Education For Sustainability: Teaching And Learning, Research And Publications, Consultancy

S P Rao and Ezrin Arbi

Centre for Equatorial Sustainable Development
Faculty of the Built Environment
University of Malaya

Abstract

The built environment is an integral part of the infrastructure necessary for survival. The environmental sustainability of our future generations is being scrutinised by the people responsible for the higher education. The role of higher education in creating a more environmentally sustainable future is undeniable. The aim would be to train the professionals to be environmentally literate. These issues present a challenge to the educationist as well as to the students of the Built Environment, to reconcile the environmental aspects as part of the built environment. The focus of the paper is mainly on the teaching approaches specifically on the integration of environmental sustainability issues into the subjects offered. This relates to the development of the student's awareness, perceptions of environmental sustainability and to the issues at stake with the intention to set a structured integration of environmental sustainability, through subjects related to the various aspects of the built environment education. These issues are in congruence with the publications of the new criteria for the validation of the courses in Built Environment, which contains newly articulated demands for students to have an understanding of the natural world and of the impact of their designs on the environment as well as on the humans.

Keywords: sustainability, education, Malaysia

Introduction

Broad definitions of "Sustainability" are bound to change over time. As propounded in the Earth Summit, "Sustainable development involve.... meeting the needs of the present without compromising the ability of future generations to meet their own needs" [Earth Summit 1992, Sitarz 1993]. Sustainability has different connotations to different people and organisations, depending on their individual circumstances and perceptions [Zeeda 2001]. The twentieth century has seen enormous changes in the ecology and the environment, especially in the tremendous loss of the natural resources, increases in pollutionlevels etc. The act of building can be interpreted as a response of the inhabitants to an inequilibrium within the man-environment interaction systems.

However, the Brundtland report gave the stimulus for the word "Sustainable development" to be adopted by the academic community [John Doling, 2003], as well as for policy discourses. Higher educational institutions have an obligation to train professionals, who would successfully contribute to an environmentally sustainable future. It is necessary to reconcile the various aspects of sustainability issues in the curriculum. They represent a challenge to the educationists and students to judiciously

consider, evaluate and adapt the various environmental aspects of the built environment.

Sustainability Issues

Sustainability suggests the achievement of balance, and a plan for long-term growth and nurturing. The impact on the environment - what is used, taken away or altered - is equal to the rejuvenation - what is replaced, preserved or enhanced. A sustainable perspective requires the juxta-positioning of the needs of the present and future, and a goal to leave adequate resources and environmental quality for future generations. Realising the environmental threats, real or potential, the quality of life, environmental movements have begun in virtually all sectors of industrialised countries including the construction industries. Therefore, knowledge of the basics of Architecture, Sustainability and Environmental issues need to be instilled specifically to the students in the Faculty of the Built Environment.

An Interdisciplinary Approach

Boundaries between disciplines are breaking down. Harlan Cleveland stresses that "in the latter part of the twentieth century, we came to realise that most of our troubles stem from neglecting the interconnectedness of knowledge and the interdisciplinary character of all real-world problems" [Harlan Cleveland, 1992].

One of the unique features of the Building Profession is its interdisciplinary nature, ranging as it does, through so many aspects of built environment studies, viz., civil and structural design, construction, materials engineering, building services, environmental control issues, urban planning, financial considerations, historical rebuilding and preservation, landscaping, social and environmental issues, building profession education and research, as well as all sorts of creative links with the arts, communications and entertainment. Another dominant feature is its inherent ability to provide a necessary interface between human activity and the physical environment. These features have contributed to making the building profession studies a productive ground for the application of recent pedagogical and technological trends and innovations of sustainability issues in environmental design [Tony Brown, 2001].

