

INNOVATION IN INTEGRATING SUSTAINABILITY EDUCATION INTO ENGINEERING AND BUILT ENVIRONMENT CURRICULUM: THE CASE FOR ASIA-PACIFIC

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Summary

This paper presents the key findings of the United Nations University – ProsPER.Net Project on “*Integrating sustainability education into existing engineering and built environment curriculum*”, reviewing the existing built environment curricula of higher education institutions in the South Asia Pacific region. The project is aimed at integrating sustainability thinking and practice into engineering and built environment curricula through a professional development program for university academics and curriculum developers. The primary output of the project is the development of a guide in built environment disciplines at undergraduate and postgraduate levels. This was undertaken through a collaborative enquiry process. The wider aim of the project is to ultimately ensure that sustainability is firmly embedded in expanding/developing further courses/offerings to students within this rapidly changing environment.

Keywords: Sustainability Education; Built Environment Curricula; Curriculum Design; Asia-Pacific

1 Sustainability Education in the Built Environment

The further and higher education sector has acknowledged the importance of learning for sustainability through various declarations [1]. To equip all sectors of the society to actively engage in change for sustainability, curriculum change is recognised as being urgently needed across all programs of study offered by higher education and not just those programs focusing on sustainability issues [2, p19]. Sustainability education initiatives from Australia and New Zealand have been widely published [2]. However, developments from other regions have received less consideration [3].

In the Asia-Pacific region, the demand for higher education has risen in tandem with overall population growth and increasing affluence, which adds urgency to the pursuit of sustainability [4]. A closer examination shows that the Asia-Pacific region offers many creative initiatives and have made considerable progress in ‘*education for sustainable development*’ and in understanding the learning dimensions of sustainability [3]. The initiatives of higher education institutions in Asia and the Pacific have been propelled by

government policies and agencies as well as several regional and subregional efforts. Region-wide efforts saw the emergence of several networks such as the Promotion of Sustainability in Postgraduate Education and Research Network (ProSPER.Net) and the Regional Centres of Expertise in ESD, both developed by the United Nation University's Institute of Advanced Studies, and the United Nations Environment Programme (UNEP) Asia Pacific Regional University Consortium (RUC) initiated by UNEP's Regional Office for Asia and the Pacific (UNEP-ROAP) [3].

1.1 Educational Responses

To foster environmental literacy and build awareness of sustainability issues, the predominant trend in higher education curriculum has largely been towards learning *about* sustainability. **Education about sustainability** focuses on developing key knowledge and understanding about natural systems and environmental issues as opposed to learning that engages and equips for change towards sustainability [5]. **Learning for sustainability** moves beyond education *in* and *about* the environment to focus on equipping students with the conceptual frameworks necessary to develop skills to effectively enact change towards sustainability [2].

Addressing sustainability in the curriculum requires more than the addition of content [6]. The implications of the *'for' approach* to sustainability education were more widely understood and a consensus has been formed that education for sustainability should not be viewed as 'one more subject' to be added to curriculum. However, the focus should be on a wholly integrative approach where sustainability is seen as a context for delivering the aims of education and not as a competing priority [7, p9].

1.2 Transforming Sustainability Knowledge

In the analysis of the development of sustainability education, Sterling [8] contends that sustainability is "likely to arise depending upon the degree which attention shifts from 'things' to relationships, and from a segregated and dualistic view of the world towards an integrative and participative perspective" (p56). Building sustainability knowledge requires a fundamentally different approach to the ways academic institutions organise education and research as well as relate to society with focus on knowledge processing instead of just knowledge sharing or transfer [9]. This is particularly so because environmental changes are constantly taking place around us, and our responses need to be resilient to these changes. If higher education institutions are to play a constructive part in the transformation of sustainability knowledge and transition of sustainable education to provide transformative learning experiences, these institutions and educators need to go through a transformative learning experience themselves [10].

2 Engineering and the Built Environment Curriculum

In this carbon-constrained world, the importance of the built environment to society places a high level of responsibility on those professionals who plan, design, construct, manage and maintain that environment. Educators in the built environment have become increasingly aware of their environmental responsibilities and the impact of buildings upon the quality of life, health and resource consumption [11] and there is a clear recognition that professional education in the sector for climate change adaptation and mitigation is

limited and urgently needed [12]. For example, professionals in the sector generally understand the need for climate change adaptation and mitigation, but not its practical implications [13]. Similarly, it is noted that most architecture and design courses pay little regard to sustainability as a holistic concept and although low-energy design is widely understood, the notion of social sustainability, of life-cycle thinking including costing and of alternative technology is given little timetable space [11].

