ZEMCH Sustainable Design Workshop – An Interactive Model for Sustainability Education

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ZEMCH 2018
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29th JANUARY – 1ST FEBRUARY 2018, MELBOURNE

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PREFACE

ZEMCH is the acronym of “Zero Energy Mass Custom Home” reflecting social, economic and environmental sustainability in the built environment. To cluster diverse ZEMCH knowledge accumulated throughout the globe, ZEMCH International Conference has been held annually since 2012 in collaboration with 689 ZEMCH Network international partners from over 40 counties. This year sees the 6th ZEMCH conference operation hosted by the University of Melbourne in Australia. The ZEMCH 2018 International Conference attracted 110 abstracts, with 67 papers finally making it through the rigorous peer review process.

Homes need to be socially, economically, and environmentally sustainable in response to societal pressures on our common future. The current concept of ‘Sustainable Development’ was advocated by the World Commission on Environment and Development in 1987, and was posited as *‘a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potential to meet needs and aspirations’.* In 1992, this notion was given additional impetus at the United Nations Conference on Environment and Development (or the Earth Summit) held in Rio de Janeiro, where an initial international treaty on environment was produced; however, this had neither limits on greenhouse gas emissions nor legal enforcement provisions for individual nations. In 1997, the text of the Kyoto Protocol to the United Nations Framework Convention on Climate Change was adopted eventually at the 3rd Conference of the Parties held in Kyoto, Japan. As of April 2008, 178 countries had signed and ratified the Protocol; in consequence, most industrialized nations and some central European countries agreed to legally binding reductions of greenhouse gas emissions averaging 6 to 8% less than 1990 levels between 2008 and 2012.

In response to growing global warming issues and the constant increase of energy prices, house-builders and housing manufacturers today are becoming more responsive to the delivery of net zero energy and net zero greenhouse gas emission, more sustainable homes than ever. The business model adopted within the built environment operation tends to be risk averse, following traditional ways of doing business and a closed system mode of operation. Such approaches often hinder enterprises from adopting unfamiliar, but necessary, innovations to realise the delivery and operation of socially, economically and environmentally sustainable homes. In theory, homebuilders and housing manufactures are sensitive to societal needs and demands. Yet, in reality, traditional builders generally tend to follow business as usual routines and do not undertake the research to determine whether or not to adopt unfamiliar design challenges, and innovative building materials and systems. Nonetheless, to build zero carbon mass custom homes that aim to satisfy the wants and needs of individual consumers, as well as society, may require the adoption of innovations. Then, how can such conventional house-builders and housing manufacturers be adapted to new business operations required for the delivery of zero carbon mass custom homes, whose design, production and marketing approaches may not be akin to those to which they are accustomed?

‘Mass customisation’ is a paradoxical concept. The current notion was anticipated in 1970 by Alvin Toffler, in his book, ‘Future Shock.’ In 1987, the term was eventually coined by Stanley M. Davis in his book titled ‘Future Perfect.’ Furthermore, in 1993, Joseph B. Pine II profoundly systematised the general methods of mass-customising products and services in his book ‘Mass Customization.’ This was followed in 2009, with Frank T. Piller’s and Mitchell M. Tseng’s edited ‘Handbook of Research in Mass Customization and Personalization’ which compiled the

R&D activities and outputs delivered by various industries globally. Nonetheless, the idea of customisation can be dated back to the 1950s, as the gravity became explicit in Walter Gropius' book entitled 'Scope of Total Architecture.' The essence of mass customisation applied to housing was speculated as he emphasized the need for 'standardising and mass-producing not entire houses, but only their component parts which can then be assembled into various types of houses.' The period coincided with the post World War Two construction boom and the need to rebuild and repair many buildings globally, where it was also known as 'prefabrication' or 'prefab'. Today this term has been renamed 'offsite manufacture' or OSM. Technological innovations have great potential for future mass customisation technologies and designs.

In fact, house is a system of energy and environment, which contains a number of parts and components. The selection of housing design elements need to be made carefully with due consideration of the project's initial and operational cost, quality, and time. Moreover, the location factor cannot be less of a consideration as it encompasses geographical and topographical conditions and local regulations. Location and orientation of house help secure the optimum use or prevention of solar radiation and wind and this affects the building's operational energy consumption and generation which correlate with greenhouse gas emissions and energy costs.