The students of the building profession should learn in such a way that they come to understand the interdependency of all fields and are capable of working within a complex and changing profession for the betterment of the built environment. For example, design for environmental sustainability crosses various disciplines. In an environmental sustainability context, building professional's potential contribution is aunified theory of human settlement that relates to all scales - large scale bioregions, cities, neighbourhoods, urban fabric and ultimately to individual buildings and open spaces. The compartmentalised world of different disciplines and different systems works against the notion of an integrated theory. People who work on human settlements should have a common core design education, before specialising in various disciplines. Common core design education participants would include architects, building surveyors and engineers working on transportation, soils, hydrology or civil engineering; landscape architects, planners, and natural scientists or environmentalists. As Stanford Anderson [Stanford Anderson, 1980] points "we need not expect or look for absolute, positive bases for environmental knowledge, providing an intellectual foundation of sufficient breadth requires integration with other departments and fields". It is to be understood that architectural education should start with liberal education and with people learning not specifically architecture as a trade, but understanding the economic, political, social and cultural context in which they exist. To accomplish this, the main focus of

a building profession education program should be not only to provide students with the ability to solve task-oriented and highly specific problems because design itself is not a plug-and-chug activity. There are no pre-set rules and there is no one 'right' way to design. Students will have to think for themselves by providing them with a rigorous intellectual foundation. The building profession students should become a 'generalist', with the ability to make connections between the many facets of architecture. To accomplish this, one must have a broad educational background that covers a wide range of topics and disciplines. As such, educationists should strive to create programmes of building professions with a broad foundation in the liberal arts and sciences. Students can then bring what they learn in their general education classes and apply them to their studies.

Also important is the need to integrate the coursework into design activities. Taking architectural programme as an example, studios can no longer stand alone as the keystone of the programme. Students do not use the studio as the place to bring together all the information that they have gained in other courses. Educationist cannot expect students to integrate what they have learned when the educators themselves fail to emphasise the importance of developing an integrated design process. Educators will have to encourage their students to be more concerned with 'mundane considerations' such as: How much does it cost? How will it affect its users? Will it stand up? How does it relate to its surroundings? What is it made of? What impact does it have on our environment? These questions cannot be ignored but to focus on creating a curriculum, which is a 'well-designed package of integral components each of which serves in the capacity of the others. Educationist must adopt a model of a building profession education in which the sustainability issues are presented in terms of their theoretical foundations and their architectural significance in a manner that is integral to the rest of the curriculum' (David Lee Smith, 1987).

Education For Sustainability

Education for sustainability is a life long learning process that leads to informed and involved students and citizens in having creative problem solving skills, scientific and social literacy, and commitment to engage in responsible individual and cooperative actions. These actions will then help to ensure an environmentally sound and economically prosperous future. Therefore, the starting place in considering the content of building profession education programme for sustainability is to examine the relationship with environmental education.

There are four components for teaching about sustainability: people, environment, economics and technology. These components focusing on people could consider such matters as human settlements and populations, health care, equity and urbanisation. The environment component would foster awareness of issues related to water supplies, waste disposal, energy use and pollution and habitat preservation. Matters related to trade, wasteful consumption, poverty and access to resources would be considered in the economics and the technology component would focus on control of emissions, transportation and industrial processes. Therefore, if education for sustainability is to be achieved, educators should take a leadership role, breaking new grounds to prepare society for an age accelerating change in a world of increasingly diverse and growing populations, an expanding economy, and changing global environment and technology. Education for sustainability requires an understanding to the interdependence and interconnections of human and environment. Its elements include knowledge of global disciplines, biological and physical sciences and

human socio-economic systems. For example, education for sustainability will prepare students of building professions for merging natural sciences and the economics with other disciplines when developing environmental issues.

Some Overseas Experiences In The Teaching Of Sustainability Issues

Professor Brian Edwards (Brian Edwards, 2003) of Edinburgh College of Art has summarised the sustainability and architectural education in the UK. The CEBE report (Brian Edwards, 2003) on sustainability teaching in the UK Architecture Schools states that 22 out of 36 schools have detailed courses on sustainability. It notes that sustainable design is taught via lectures and studio but rarely are these integrated; little attention is paid to social and economic sustainability and the major emphasis has been on energy conservation in buildings. Architectural education must evolve to keep abreast of the changing priorities. He raises two important questions, viz.:

- Do we impart the skills and knowledge to prepare students for the green challenges ahead?
- Can we continue to educate in subject isolation when the challenge is holistic in nature?

Prof. Riffat and Dr. Smith (Riffat and Smith 2002) have given an excellent summary of the sustainable technologies for the built environment. They document the Nottingham experiences in the new jubilee campus development. Their paper is an excellent summary of the extensive research, but does not detail how this gets into the teaching curriculum.

In the EU there are several postgraduate programmes on Renewable energy and related issues. There are several modules on sustainable energy in the undergraduate curriculum (Kaplanis *et al.*, 2002).

