Abstract:

The paper is related to the Conference theme of Research and Innovation: [CIB T2] Building and the Environment, and it should be of interest to the architects and especially to the academician, building researchers and students.

The research and practice in LT (learning and teaching) environmental issues in the architectural, architectural technology and other BE (built environment) courses at undergraduate level forms the basis for this paper. It explains the theories of LT processes, and explores their application in practice through actual examples and workshops within BE education in the United Kingdom in general, and at APU (Anglia Polytechnic University) in particular.

It also includes reflections on the findings of Sustainability SIG (Special Interest Group) on behalf of the LT Support Network Centre for the Built Environment to which we have contributed.

Sustainability is and will continue to be a major issue for all parties involved in the built environment, including its learning and teaching. It is at the top of the UK Government ‘green agenda’, it is in the RIBA (Royal Institute of British Architects) enhanced sustainability syllabus and the BIAT (British Institute of Architectural Technologists) Sustainable Development Policy.

Sustainability is also one of the important subjects for educators in BE (but not so much the ways in which it is taught). The paper reviews current practices, shows critically the extent of teaching being based mainly on showing examples from practice and discusses the excessive practice-lead LT. It includes actual examples of studio LT kits (Green Specification, Water, Waste etc) and students' projects (Writer’s Retreat, Asylum Seekers Centre etc), which demonstrate pedagogical aspects and underpinning theories, such as Kolb model, learning-by-doing and others (with the emphasis on both how and what is taught) and critical analysis and reflections of this process.

Keywords:
sustainability; built environment; learning & teaching; research

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INTRODUCTION
Eco-logic

At present, the paper has a preliminary and exploratory status and is based on ongoing research, which intends to review the current BE (particularly in architectural education) undergraduate learning and teaching practice on environmental issues in the UK. More important events, guidelines, benchmarking, regulations, theoretical works and practical examples are identified and used as the basis for a LT design for sustainability at the undergraduate level of built environment courses in general, and at APU in particular. The paper concludes with practical examples from our teaching practice, supported by our own research and with an outline of planned activities in the future.

PARADIGM SHIFT
Why to do it?

Not long ago it was believed that ‘global warming’, ‘green crusades’, ‘war on waste’ and similar headlines are only a fad and that they will soon go away (Smith, 2001). However, disappearance of some natural resources and many environmental changes and disasters in the recent history have compelled us to change our attitudes towards organisations and individuals from all over the world who have indicated that the sustainability issues are not only here to stay, but need to be addressed for the survival of our planet. It applies to all aspects of life but particularly to those involved in creating the built environment, which alone uses over 50% of energy produced in this country. (Edwards 2001). The sustainable practices in BE have become both our social responsibility and a fundamental ethical norm.

To all those who have laid the foundations for ‘The Limits of Growth’ Report and Conference on the Human Environment in Stockholm in 1972, IUCN’s World Conservation Strategy in 1980, Montreal Protocol and UN’s Our Common Future (Brundtland Commission) in 1987, Earth Summit in Rio 1992, Kyoto Conference on Global Warming in 1996, the UK Government’s Strategy for Sustainable Construction in 1998 and the last year Earth Summit in Johannesburg, we ought to say: ‘You have awakened us, but in so doing you have lit a fire that cannot be extinguished. We will follow you as long as you advance, we will spur you if you halt, and we will take a vociferous lead if you turn back.’ (Elsdon 1992)

METHODOLOGY
Where to go and who’s requirements?

‘Theory is the body of principles that explains and interrelates all the facts of a subject. Research is a tool by which theory is advanced. Without it, teaching can have no direction and thought no cutting edge.’ (Martin 1959)

There is no doubt that the theory of designing buildings for sustainability can be taught in accordance with the good educational practice. All its constituent parts can be interrelated, and that, through academic research, teaching tools could be developed, which would help students learning.