The total number of possible ordered pairs (or combination) of given standard housing components can be quantified. In this approach, the mass customization (*MC*) has been systematised and visualised simply by making use of a conceptual analogue model as follows: $MC = f(P, S)$. In this model, the service sub-system (S) concerns communication platforms that lead the users to participate in customizing their design output while the product sub-system (P) covers production techniques that aim to encourage the standardization of housing components for mass production and dissemination. Standardisation of building components seems to be a limited hindrance to design customisation if communication platforms are well developed. Design-consulting staff and appropriate communication interfaces are required to facilitate user choice of standard design components. These fundamental design service factors can also be integrated into a comprehensive model: $S = f(l, p, t)$. In this model, the service sub-system (S) is supported by the existence of the location (l), personnel (p) and tool (t) factors and they are necessarily interrelated. In general, building components can be divided into three categories: volume, exterior and interior. These can be considered the main elements of the product sub-system (P) which can be explained by the following conceptual model: $P = f(v, e, i, o)$. The volume (v) components are used to configure the building's internal space that determines the size and location of each room while the exterior (e) and interior (i) components serve to co-ordinate decorative and functional elements that customize a building. In addition, (o) denotes other optional features such as building amenity and security systems, inclusive design components and renewable energy technologies. In general, envelope and ventilation heat losses are associated with building volume and exposures, while thermal transmittance links up with materials applied to exterior and interior components. Energy monitors may fall into the category of optional features.

Most of the net zero-utility-cost housing manufacturers typically in Japan have begun to install a number of renewable energy technologies as standard features rather than options based on their value-added, high cost-performance marketing strategy. The strategy itself is far from new having been applied to a variety of end user products around the globe. For instance, although today's automobiles can be produced with lower production costs than those in the past, their selling price does not seem to be affected dramatically by higher productivity. New cars are still generally regarded as expensive; nevertheless, the list of items now offered as standard in new cars, such as air conditioning, in car entertainment systems, airbags, remote-control keys, power steering, power windows and adjustable mirrors, were offered only as expensive options in older models. Clearly, the quality of newer models is much higher than that of older models. The same is true for the housing industry in Japan. Quality-oriented production contributes towards the delivery of high cost-performance housing, in which high-tech modern conveniences that are installed as optional in conventional homes, are available as standard equipment (*Se*). In this context, the product subsystem (*P*) can further be modified into the following conceptual model: $P = f(v, e, i, o) + Se$. In fact, Japanese housing manufacturers mass-produce net zero-utility-cost customizable homes in which a variety of housing amenities and renewable energy technologies such as solar PV, air source heat pump, micro combined heat and power systems are installed as standard features, rather than optional extras. Despite the reduction of equipment choices, volumetric, exterior and interior design components still remain substantial options from which the users can choose so as to customize the end product.

To deliver a marketable and replicable net zero energy/emission mass custom homes or ZEMCH, the strategic balance between the optional and standard features seems to be critical. The optional features may be provided with the aim to enhance design quality (or customisability) that helps contribute to satisfying desires and expectations of individual stakeholders. The standard equipment, on the other hand, needs to be installed in buildings as it aims to exceed product quality whose levels can be adjusted in conjunction with societal demands and requirements.

ZEMCH 2018 International Conference encompasses a wide spectrum of hopes and fears around the design, production and marketing approaches to the ZEMCH delivery and operation, and showcases some exemplars budding out in different climates around the globe. All papers included in this proceedings were peer reviewed in accordance with the full review process of the Department of Education and Training (DET), Australian Government. It is the cooperative effort of many authors and qualified reviewers. The editors and organising committee wish to thank all the authors and the reviewers.

Sara Wilkinson, Lu Aye and Masa Noguchi
Co-chairs
(On behalf of the ZEMCH2018 Organising Committee)
29th January 2018

CONTENTS

ZEMCH SUSTAINABLE DESIGN WORKSHOP: AN INTERACTIVE MODEL FOR SUSTAINABILITY EDUCATION

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Abstract: *The term 'sustainable development' has been widely used after the Brundtland Commission report published in 1987. Education for sustainable development was promoted by the UNESCO and four key learning processes were identified covering collaboration and dialogue, engagement with the whole system, innovative curriculum, as well as active and participatory learning. Due to the complex nature of sustainability, it is very important to prepare students to respond to the interconnected social, economic and environmental aspects of sustainability. In this paper, the ZEMCH Sustainable Design Workshop delivered at the University of Melbourne in 2016 was used as a case study to examine whether it could fulfil the four key learning processes of education for sustainable development promoted by the UNESCO. The course outline of this workshop was firstly introduced, followed by an analysis illustrating how the four key learning processes were implemented. The results indicated that ZEMCH teaching approach was in line with the key learning processes proposed by UNESCO. The pedagogy of the ZEMCH Design Workshop was evaluated, potential improvements were discussed and further guidance for replicating similar course at other institution was given.*