Land Use Planning And Related Sustainability Issues In Malaysia

A major contribution of the environmental movement has been the major changes it has made to the traditional land use and planning programmes. Now, sustainability is a central theme in land use planning. Malaysia has adopted a pragmatic approach in dealing with climate change and environmental issues in line with Rio Declaration. A detailed review of the Malaysian position is given by Ismawi and Ansari (Ismawi and Ansari, 2004). The relevant list of Federal Legislations related to coping with climate change and environmental issues are:

Environment Quality Act 1974
EQ (Clean Air) Regulation 1978
EQ (Prescribed Activities) (EIA) Order 1987
National Forestry Act 1984
Fisheries Act 1985
Town and Country Planning Act 1976
Petroleum Mining Act 1986 (Rev. 1972)
Petroleum Development Act 1974
Land Conservation Act 1960.

The Environmental Quality Act was introduced in 1974 and subsequently amended in 1987 to include 19 types of prescribed development projects subjected to mandatory environmental impact assessment (EIA), in which impact on climate is one of the areas to be assessed.

Integrating Environmental Sustainability Into The Education Of A Building Professional In Malaysian Context

Vision 2020 of the Government of Malaysia aims for Malaysia to be a fully developed country by 2020 and puts emphasis on environmental sustainability requiring Malaysia to ensure that valuable natural resources are not wasted. Malaysia has worked for a closer match between the needs of the environment and those of development. Therefore, the integration of environment and considerations in

development planning must go hand-in-hand. One of the earliest building designs considering environmental sustainability issues is the Menara Mesiniaga [Ken Yeang, 1996] as shown in Figure 1. The most striking design feature for this multi-storey building is the planting, which is introduced into the façade and the 'sky courts'. The use of landscaping in this building is to balance the hard and reflective s urfaces as well as to reduce the heat build-up around the building. This is necessary to reduce the impact of urban heat island in densely built-up areas.

The environmental considerations must increasingly be integrated with development planning and design as well as with the building professional education curriculum planning. However, to design a structured syllabus with these goals in mind is not an easy or simple task. At this point in time, the students might not have the capability to truly build sustainably, but they can begin to ask the right questions and to factor more information into their decision-making process.

To meet structured architectural education syllabus requirements and at the same time focus on a broad range of environmental impacts, we need to think strategically (Esmond Reid, 1988).[1] The education of a building professional often emphasises economy of means with emphasis on elegance, beauty and balance. Now, this approach must be expanded to include design for living within the constraints of the environmental aspects, namely, mentality and ethics. For this reason, studio based learning should not be the be-all and end-all of an education system. The ultimate goal of the building professional education system should not be to merely train the students, but to help students see the vast potential for interrelations between ideas and disciplines, to encourage them to confront all new problems of design, to generate a spirit of cooperation and intellectual respect for others (environment, social and economy), that will ultimately help them work in professions that require collective input (Esmond Reid, 1988, Narayan Swamy 2001, John Kunz et al 2003, Esa Mohammed 2002).

Apart from that, the concept of educating is not just teaching and explaining; it is the contents taught that is of utmost importance. The educationist needs to educate design students not only in the technical skills essential to the practice of their profession, but also to induce an understanding of a greater goal that must eventually be shared by the whole culture – that of creating an environmentally sustainable society. It is necessary to supplement teaching with appropriate research to gain an in-depth knowledge. The educationist has to allow for such a mindset, that it has to prepare younger designers to accept the need to aim for environmental sustainability as a basic design requirement for products and processes.

We now live in a nearly totally designed environment, with air-conditioning being all pervasive. As stewards of this environment, architects are urgently needed as intellectual leaders who might help formulate new visions of Space, and clarify the actions that will preserve the nation's quality of life for generations to come. Leading architectural practitioners should be involved in the faculties of the higher institutions in Malaysia. It should be imperative to create one or more subjects that would introduce the beauty of architectural ideas in terms of environment and the underlying philosophies that will later affect all their design work.

---

[1] According to Esmond Reid. [1988], "Complexity, circularity and diversity are three underlying essential features in natural dynamically stable systems. Therefore, the education syllabus should be based on these fundamental concepts. He then added that all education system with syllabus that is partitioned, linear, fragmented and segregated cannot teach complex, whole-systems thinking in environmentally sustainable terms.