2.1 The ProSPER.Net Project

Education has long been recognised internationally as fundamental to addressing the global challenges society faces [2]. The unique features and issues of sustainability have a profound effect on the way academic curricula are structured.

The ProSPER.Net project follows a collaborative inquiry process wherein the role of the industry in assisting to achieve outcomes and ensuring that sustainability goals of projects are met is vital. The central objectives of the ProSPER.Net Project are to:

- Integrate sustainability thinking and practice into engineering and built environment curricula through a professional development program for university academics.
- Identify key priorities for inclusion in the professional development program.
- Contextualise the priorities within global and local policy commitments for sustainability in the built environment.

Further information on this ProSPER.Net research project is available in the academic network's publications [14, pp 28–33].

In focusing on the main issues about applying the principles of sustainability in the built environment and the tensions with regulatory and best practice approaches, a regional approach was adopted for the ProSPER.Net project. This regional approach took account of international, national, local and sub-regional concerns in relation to sustainability teaching and learning, and expectations of both graduates and the industry. The core activity of the ProSPER.Net project was a workshop which brought together the participants and shared knowledge and experiences to recommend practical approaches for integrating sustainability issues whilst understanding the theoretical dimensions of sustainability and sharing experiences about what approaches best work for all stakeholders. Nine (9) teaching academics from universities in the Asia-Pacific region participated in the project and the workshop. The aim was to select a mix of universities from the Asia-Pacific region because growth in the building and construction sector is expected to occur most in this region, with attendant growth in population. The invited industry participants were selected from a mix of international and national participants in Vietnam.

To achieve the objectives of the research project, an action research framework was adopted. Using participatory action research, the workshop identified how best to integrate sustainability thinking and practice into curricula. In collaboration with the industry practitioners, it identified the key priorities for inclusion, within global and local policy commitments.

2.2 Overview Programs and Courses: The Case for Asia Pacific

To contextualise the current state of sustainability integration in the existing built environment curricula in the Asia-Pacific region, the ProSPER.Net workshop participants provided a list of programs and attendant courses currently taught in their respective universities and institutions. The compendium of university programs and courses at

undergraduate and postgraduate levels taught in the participating universities and institutions was streamlined and tabulated according to departments within the discipline area of engineering and built environment; common names of programs offered; course names and subjects offered within the programs and the subject topics covered in the courses. To quickly and simply analyse the information, the frequency of keywords describing the content in the template was reviewed. Using the language of visual design, *tag clouds* were generated as graphical representations of word frequency. Understandably and as expected, the schools, departments and institutes in the discipline area of built environment were predominantly within the schools of engineering and architecture (**Fig. 1**). Interestingly, among the nine (9) participating universities, only RMIT University (Australia) indicated having a school in construction and project management. This perhaps, could have a bearing on how the discipline generally relates to the industry and marketplace in a particular country and the professional accreditation requirements needed to practice in that profession. In summary, *Architecture* and *engineering* weighed heavily with regard to common names of programs offered within the schools, departments and institutes (**Fig. 2**). However, key terms such as *environmental*, *management*, and *planning* have also emerged as qualifiers for program names.



Fig. 1 Schools, departments and institutes in built environment discipline area



Fig. 2 Common names of programs

Within the programs, the courses are much more specific and indicated sustainability content (**Fig. 3**). Keywords gleaned from the course and subject topics also reflected and supported the predominant terminologies in the course names (**Fig. 4**).



Fig. 3 Courses (subjects) offered within the programs



Fig. 4 Keywords and subject topics outlined within the course contents

The degree to which sustainability is tokenistic was evaluated by examining where sustainability is mentioned in the program. In the ProSPER.Net review of university programs and courses, for purposes of pre-work and information for the workshop and understanding the extent to which sustainability/environmental courses are already part of the curricula, the dominance of certain terminologies in the course names was taken as indicators of how sustainability concepts are integrated. If sustainability terminologies appear in the description or subject topics, the integration of sustainability concepts was assumed. This was then included as one of the issues to be reviewed in the workshop discussions on framing the curriculum design and structure.

3 Integration of Sustainability and Innovation of Education

Engineering and built environment programs are predominantly professionally accredited courses and thus have a strong need to respond to external influences through the reframing of curricula so as to produce graduates equipped to work in an evolving and challenging context. The strong links with the professional bodies and industry, reinforced through the use of practitioners to deliver and support subject areas, should ensure that graduate entrants to the professions are appropriately equipped. Many schools, departments and institutions within universities have strong industry-based research and consultancy links, operating at the forefront of the discipline. However, it has also been identified that the skills based in the sector remain insufficient to meet the needs of the new sustainable communities' agenda [12].

