggest more than a design or research proposal. Once again, both physical and virtual testing is hardly undertaken.

During the course tutors have clearly observed that the engagement of postgraduate students with relevant understanding of sustainable strategies, and who were taught environmental and sustainable design in their undergraduate level has been much better and advanced than others who were first introduced to these strategies at their postgraduate level. These students had deep solutions, relevant to their local climate and identity, with proper understanding of sustainable design techniques and application and material usage. Thus, the paper concludes that the proper application of sustainable design strategies at early stages of architecture education has developed architects with sturdy understanding of their environment, climate and local identity, which can never happen if this is addressed in postgraduate studies or at later stages of the Architecture career.

As an emerging discipline, recognition needs to be given to the fact that this is very much a process that requires "change management" at an institutional & social level. The reason we think that this is important is that we as people (tutors and students alike) are subject to history and the socio-political chains that attach us to our past. The simple fact of the matter is that, as in any sector, the curriculum is set by the demand, which is set by the necessity,

which is set by governance (bad or good) at a cultural level nationally through legislation and statutory requirement etc.... The real barrier therefore becomes getting the message across early in the primary and secondary school level to effect a cultural change in the upcoming generation. Teach them early enough and they will become native to the methods principles and execution strategies of sustainable design. Teach them late and they must migrate to a level of understanding of the same principles which they will always see as removed from the norm or potentially “higher principles” this can only stifle and confuse their creativity.

There is also a psychological issue here that needs to be linked to the zeitgeist issue. The students need to see “what is in it for them” in a selective system where they have to choose to pursue a GREEN DESIGN. Now if the messages they are getting are all positive (media/peers/government etc...) then they indeed may elect to go down this route as they will see it as a viable way to further themselves and secure employment at the end of their studies. Thus, one should not underestimate the deep rooted psychological implications of this assertion, and the power it wields over the social hierarchy of our modern day society, because its there, just under the surface.

At post grad level (where criticality is a must) the lack of substantial argument and dialogue in the area of sustainable design is terrifying. Detractors from the green agenda are not openly engaged with at an educational level so the student (or anyone else for that matter) never gets both sides of the story and the opportunity to make a value judgment based on contrasting arguments. We could postulate that by dismissing the detractors from the education system as “industry plants” or the like we run the risk of indoctrinating the student and removing the criticality function from their way of thinking. This is missing a trick because in our opinion we would move further.....quicker if a dialogue was engaged.

In recommendation to the aforementioned comments and conclusion, we believe that several aspects must be taken into consideration for improvement and enhancement of sustainable design education at architectural schools in general, and schools in unsustainable societies in particular and specifically at the AEED department:

1. Environmental awareness campaigns need to be enhanced and increased at primary, preparatory and secondary school levels. The larger the scale of the campaigns and the audiences approached, the more successful they are likely to be.
2. Sustainable design education is gaining significance at the AEED department on the parts of students and staff alike. It is important however, to encourage students to utilise the vocabularies and design elements they have learnt at earlier levels of their design education in all subsequent modules. Architectural design projects in particular, of all function and levels of creativity need to display a high level of environmental awareness and education.
3. Methods of testing and consequent manipulation of students’ architectural designs probably need to be enhanced, if the AEED department’s ‘sustainability strategy’ can begin to be compared to the strategies of other RIBA exempted schools.

Acknowledgement

Thanks are due to 5th term students at the AASTMT, Architectural Engineering, Alexandria for taking part in the questionnaires and sharing their experience. We are also thankful to our Teaching Assistants and post graduate students at the M.Sc. course who gathered valuable

materials and took part in the Green Day Campaign “*Save our Planet Earth*” and to the children of the visited schools.

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About the Authors

Dr. Amira Elnokaly

Dr. Amira Elnokaly holds a B.Sc (Cairo University) Mphil / Ph.D (Nottingham) in Architecture. She is currently a Senior Lecturer at the Lincoln School of Architecture, The University of Lincoln, UK. Prior Joining the Lincoln University she was an Assistant Professor of Architecture at the Architectural Engineering and Environmental Design Dept., at the AAST. She is a licensed architect in Egypt and has a large experience in practice where she was one of the founders of the Environmental Design Research and Consultancy Firm (EDRC), where she worked as an Energy and Environmental Design Consultant (2005-2008). Her research interests are diverse but are related by a consistent concern with embracing a sustainable mindset in architectural education, and ecological and environmental related issues in the Built Environment. She has widely published on the application of CFD on Building Design, Renewable Energy Technology, Sustainable Architecture and Environmental Design of Buildings, and Curriculum Development and Architecture Design Studio Teaching. Dr. Elnokaly is a design studio tutor who teaches a variety of courses and a very specific interesting course titled "Design in a Climate of Change". She has secured a number of research funds in the last years, and this year won 3 funded research projects from the TSB (Technology Strategy Board) competition titled "Retrofit for the Future".

Dr. Ahmed Elseragy

Dr. Ahmed Elseragy is an Associate Professor and Environmental Design Consultant with 16-years experience, provided environmental design and architectural consulting services for many organizations operating in Asia, Africa, and the Middle East. Dr Elseragy's experience and expertise is in innovative structures, environmental design, sustainable buildings, eco-architecture, buildings' environmental performance simulation, passive cooling strategies in buildings, and architectural education. He is a professional architect with a PhD Degree in Environmental Design and Sustainability in Buildings from the University of Nottingham, UK. He is an active member in many international professional bodies. He currently holds the post of Dean of International Network and Affairs at AASTMT and Director of the AASTMT London International Office (LIO), London, UK. Prior to this he was an Associate Professor of architectural studies and Design Studio Tutor at the Arab Academy for Science and Technology AASTMT since 1997 in the Architectural Engineering and Environmental Design Department, Alexandria, Egypt, which is the only RIBA part 2 accredited School of Architecture in the Middle East. He participated in establishing the new architecture department in 1997 and therefore, has long experience in architectural and built environment education and curriculum development. He held various Senior Posts at the Architectural Engineering and Environmental Design Department, AASTMT where he was the Course Leader of the B.SC in Arch. (Hons) and coordinated some core modules at the Undergraduate level and lead the Master Course run at the Department. Dr. Elseragy has managed to disseminate his research work on different levels. One of his main fields of interest and concern is Architecture and Design in a Climate of Change. His research interests are diverse but are related by a consistent concern with cultural, sustainable and environmental related issues in the built environment. He has widely published on sustainable development, traditional architecture, roofing and structural Systems of Buildings, passive buildings and techniques, computational modeling of buildings' environmental performance, experimental physical

models, architectural identity and heritage, and curriculum development and architectural education.

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