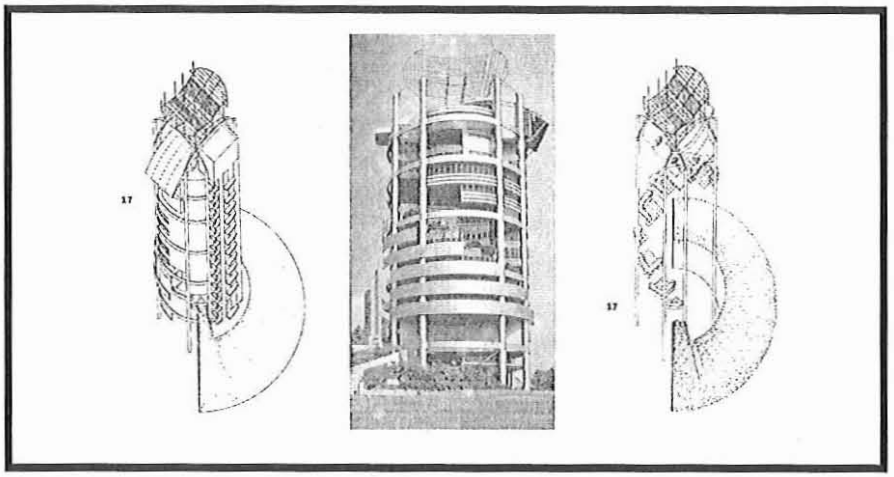

Figure 1. Menara Mesiniaga Architect: Prof. Ken Yeang, Malaysia, (T.R. Hamzah & Yeang Sdn. Bhd)

Teaching Of Sustainability Issues In The Faculty Of The Built Environment, University Of Malaya

The Faculty of the Built Environment is the youngest faculty in the University of Malaya. It was established in June 1995 as part of the Faculty of Engineering and achieved the full faculty status in May 2000. Its mission is to conduct professional courses for the building industry. The Faculty has four departments at present. They are: Architecture, Building Surveying, Quantity Surveying and Estate Management. The relevant Malaysian Professional bodies, right from the first batch of students, have accredited all the four courses in the Faculty. This is a commendable achievement. Moreover, all the four courses conducted in the Faculty have been accredited by relevant overseas institutions such as RIBA, RICS and ABE.

Recently, the Faculty has moved to the creation of "Built Environment Studies and Research Institute" (BESTARI), under the Dean's office, as a separate research institute. At present BESTARI has 5 research centres under its wing viz, Equatorial Sustainable Development (ESD), Accessible Built Environment (ABLE), Project and Facilities Management (PFM), Building Conservation and Records (BCR) and Centre for Studies on Urban Real Estate (SURE). By the activities of these specialised research centres, the Faculty aspires to be a centre of excellence in the development as well as in the dissemination of knowledge of sustainability in the Built Environment.

Sustainability issues are carried through in all the courses in the faculty. For example, Building Surveying and Quantity Surveying students are taught the importance of building materials, their use, construction and maintenance of buildings from the viewpoint of sustainability. Students in Real Estate are taught about the green issues, climate change effects on the built environment as well as other similar issues

Teaching in the Architectural Studio is used as vehicle for purposes of illustration. In the studio, Design studio projects are the main vehicle by which all the subjects taught in the lectures, seminars as well as from fieldwork are integrated to enhance the learning and creative design skills (Narayan Swamy 2001, John Kunz *et al* 2003, Esa Mohammed, 2002). The project becomes the central objective for students it is the focus and test of the ability and understanding of students relative to the educational process

(Tony Brown 2001). Problem-Based Learning techniques are often used in the teaching in the Architectural Studio as a method of achieving deep learning and simultaneous mature participation within the educational process. Problem-based techniques may range from the search for an optimal solution to precisely framed albeit abstracted problems through to scenarios more akin to complex real life situations where the principal difficulty is one of identifying and framing the appropriate problem parameters. The Department of Architecture uses a three-pronged strategic approach (Rao and Zunaibi 2003) as shown in Figure 2.