Keywords: *Education for Sustainable Development, ZEMCH Sustainable Design Workshop, Mass Customisation, Experiential Pedagogy*

1 Introduction

Since the Declaration of the United Nations Conference on the Human Environment at Stockhom in 1972, education has been formally recognised on an international level for playing an essential role for fostering environmental protection and conservation (UNEP, 1972). This led to the development of environmental education (ED) at various universities in the 1970s and 1980s (Wu & Shen, 2016: 633). In 1987, the Brundtland Commission in *Our Common Future* report clearly defined sustainability as 'satisfying the needs of present without compromising the ability of future generations to meet their own needs' (Brundtland Commission, 1987). Apart from the previous concern for environmental protection, the Brundtland Commission highlighted the importance of the other two pillars of sustainability: social equity and economic development. After the release of *Our Common Future* report, the concept of sustainable development (SD) and its principles have been adopted by some higher education institutions, which responded to various declarations, such as the Talloires Declaration in 1990 (Lozano, 2006; 2013), and the implementation of campus greening and other sustainable and ecological initiatives in universities (Wood & Cornforth, 2016: 344). However, those non-binding declarations might not lead to a significant change in university's sustainability practices (Bekessy et al., 2007). Therefore, Wals and Blewitt (2010) called for the third-wave sustainability in higher education, requiring for a re-orientation of the curriculum and pedagogy for sustainability as well as an integration of sustainability within and across tertiary curricula.

Although the term SD has been widely used after the Brundtland Commission report published in 1987, sustainability education may merely be perceived from the environmental sustainability aspect (Lozano, 2006: 787). Due to the complex nature of sustainability, it is still an issue to overcome the dominance of traditional single-discipline based teaching approach (Howelett & Ferreira, 2016: 310). How to transform the pedagogy for enabling students to respond to the interconnected social, economic and environmental sustainability through an interdisciplinary model is a challenge. Such challenge is also valid for teaching sustainability in the built environment, involving the social practice of the users, economic viability and the impact to the natural environment. Facing the challenges of global warming and the staggering increase in energy prices, developing a net zero energy and greenhouse gas (GHG) emission sustainable houses has become a pressing issue.

The United Nations Educational, Scientific and Cultural Organisation (UNESCO) promoted Education for sustainable development (ESD) through the United Nations Decade of Education for Sustainable Development (DESD) from 2005 to 2014 (UNESCO, 2005). A key document for DESD is *Education for Sustainable Development: An Expert Review of Processes and Learning*, which identifies the following four key learning processes for the education for sustainable development (UNESCO, 2011):

Processes of collaboration and dialogue: Sustainability issues cannot be adequately addressed or understood without a primary recognition of interdisciplinary collaboration among multi-stakeholders (Jones et al., 2010: 20). Complex problems have to be tackled beyond the scope of any discipline (Klein, 1990: 11). However, if multiple perspectives are merely presented without any integration of disciplinary knowledge, this will only lead to multidisciplinarity rather than real interdisciplinarity (Spelt et al., 2009: 366). Therefore, during group collaboration, students from diverse background are encouraged to share their respective cultural knowledge and personal experiences, which can contribute to a better understanding of the integrative nature of sustainability through intercultural dialogue (Ivanitskaya et al., 2002).

Processes which engage 'the whole system': The term 'whole system' was used by UNESCO to highlight the importance of engagment with a complex web of relationship through systems thinking (Johnston, 2012: 220). Therefore, real-world learning experiences are very important in sustainability education (Brundiers et al., 2010). Bringing real-world issues into the classroom can draw students' awareness of the complexity of the whole system and equip themselves the capabilities to formulate corresponding strategies, which can enable them to respond to the ever faster changing professional environment (Barth, 2014: 118). The learning-by-doing approach encourages students to tackle the respective issues on their own through problem-solving rather than the absorption of content knowledge (Steinemann, 2003).

Processes which innovate curriculum as well as teaching and learning experiences: In addition to integrate real-world learning opportunities into the sustainability program, experiential pedagogy is promoted as a crucial component of an innovative curriculum (Sipos, 2008). Two-way communication is highly recommended to counteract the risk of tutors taking an authoritarian role in the learning process (Cotton, 2010: 46).