From the growing number of studies on how to integrate sustainability in higher education, and broad and general frameworks for its integration into curricula, the approaches can be summarised as follows: (1) an incremental approach whereby small groups can start out and if successful can be expanded throughout the university [15]; (2) the need to think strategically about integrating sustainability into higher education [16]; and (3) the need for a broad and general approach [17].

The literature indicates that the many core principles of integrating sustainability into higher education require substantial shifts in thinking and practice. Some may be out of reach of the individual lecturer and more challenging for some disciplines than others. Table 1 illustrates the magnitude of change and transformation required in teaching sustainability [8].

Tab. 1 *Integration of sustainability within higher education implies shifts [8, Table 4.3, p58]*

From	To
Transmissive learning	Learning through discovery
Teacher-centred approach	Learner-centred approach
Individual learning	Collaborative learning
Learning dominated by theory	Praxis-oriented linking theory and experience
Focus on accumulating knowledge and a content orientation	Focus on self-regulative learning and a real issues orientation
Emphasis on cognitive objectives only	Cognitive, affective, and skills-related objectives
Institutional, staff-based teaching/learning	Learning with staff but also with and from outsiders
Low-level cognitive learning	Higher-level cognitive learning

Moving towards a sustainable education paradigm is not a choice between these opposites (**Tab. 1**), but a “change of weighting that moves away from the dominance of the old paradigm” and the transformation and conservation of “some of the characteristics rather than abandoning them in their entirety” [8, p57].

3.1 Learning Outcomes

Learning outcomes are the point at which education principles and other principles meet [18]. As the literature review for this project uncovered, the workshop discussions similarly revealed that sustainability pedagogies is rife with the need for the different approaches to teaching and navigating the difficult transformative changes to higher education curricula. However, there is limited parallel discussion on the learning outcomes associated with these approaches [19].

The workshop discussions centred on what would be the educational responses and focus of a curriculum in the built environment which espouses sustainability education, the academic and industry participants outlined their expectations on the learning outcomes and anticipated attributes of graduates (**Tab. 2**).

Tab. 2 Learning outcomes and anticipated attributes (ProSPER.Net Workshop)

	From academics	From industry
1	Genuine concern	Motivation to make change
2	Discipline / competence / sustainability	Life-cycle thinking
3	Good team player	Open to other disciplines
4	Right attitude	Environmental / social / economic implications of their work

For the learning outcomes that weighed heavily for the academics, it was interesting to note that while professional competence was considered to be important, so also were softer skills [20]. From the expectations of what industry has identified as key needs and attributes of the graduates who would fill the requirements of the marketplace, the responses show that learning outcomes are not all about professional competence. Perhaps learning outcomes would have to be dealt with in specific programs and courses. Moreover, education for sustainability further necessitates knowing what are the learning outcomes desired from the students – what are the capabilities, abilities or competencies to be achieved [6].

3.2 Sustainability Pedagogies

Based on the prioritised expectations on the learning outcomes and the marketplace requirements for built environment graduate attributes discussed in the ProSPERNet workshop, the ideas and suggestions for the integration of sustainability into the curricula offered by the workshop participants is outlined in Table 3.

Tab. 3 Development and changes to built environment curriculum (ProSPER.Net Workshop)

How educators will make the change	How educators will make the change
Change teaching content	Continuing professional education
Research collaboration	Open lectures / seminars open to all in the university rather than just within the program
Sharing / networking lessons learned	Research collaboration
Best practice examples / case studies used where possible	Form partnerships: students and industry through conferences such as with Green Building Councils, etc.
Dialogue / discussions with industry	Getting industry speakers
Invite industry to: student presentations, faculty presentations	Accreditation considerations
Dialogue / discussions with other university staff / officials	Organise activities with industry (e.g. conferences, seminars, etc.)
Keep looking for funding	Send graduates to individual companies
Lobbying politicians	Mentoring
	Alumni tracking – surveys
	Advisory boards
	Adjunct professors
	Feel good stories / testimonials

Interestingly these approaches echoed the methodologies and models found in Australian tertiary curricula [2]. Drawing from the workshop discussions and insights offered by both the teaching academics and industry representatives, to address and effect targeted learning outcomes invariably require the use of multiple approaches (**Tab. 3**). Moreover, whilst the debate on what the capabilities of students should be is taking hold in parallel with the sustainability pedagogies, only a minority of higher education institutions have looked at curriculum change in this light, either within disciplines or in terms of whole institutional approaches [6].