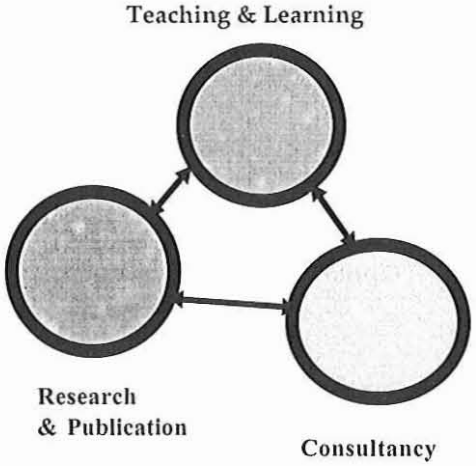

Figure 2.
Strategic Approach for Excellence in Teaching, Research and Consultancy

The teaching philosophy is

- based on the objectives of providing complete and comprehensive architectural education in five years in order to face global challenge.
- based on the progressive and accumulative knowledge acquisition.
- The studio design pedagogy is the core of the programme, as shown below.

The overall percentages for various subjects are as shown in Table 1.

Table 1
Percentage of teaching hours

Particulars	BSc (Arch) %	BArch %	Overall %
Design	31.9	43.3	36
Construction and Technology	22.1	16.7	20
Communication and Graphics	6.2	0	4
Professional Practice	9.7	10	10
Theory and History	13.3	10	14
Research and Analytical Studies	1.8	15	6
University Courses	15	0	10

The architectural curriculum is based on Architectural Design as a vehicle for integration of all the taught subjects. During the first three years of their course the students are given inputs on environmental physics, building structures and building services, as shown in Table 2. The Faculty is implementing problem-based learning in most of the subjects. As part of this exercise, students are set to solve practical problems, which would involve environmental sustainability issues. The students are encouraged to be proactive in their research and presentations. In year 4, at present, an elective is offered on sustainability issues as well as on Building Conservation studies. The students are taken on field trips as well as leading practising architects are invited to the studios to show how they tackle sustainability and conservation issues. In year 4, at present, an elective is offered on sustainability issues. The Faculty is fortunate to have Prof. Ken Yeang, who is

renowned for his design of ecologically and environmentally sustainable buildings (Ken Yeang 1996). The University's research facilities in the Centre for Equatorial Sustainable Design are to be used as a test bed to test new ideas in the future. The facilities are being used at present to monitor the performance of some of the building integrated photovoltaics and other concepts on sustainability in the built environment under the Malaysian climate. The students are encouraged to have meaningful discourses in the studio setting for achieving an environmentally sustainable building.

Conclusion

Environmental concerns today profoundly influence all aspects of modern design and practice. Yet most universities have been slow at integrating environmental considerations into the fabric of the curricula. Education is a prime environmental issue. Therefore without significant precautions, education may equip people to become more effective vandals of the earth. People should be educated to think broadly and to understand the overall impact of their actions on the ecology and the environment. There is tremendous pressure as well as responsibility on the institutions of higher learning to train building professionals who are committed to sustainable development. They need to learn and think globally about sustainability. This in turn, will give a better quality of life for the people by reversing the trend of ecological disasters.

Table 2:
Learning objectives in Year 3
Design studio projects

YEAR 4	Advanced Architectural Studio	
Learning Objectives	**Design Parameters**	**Concurrent Subjects**
Orientation		
Urban Studies [Kuala Lumpur sites]		Urban Studies & Planning
Urban Intervention	Social / Cultural Masterplanning	ArchTheory & Philosophy
Interim Crit 1	U Design Parameters Urban Planning	Research Methodology Advanced Technology
Interim Crit 2	Housing Issues	Elective I
Final Design Scheme	Conceptual Masterplan	
Sketch Design	High rise / complex Integrated Services Planning	Advanced Technology
Interim Crit 1	Masterplan with high-rise [10-20 storeys]	Professional Practice I Elective I
Interim Crit 2	Campus Design	
Final Design Scheme	Integrated Bldg Systems Structural Design Services Design	
Technical Design	Sustainability Considerations	