Processes of active and participatory learning: The learning process should be problem driven and project oriented, so students have freedom to identify which key issues and objectives they want to address, which trigger their motivations to be actively involved (Barth, 2014: 95). Applying knowledge to address sustainability problems requires students to ask critical questions (Brundiers et al., 2010: 312). Critical thinking skills is essential for understanding the complexity of sustainability and stimulates students for self-reflection and evaluation of assumed norms (Scott and Gough, 2003).

In this paper, the ZEMCH Sustainable Design Workshop delivered at the University of Melbourne in 2016 was used as a case study to examine whether it could fulfil the above-mentioned four key learning processes of education for sustainable development promoted by the UNESCO.

2 ZEMCH Sustainable Design Workshop

ZEMCH stands for 'zero energy mass custom home' which emphasises the idea of mass customisation by combining the notions of mass production and customisation together. The aim of ZEMCH is to raise the level of social sustainability for accommodating users' individual needs, and at the same time, reiterates the importance of affordability in view of economic sustainability, and zero energy or net carbon neutral towards environmental sustainability (Noguchi, 2016: v-vi).

The ZEMCH Workshop was initially held in Brazil in 2014 as a pilot project, followed by two subsequent workshops in 2015 and 2016 respectively. All of them focused on social housing development in Brazil (Yokota et al., 2016). After gaining the experience of delivering the workshops in Brazil in three consecutive years (2014-2016), the ZEMCH Sustainable Design Workshop was firstly taught at the University of Melbourne in 2016 and the theme of the workshop was related to private housing development in Melbourne. Melbourne has been ranked as the world's most liveable city by the Economist Intelligence Unit since 2011 and has been increasingly attracting people from all over the world to come for living, working and studying (The Economist Intelligence

Unit, 2016). Under the influx of immigrants and the impact of population growth, there is a significant housing demand in Melbourne. According to the statistics, Greater Melbourne's population grew by 182,538 people over the two years (2014-2015) requiring a total of 70,207 dwellings or 35,103 dwellings per annum (Pressley, 2016). However, there are some housing issues to be overcome, including affordability, diversity of choices and environmental performance (City of Melbourne, 2013:7). Therefore, the provision of customised quality housing at reasonable prices to suit the diverse needs of end users is critical.

The ZEMCH Sustainable Design Workshop was a five-day intensive workshop coursework offered for postgraduate students from architectural, engineering and construction disciplines at The University of Melbourne. This intensive workshop took place during the non-teaching period to avoid potential time clash and to serve as a complement to other postgraduate subjects.

A total of sixteen postgraduate students attended the workshop and they were divided into four groups: Groups A, B, C and D. The workshop activities were allocated into three categories: pre-workshop period, workshop and post workshop period.

During the pre-workshop period, students were recommended to study the textbook, *ZEMCH: Toward the Delivery of Zero Energy Mass Custom Homes* (2016) before attending the intensive workshop. The required pre-reading helped students to obtain basic knowledge regarding the ZEMCH principles.

The scope of the five-day intensive workshop was divided into five main phases: 1) theoretical basis, 2) industry engagement and site visit, 3) function analysis and evaluation criteria scoring matrix, 4) housing prototype development, as well as 5) final presentation. On the first day of the workshop, the subject coordinators and tutors delivered introductory lectures for students and provided software trainings on energy and environmental design simulation. For enhancing industry engagement, housing manufacturers were invited to deliver lectures about current industry practice and site visit was arranged for students. After site visit, the function analysis and evaluation criteria scoring matrix were explained. After that, students in each group started to use the knowledge gained and digital skills learnt to develop housing prototypes. On Day Five, students presented their final work in groups which marked the end of the intensive workshop.

At the end of the semester, students were required to participate in a two-hour written examination as a post-workshop requirement. Figure 1 illustrates the intensive workshop framework.