So, where do we go for ‘all the facts’ and who is affecting ‘all constituent parts’ of this subject? The UK Government, Government organisations (such as Environmental Agency, Environmental Technology Best Practice Programme etc.) and DETR (Department for Environment, Transport and Regions) in particular, have published a number of documents of strategical importance to the subject of sustainability issues, which will be the starting point and the base for this research (DETR, 1998). European Union law and documentation (e.g. regulations, directives, acts, Eurocodes etc.) are part of the legislative scene, now and even more so in the future, and will have to be considered as part of a future strategy. Works of research organisations, such as BRE (Building Research Establishment) and professional bodies, such as RIBA and BIAT that are accrediting undergraduate courses and their syllabi, are incorporated in our teaching schemes. Their green manifestos and other documentation will have a most direct influence on this research, although it is evident that they are falling behind both the practice and the university teaching.
There are two important areas of this research. Firstly, it is to review the literature of the leading research organisations and construction industry groups, and secondly, to link with these groups to develop parts of common interest and mutual benefit (Focus Group, 2000).

Built environment courses and schools of architecture in particular, will be the main focus of our attention for it is here that the future lies. Cambridge, Cardiff, Delft, Dublin, Glasgow, London, Portsmouth, Sheffield, Oxford and others are recognised as ‘leading lights’ and act as primary generators of new approaches to environmental LT. At APU there is a very strong focus on teaching and research into sustainability issues; its Business School - completed last year - and Learning Resource Centre built in 1994 (Queens Building), are two examples of environmentally conscientious buildings, which provide a good platform for this purpose.

A good deal of information on LT practice in the UK related to sustainability was collected after the Architecture Education Exchange Conference in September 2001 in Cardiff, through the work of the Sustainability SIG, the general aims of which were:

- to conduct research into the learning and teaching of sustainability across the curriculum within architectural education in the UK
- to raise awareness and to broaden the engagement of architecture educators and students to issues of sustainability
- to promote a holistic approach to sustainability learning and teaching: embracing social, environmental and economic aspects, and
- to compile a database of activity, and networking between sustainability teachers.

A limited research was carried out into LT of sustainability, with pedagogy in focus, and was presented at the Shared Visions Conference in Brighton in September two years ago (Shared Visions 2002). Important parts of it are incorporated into this paper but the findings and reflections are the authors’ and not necessarily of the SIG. (Erdel-Jan 2002). However, the general findings were presented and discussed at the joint SIG/RIBA Symposium on Sustainability in Architectural Education in London on 24 June 2002 and is also available on the CEBE (Centre for Education in the Built Environment) web site (CEBE 2002).

**CONTEXT**

**What to teach?**

The sustainable developments themselves, as defined by the Brundtland Commission (1987) are not the subject of this research. The main focus is on individual environmental issues in terms of what is best to teach and how best to teach them. Many of the issues are overlapping and there is no definitive list of sustainable problems that must be addressed. For the purposes of this paper, the issues are grouped in Table 1. to show firstly, their elementary classification and secondly, to illustrate a number of tools for evaluation in terms of the implications for the built environment.

<table>
<thead>
<tr>
<th>Energy Consumption</th>
<th>Life Cycle Assessment</th>
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<td>Embodied Energy</td>
<td>Total Environmental Impact and Assessment</td>
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<td>Renewable Energy</td>
<td>Total Building Performance</td>
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<td>Solar Protection and Solar Gains</td>
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<td>Global Warming and Greenhouse Effect</td>
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<td>CFC and Other Ozone Depleting Gases</td>
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<td>Air Pollution, Noise and Nuisance</td>
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<td>Ecology</td>
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<td>Biodiversity</td>
<td>Materials and Eco-labelling</td>
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<td>Water</td>
<td>Quality of Life</td>
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Table 1. Sustainability issues, their implications on BE and evaluation tools

- water conservation
- heating
- cooling
- mechanical ventilation and air-conditioning
- green specification
- natural ventilation
- waste
- lighting and daylighting

Table 2. Selected issues for developing learning & teaching tools

Table 2. shows the issues that have been selected for the earliest research, because of their presence in almost all projects, and some of them will be illustrated in detail at the conference, as they would be presented to APU students.

The emphasis in this respect will be placed both on ‘what’ is being taught, on ‘how’ it is taught and ‘how’ students best learn about them. Thus, the research would lead sequentially: through learning and teaching, to practical applications at undergraduate level.