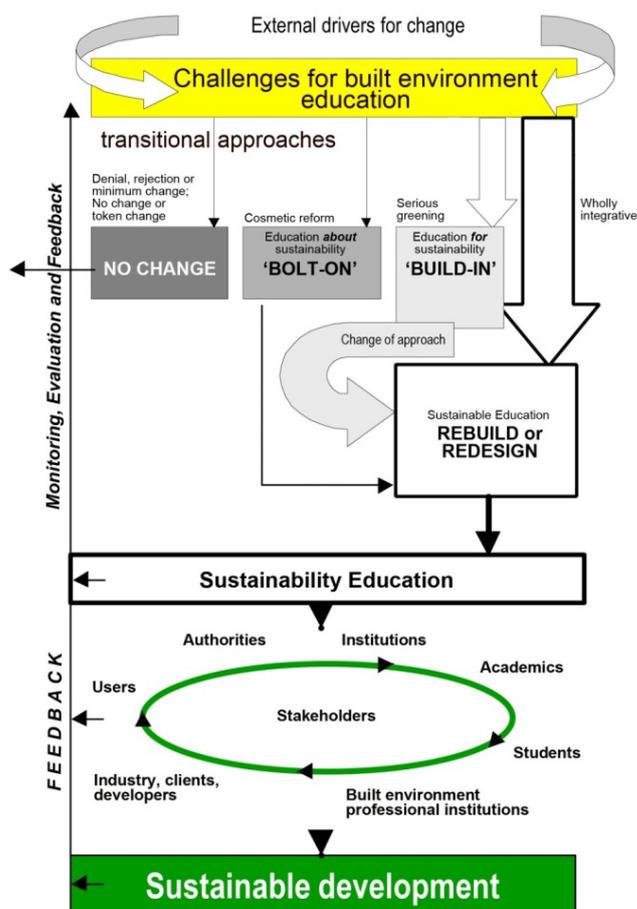
4 Conclusions: Directions and Imperatives – Framework for the Guide

A major driver for more interdisciplinary approaches to teaching and learning is the very nature of sustainability itself. Its systemic and complex set of issues requires commensurate approaches to knowledge, research, teaching and learning. The emerging consensus is that sustainability issues cannot be sufficiently understood or addressed without a primary recognition of the need for interdisciplinary approaches [21]. However, educational structures and practices are widely characterised by disciplinary compartmentalisation [22]. Whilst there is expertise and experience in interdisciplinarity in higher education institutions, it still appears on the margins of the mainstream, which remains dominated by discipline-based practices and structures [23].

Informed by the ProSPER.Net workshop outcomes, the formulation of the framework of the curriculum guide drew insights from the strategies and actions for sustainable construction [24, 25], which illustrate the process of continual improvement of sustainable practices in the built environment sector (Fig. 5). The guide's emphasis is on recognising the systemic nature of sustainability, the learning process of integrating sustainability thinking and practice into the built environment curricula and the key role the professions play in the creation of sustainable built environments. This iterative and continual learning process hinges on addressing the key challenge of building sustainability progress in the local and regional contexts and the academic strengths of higher education institutions rather than on generic approaches.

In summary, the guide is structured in three sections with a view of facilitating rather than directing change in an interactive format to capture feedback and experiences:

- Section 1 – A framework, which outlines the priorities in the professional development program; contextualising these priorities and strategies for capacity building for the different stakeholders are presented.
- Section 2 – The broad framework established and development of Section 1 provides a rationale for the guiding principles for teaching and learning issues, identifying learning aims and developing learning outcomes; transformative sustainability approaches and methods; repository of references and useful resources; presentation of best practice and case study example and monitoring and closing of feedback loops.
- Section 3 – Platform for curriculum dissemination and distribution. This section outlines the available knowledge networks for faculty development and provides a platform for reporting and monitoring of progress and evaluation.



*Fig. 5 Learning process to sustainability education
 (Adapted from Agenda 21 on Sustainable Construction [24])*

The general direction of education for sustainability is moving increasingly towards integration and innovation. However, the slow progress of the integration of sustainability in the built environment curricula may have been due in part to the practice-led approach, which is hallmark of the discipline and by the assumption that sustainability already permeates the curricula by its nature [22].

The diverse experiences of the academics and industry representatives in the ProSPER.Net workshop point to these issues, which are key to professional education for sustainability:

- Curriculum design and structure;
- Capacity building for academics in transforming sustainability knowledge;
- Sustainability pedagogies;
- Pedagogical implications in the engineering and built environment disciplines;
- Learning outcomes – student experiences;
- Industry input – students as employable graduates; and
- Challenges to professionals in the field of built environment, their institutional structures and boundaries.

To successfully introduce sustainability concepts into courses and curricula, educators must understand the process of making changes [9] and innovation in universities [16]. The typical barriers to incorporating sustainability in higher education institutions highlights the notion that “capacity building of educators” must then be considered to be the

cornerstone of transforming universities to become effective in empowering students to become change agents for sustainability [15].

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