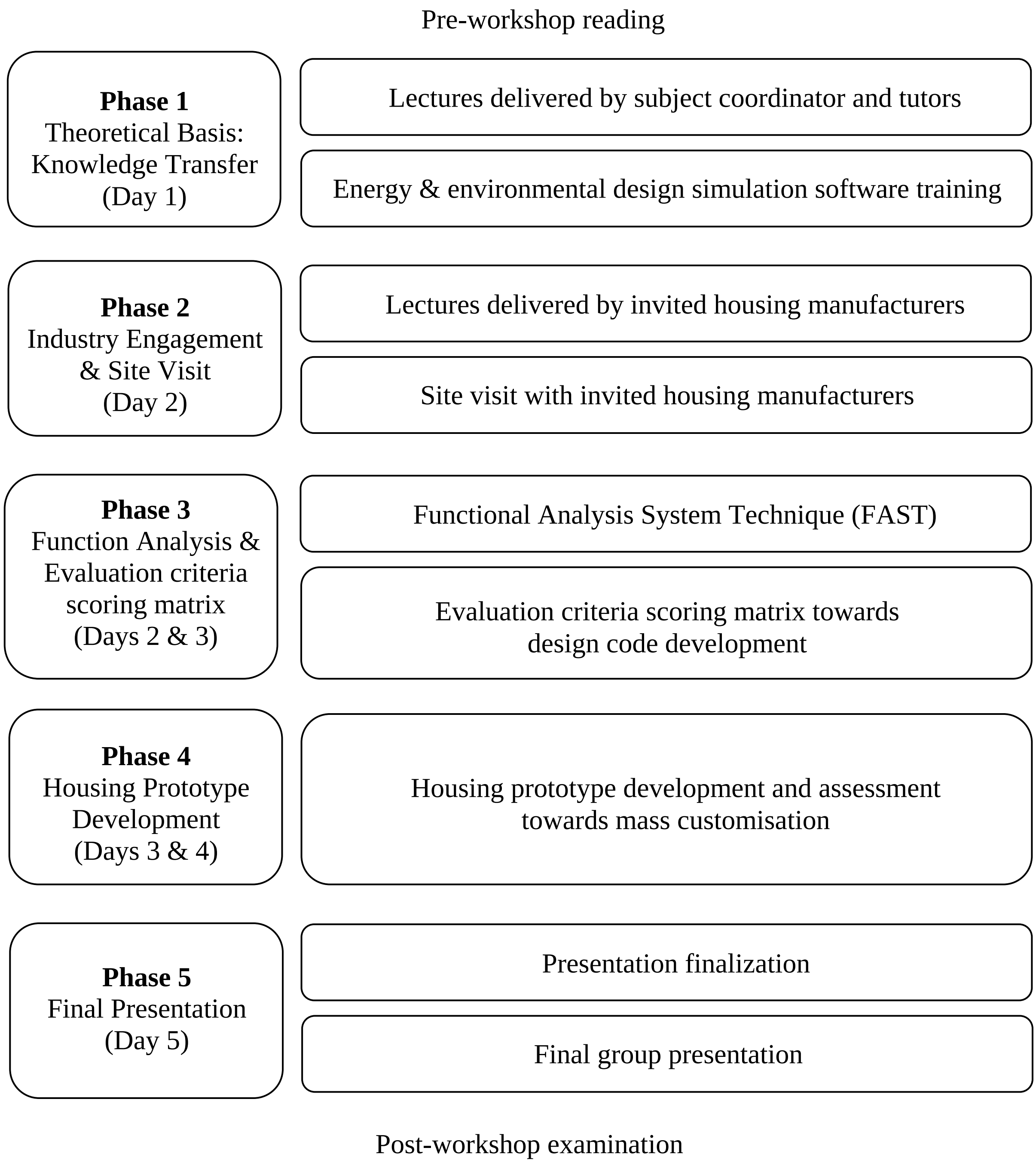

Figure 1: Phases and activities of the ZEMCH Sustainable Design Workshop

In Phase One, technical design knowledge required for the delivery of zero energy mass custom homes was transferred. The ZEMCH concept was introduced and design stimulation training for software, such as HOT 2000, RETScreen, Ecotect and Groundhog was provided to equip students the relevant digital skills for analysing environmental and energy implications.

Two industry partners, MARA Studio and Misawa Homes Australia, were invited to share their practical experiences in mass customised house design and production with students in Phase Two. They further engaged with students during the site visit and subsequent dialogue sessions. The south lawn, located within the campus of the University of Melbourne, was selected as the site for exploration and design development during the workshop. Students were encouraged to carefully observe existing site conditions for preparing subsequent site analysis. After the site visit, students were divided into four groups (Groups A to D) with four students in each group. In each group, there was a mix of domestic and international students.