THEORY AND PRACTICE
How to teach?

‘There is nothing so practical as a good theory.’ (Kolb 1984)

Creating positive attitudes to learning is the starting point for all teachers, as Herman Hertzberger has put in his Lessons for Students of Architecture: ‘…the aim of my ‘lessons’ has always been to stimulate students, to evoke in them an architectural mind that will enable them to do their own work...’ (Hertzberger 1991). In this respect, ‘learning by doing’ is one of the most popular methods for achieving those goals, starting with (1.) a known base and collecting design data, through (2.) the first design proposals, (3.) critical analysis and reflections, and (4.) finishing with a decision whether the design problem has been solved, or the process should be repeated at a new and higher level.

Kolb’s Four-Stage Learning Model explains this pedagogical theory (Figure 1.)

Figure 1. Kolb Mode
In this model Kolb suggests the cyclical approach to experiential learning, which takes place through four stages: Concrete experience, Reflective observation, Abstract conceptualisation and Active experimentation, and which incorporate the basic learning processes: inquiry/research, creativity, decision making, problem solving and learning (Kolb 1984).

To this model the recognised activities of the design process have been added in Figure 2. to suit the project-based learning and teaching (in the studio or in students’ own managed time), such as brief studies, site analysis, precedents, first proposals, scheme design, crits, feedback, alternatives etc. and repeating the whole process at a new level until a satisfactory solution is achieved. The simplicity and clarity of the educational message in the expanded model is striking.

The cyclical approach in the Kolb Model has been sometimes criticised as a ‘waste of time’. This is a clear misunderstanding of the design process, because ‘practising architecture is asking oneself questions, finding one’s own answers with the help of the teacher, whittling down, finding solutions, over and over again’ (Zumthor 1998). This applies to designing for sustainability, too, which should never be just an-end-of-job-assessment process i.e. a checking procedure to find out how many ‘green points’ have been achieved and how ‘green’ the job is. It should not result in redoing the whole design process, either, as designing for sustainability should be a matter of attitudes and of the ‘green ethics’. The ‘green ethics’ is challenging us to adopt a strategy, which is based on an all-encompassing approach. The approach includes the whole process of planning and designing, construction and use of buildings (whether new built or refurbished), from site selection, briefing, analysis and design of building form, construction works on site, manufacturing and production of components, materials, finishes and services, to buildings in use and maintaining, monitoring and controlling their performance, assessing and monitoring the effects of that process and product on the local and global environment (Edwards 1996).

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Fig. 2. Expanded Learning and Teaching Model based on Kolb Model
The Kolb model of experiential learning and teaching has a striking resemblance to the design processes involved in many architectural design studios. The model broadly complies with the learning and teaching of design as well as the processes and methodologies employed in the creative act of designing. Design is in the main learnt and taught through designing. Timetables and programmes are structured to reinforce learning through doing.

Arguably all architectural development and design should be sustainable and be capable of being evaluated as such. However, design projects for students are rarely built and in many ways the academic project gives greater scope to explore the implications of sustainability.

The authors have found that to maximise the learning and teaching of sustainability through design particular care should be taken in the selection of the choice of design projects. The choice should highlight issues of sustainability and be able to inculcate an attitude that takes sustainability beyond that of problem solving and into the world of opportunity making.

Two examples of design projects that were particularly successful will be illustrated at the conference.

The first is for first year architectural students. The project was to design a retreat for a writer. The brief was to create a room with a view within which the writer can write. Additionally, requirements were adjacent places to eat and sleep. The student’s scheme illustrated chose a local famous competitive yachtsman. The retreat is sited within the landscape known by the writer and addresses in strategic terms the issues of sustainability, self-sufficiency, energy, and expression.

The second is for final year students. The project was to design a centre for 450 asylum seekers. The proposal illustrated addresses the issues of contained living, social structures and connections, construction, transportation, energy and waste.