Table 3:
Learning objectives in Year 4
Design studio projects

YEAR 3	Comprehensive Design Project	
Learning Objectives	**Design Parameters**	**Concurrent Subjects**
Urban Context	Historical Town Quarter Taiping	
Urban Intervention	Urban Space & Form Analysis	Arch. Theory Arch Hist Study
Design in context	Community & Residential building Low-rise, identity ie Community ctr. or Budget hotel	Build. Struc. 3 Profesional Practice
Design out from the context	5 storey commercial building with parking ie Mixed-use Retail and office or Shopping Plaza	
Site Planning & Landscape	Chosen scheme Budget Hotel Commercial Dev.	Building Economic Project Man. Building Analysis Town Planning Arch. Theory
Structure, Material & Const.		
Servies Intergration		
Design Competition [Review Concept]		
Sample Board [Detail Design]		
Report & model-making		
Presentation Drawing		

References

Brian W Edwards, 2003 "Sustainability and Building Design", Power point presentation on the Internet. (http://www.suns.org.uk/Documents/suns%20june%2016%20event/ProfEdwards(160603).pdf

David Lee Smith, 1987. "Integrating Technology Into the Architectural Curriculum," Journal of Architectural Education. XLI:1, Crosbie,

Earth Summit, Rio de Janeiro, 1992 as quoted in the website http://www.csbr.umn.edu/sustainability

Esa Mohammed, 2002 " Globalisation and Liberalisation : The Architect's challenge", Majlis Peperiksaan Senibina, Lembaga Akitek Malaysia, Kuala Lumpur, Malaysia.

Esmond Reid, 1988. "Understanding Building: A Multidisciplinary Approach", MIT Press, Reprint Edition

Harlan Cleveland, 1992 as quoted by Sharon E. Sutton, "Architects and Power," Progressive Architecture. LXXIII:5 (May 1992), p. 66.

Ismawi Hj. Zen and Abdul Haseeb Ansari, 2004. "Land use planning and Sustainability: An Environmental view point", Chapter 1 in "Sustainable built environment through management and technology" Ed. Khairuddin A R and Abdul Azzez K H , Kuliyyah of Architecture and Environmental Design, International Islamic University of Malaysia, Malaysia.ISBN 983-2957-08-07.

John Doling, 2003. "Sustainable house ownership: Western experiences", Proceedings of 1st APHR conference Housing and Sustainable development, Kuala Lumpur, Malaysia, pp 107 – 118

John Kunz, Raymond Levitt and Martin Fischer, 2003, "Management and leadership education for civil engineers", Center for integrated facility engineering, Working paper # WP 079, Stanford University, USA

Kaplanis S. *et al*, 2002 " A European M.Sc Course on Solar Energy: Technology & management", Proceedings of the World Renewable Energy Congress, Ed. Prof. Ali Sayigh, Cologne

Ken Yeang, 1996, "The skyscraper bio climatically considered"- A design primer, Academy Editions, London. Also in http://www.trhamzahyeang.com/profile/company.html

Narayan Swamy, R., 2001. "Environment, Sustainability and Durability - The triple challenges to the construction industry and the education of civil/structural engineers", International Journal of Engineering Science and Technology, Vol 1, No. 1, pp 1 – 12, Kuala Lumpur, Malaysia

Rao S. P and Zunaibi Abdullah, 2003 "Use Of Internet As A Tool For The Delivery Of State-of-Art Information To The Architecture Student In The Studio" Proceedings of the Association of Southeast Asian Institutes of Higher Learning (ASAIHL), International Conference 2003, Universiti Malaysia Sabah, Kota Kinabalu, Sabah, Malaysia, 28 Sept - 1Oct 2003, pp 288 - 294.

Riffat, S B and Smith, S.J, 2002, "Sustainable technology for the Built Environment", Proceedings of the World Renewable Energy Congress, Ed. Prof. Ali Sayigh, Cologne.

Stanford Anderson, 1980. "The Present-ness of Interpretation and of Artifacts: Towards a History for the Duration and Change of Artifacts," in History in, of and for Architecture. ed., J.E. Hancock (Cincinnati: University of Cincinnati School of Architecture), p. 56.

Sitarz, D (Ed), 1993. "Agenda 21: The Earth Summit strategy to save our planet." Boulder, CO, Earth Press.

Tony Brown, 2001, "Education for sustainability: An operational model or teaching sustainable design", Second Nature Conference, Wisconsin, USA, Aug 24-26, 2001, 8pp.

Zeeda Fatimah Mohamad, 2001. "Curriculum: Implementing education for sustainable development at University of Malaya", v5, No. 1, Dec 2001, J. ULSF, Washington, DC, USA, 8 pp.