At the beginning of Phase Three, students brainstormed with their groupmates the main objectives they would like to handle and how the objectives might be accomplished. Using the Function Analysis Systems Technique (FAST), different functions were properly described, identified and categorised (Wixson, 1999). Firstly, each function was written on a small post-it pad for sticking it onto a large piece of paper for developing the FAST Diagram. The FAST Diagram is basically a graphical representation showing the logical relationships between various functions based on the questions of “why” and “how”, illustrating the reasons behind and the ways of implementation (Figure 3). The main objective was written on the far left of the diagram followed by various dependant functions. Secondly, through the evaluation of the values of different functions, the positions of post-it pads would be re-arranged in terms of their importance. Functions with higher order were located near the left, whereas functions with lower order were located to the right. Finally, during the re-arrangement process, two main questions to be considered were: “why is such function necessary?” and “how is the function performed?” (Figures 2 & 3). Therefore, some functions identified on the FAST Diagram were then selected for preparing the Evaluation Criteria Scoring Matrix. Each evaluation criterion was compared with each other in pairs and three levels of importance were defined as weighting criteria: 1) high, 2) average, 3) low. The total scores in terms of points and equivalent weight in terms of percentage were then calculated. The weighting proportion of different criteria was useful for the subsequent development of the design code, which defined the hierarchy of the functions according to its order of importance (Figure 4). The FAST Diagram and the Evaluation Criteria Scoring Matrix were crucial elements of the workshop highlighting the underlying principle of mass customisation.

In Phase Four, students referred to their priorities according to the FAST diagram and the Evaluation Criteria Scoring Matrix results to develop housing prototypes towards their defined objectives. Previous site visit and analysis were highly relevant for understanding the site configuration, generating the master plans and exploring design solutions. Students also applied software stimulations for environmental and energy analysis.

At the final phase of the workshop, students completed their designs and prepared for final presentations. Each group was required to prepare and deliver a poster (Figure 5) and an oral presentation to summarise their analysis and design outcomes. Industry partners and other external critics were invited to attend the final presentation session for providing feedback and assessing students’ performance.

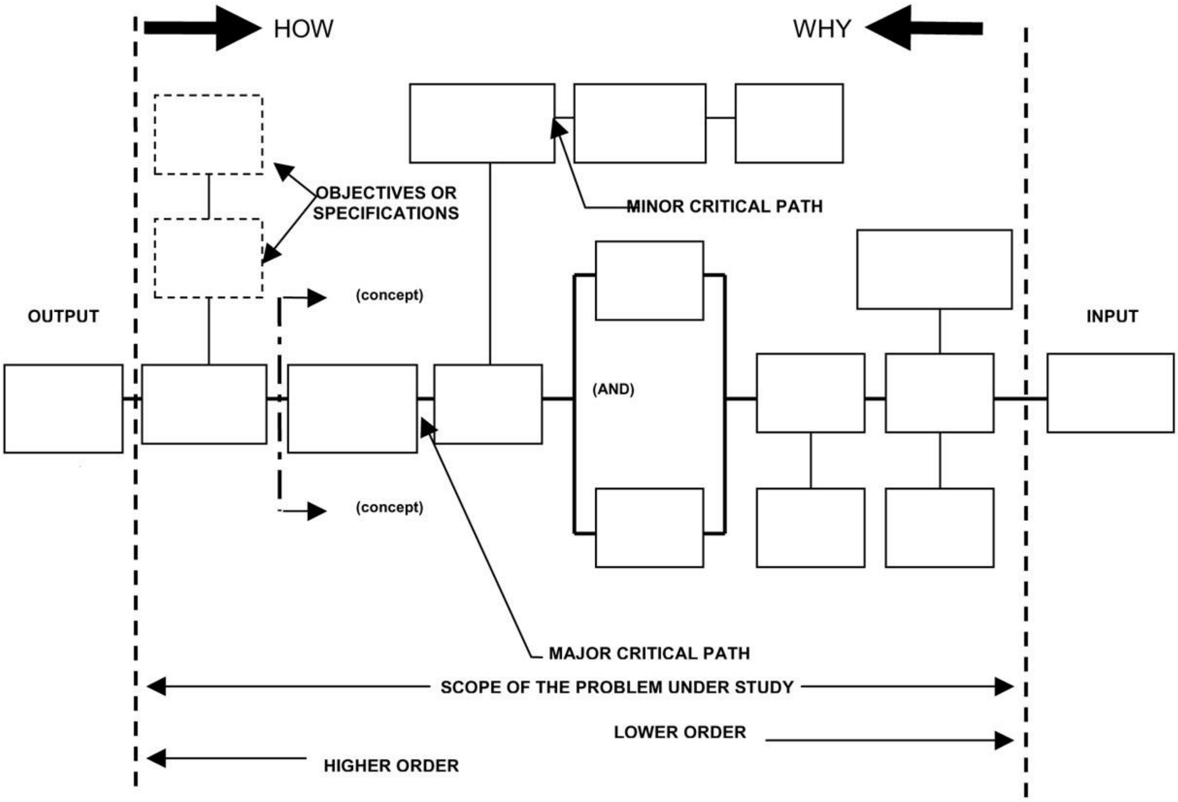

Figure 2: The schematic FAST Diagram (Wixson, 1999)