To be able to explore designs which are conceptually generated from sustainability issues puts into sharp focus many of today’s existing environmental assessment methods. Often assessment methods are creating barriers for their own application in practice; they may require an account of the completed project design in great detail, or are carried out behind the closed doors by other organisations. They can also be expensive, and perhaps well beyond the means of individual clients or small architect’s practices. Those aspects are unhelpful at the early design stage of a project and are therefore of little value to students of architecture. What are required are simple environmental indicators such as that generated by the LT Method (Baker 1994), the ‘environmental rose’ and similar, which can be used to rapidly inform the environmental design cycle.
The ‘environmental rose’ was developed for APU students to overcome such limitations. 

![Figure 4. ‘Environmental Rose’](image)

The ‘environmental rose’ is a LTT (Learning & Teaching Tool) based on the Environmental Profiling System methodology from the BRE Green Guide to Specification (Howard 1998) and is a simple illustration of a tool that can be used for students’ self-assessment of the sustainability of single building components. This is a quick exercise and very popular with students, because of its ‘real life’ usefulness, its links with the actual costs and the simplicity of its use. It is essential here, for LT purposes, and as Kolb has shown, that the students carry out their sustainability assessment several times in order to find out firstly, the achieved result and ultimately, the new improved solution. It is this design process that is so important for students to develop at university.

However, many of the environmental issues are complex and their computation and evaluation can often get in the way of this design process. Just trying to meet the design requirements of the new Building Regulations (HMSO 2002) can be a daunting exercise for any architect - never mind architectural students. Yet the environmental implications of all designs need to be addressed to meet these Regulations. Manual computation of the requirements will not simply be an option. For example, the new method of calculating the thermal transmittance (U-Values) of building elements that takes account of thermal bridging, air gaps and fixings, is just so complex that it is doubtful that any architect will want to spend design time to investigate. Many will opt for the standard off-the-self solution to save time. This can only stifle creativity. If the environmental and sustainable issues are to be at the core of the design process then simple and quick methods must be developed to aid the designer in the quest for the ‘green solution’.

A series of simple computer programs have been developed at APU that can be used as part of the early design process (Frame 2002). These programs put the architect in control and provide instant output that enables designers of sustainable buildings to evaluate the implications of their designs without getting ‘bogged down’ with the numbers or having to rely on the services of the building services engineer at the early design stage. The software however, does not replace the need to employ the services engineer at the detailed design stage. The software packages empower the architect to make informed decisions in the light of experimentation at a speed that does not impede the natural design cycle.

These software tools therefore, fit well into the sequences of the above Experiential Models of learning and design, which involves (a) achieving objectives, (b) experience, (c) reflection and finally (d) learning. It also
shows how the result of an academic research can become learning and teaching tools and also a product for the 'real life design', informing practitioners. One of our main functions is to educate the students - future practitioners, but not to train them. (Hawkes 2000). This aspect of undergraduate education is criticised by many practising professionals and the use of the APU environmental indicators should be seen as an academic activity which bridges that gap between education and practice, adding to its cutting edge.

FUTURE ACTIVITIES
When to do it and conclusions

Future research will involve the further collection and analysis of the literature, visiting exemplar buildings, and interviewing the designers and clients involved, collaborating with colleagues and students, and placing the results of findings within the theory of and strategy for learning and teaching sustainability issues.

The size of the research and its timetable is very much appreciated. But the need to avoid ‘deadly environmental sins’ (Independent, 22 July 1993, p.13), to stop the sky falling (New Scientist, 1 May 1999, p.32), to demystify ‘sustainability myths’, to make our building design process and construction product sustainable - and to teach about it meaningfully - are the challenges that are facing us all. By facing and resolving those challenges now, designing for sustainability will result not only in making good sustainable buildings, but also in making places for good-quality-of-life for all.

Good teaching and learning practices are in themselves most sustainable, as the educational experience should facilitate future generations to meet their own needs. The belief in those values and reasons provide motivation for this research and teaching, and the basis for other published work (Erdel-Jan 2000).
REFERENCES


Brundtland Commission (1987): ‘Development which meets present needs without compromising the ability of future generations to achieve their needs and aspirations.’ EU: Brundtland Report.