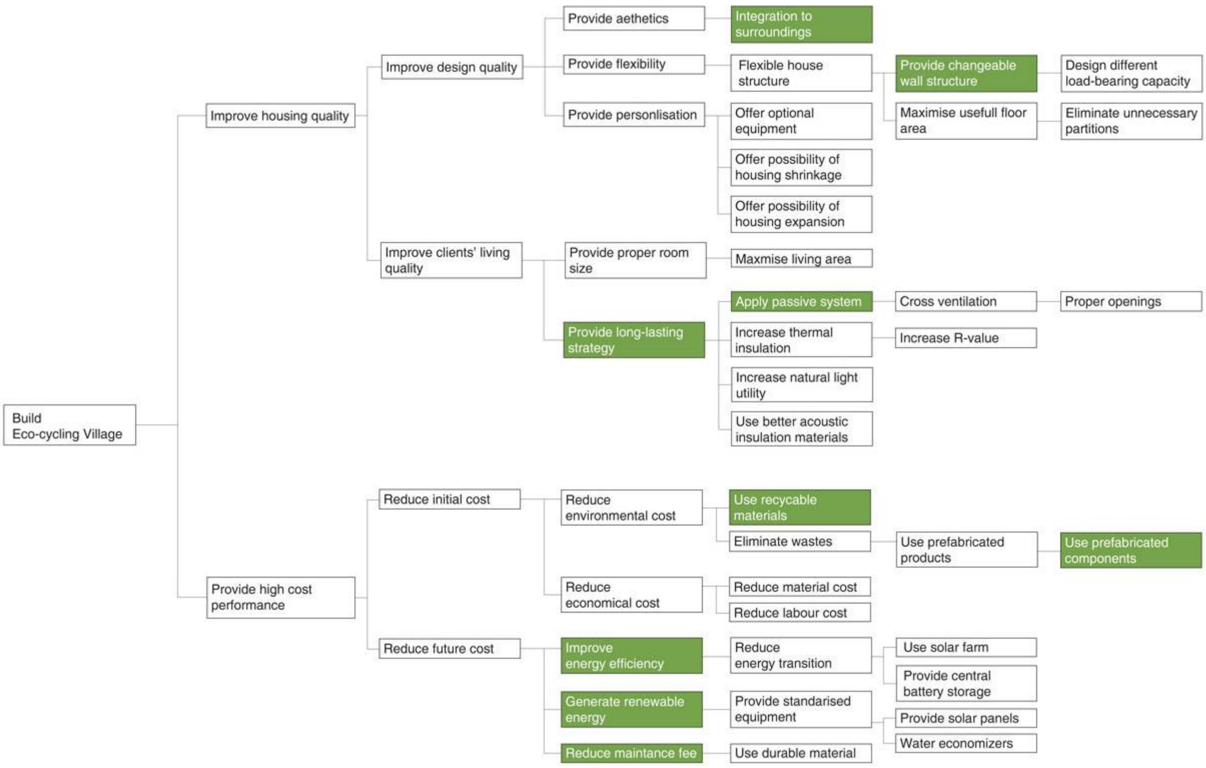

Figure 3: FAST Diagram prepared by Group A

A	B	C	D	E	F	G	H	I	J	Factors	Individual Scores	Weight (%)
	B_2	C_1	A_2	E_3	F_3	G_1	A_2	I_1	A_1	Natural Surroundings	5	6
		C_1	B_2	E_1	B_2	G_2	B_3	I_1	B_2	Passive Heating and Cooling	11	14
			C_3	C_1	C_1	C_2	C_3	C_1	C_2	Power Generation	16	20
				E_3	F_2	G_2	D_2	I_2	D_1	Food Generation	3	4
					E_1	E_1	E_2	E_1	E_2	Reduction of Building Costs	14	18
						G_1	F_2	I_1	F_2	Sustainable Material Selection	9	11
							G_3	I_1	G_2	Energy Efficient Services	11	10
								I_3	J_2	Reduction of Waste	0	0
									I_2	Glazing	11	14
										Rain Water Harvesting	2	3
										Total	82	100

Importance
1 Minor
2 Moderate
3 Major

Figure 4: Evaluation Criteria Scoring Matrix prepared by Group B

Figure 5: Presentation posters prepared by Group C (left) and Group D (right)

3 Results and Discussions: The four key learning processes for the education for sustainable development

The four key learning processes for the education for sustainable development listed in UNESCO's document, *Education for Sustainable Development: An Expert Review of Processes and Learning* were covered in the ZEMCH Sustainable Design Workshop as explained below:

3.1 Collaboration and Dialogue

Collaborative learning approach was emphasised in the ZEMCH Sustainable Design Workshop. Through a series of group discussions, students could freely share their opinions and listen to others' views. Different ideas and thoughts were not simply tolerated but in fact appreciated. This process was valuable for students to develop their interpersonal skills and learn how to implement a collaborative process and work in teams. As the Design Workshop lasted only for five days, how to bring different opinions together and work effectively within the limited time frame became challenges for students to ensure timely delivery of design outcomes. On the basis of collaborative experiences, a range of perspectives among students were encouraged to be expressed towards a consensus of having a shared group understanding towards sustainable development. Interdisciplinary collaboration was further enriched by cross-cultural dialogues due to the significant proportion of international students coming from various countries at the University of Melbourne.

3.2 Engaging the Whole System

Students were required to develop strategies to address the issues of social, economic and environmental sustainability holistically. In the ZEMCH Sustainable Design Workshop, the FAST Diagram could facilitate students to identify their main objectives and to propose possible solutions to tackle identified issues in a systematic manner. The inter-relationship between causes and actions could be visually represented by the FAST Diagram. The Evaluation Criteria Scoring Matrix was also helpful for students to handle complex issues and compare the level of importance of various factors.

The challenges of the ZEMCH Sustainable Design Workshop were to accommodate users' individual housing needs at reasonable prices with zero energy consumption. For students to have a better understanding of the real-world situation, industry partners outside academia were involved in the learning process for sharing their hands-on experiences and current practices. Interaction with industry partners could enable students to have a more comprehensive understanding of the issues at stake from various perspectives and learn how to engage with different stakeholders. Through the exposure to realistic contexts, students could learn how to link theory to action and how to apply their knowledge to develop practical but innovative solutions to cope with society's challenging and pressing problems.

3.3 Innovative Curriculum

The innovative curriculum learning process was achieved through site visits which provided students with first-hand experience to perceive the characteristics of site conditions in person. Subject coordinator, tutors and industry partners were also involved in the site visit for having more interaction with students. Besides collecting physical environmental parameters, students could have a variety of spatial experiences, including the atmosphere of the place, scale and proportion, materiality and colour, as well as subjective visual and tactile perception. During the site visit, students recorded their personal observations by drawing sketches, taking photos and even videos. Those findings were important to inform their subsequent group design strategies.

Through the workshop, students were encouraged to think big and project sustainability visions. Alternative options could be explored against mainstream conventions towards a sustainable and desirable future. For achieving the desired outcomes, students were required to unfold an open-ended exploration for alternative possibilities and to formulate practical strategies to implement sustainability ideas to deal with the changing needs of our society.

A series of peer review activities were organised throughout the whole learning process. Students were required to present their work in teams and encourage to raise queries to other groups' presentations. Tutors actively participated in providing feedback to students after presentations for setting up the discussion atmosphere in the classroom, which could enable students to experience the dynamics of communication and gain confidence in expressing their ideas.

3.4 Active and Participatory Learning

Active and participatory learning was reinforced in the ZEMCH Sustainable Design Workshop through problem-solving approach. Under an inquiry-based model, students were expected to intensively participate in the workshop and take the initiative to find relevant information. Apart from collecting data, students were required to negotiate and reach consensus among their group members, especially with different personalities and conflicting positions. During the process, students could examine their underpinning beliefs and clarify their own values. After defining their objectives, students were required to share the workload among themselves. Since the number of students in each group was caped at the maximum of four, so each student had the responsibility to contribute his or her effort as a key player and tackle identified issues collectively. Such participatory learning approach could cultivate students self-directed learning interests and stimulate students' motivation towards lifelong study interest on sustainability development.

4 Conclusion

This paper demonstrates that the ZEMCH Sustainable Design Workshop delivered at the University of Melbourne is in line with the four key learning processes established by the United Nations Decade of Education for Sustainable Development and shows how the four key learning processes were implemented in the workshop.

Students' feedback about this workshop was collected through Subject Experience Survey (SES) at the end of the semester. Over 80% of students agreed or strongly agreed that the workshop was intellectually stimulating and the assessment tasks were useful in guiding their studies. Having said that, some students raised the areas of improvement, such as the time dedicated to software training could be longer and more practical exercises could be provided to enable them to master the skills before applying the skills to the group work.

After delivering the ZEMCH Sustainable Design Workshops in Brazil and Melbourne, such pedagogy can be applicable elsewhere and the program can be replicable at other institutions within the ZEMCH Network worldwide and beyond.

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