THE PROCEEDINGS OF

The Malaysian Architectural Education Conference

the FUTURE of ARCHITECTURAL EDUCATION

MAEC 2012

MALAYSIAN ARCHITECTURAL EDUCATION CONFERENCE

FACULTY OF DESIGN AND ARCHITECTURE
UNIVERSITI PUTRA MALAYSIA

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Foreword From Chairman COHAS

The Council of Head of Architecture Schools (COHAS) was formed in 2006. It is a coalition of seven Malaysian public Higher Education Institutions (HEIs) that offer architectural programs namely Universiti Teknologi Malaysia (UTM), Universiti Teknologi MARA UiTM), Universiti Sains Malaysia (USM), Universiti Malaya (UM), Universiti Putra Malaysia (UPM), Universiti Islam Antarabangsa Malaysia (UIAM) and Universiti Kebangsaan Malaysia (UKM). COHAS is an entity recognised by the Board of Architects Malaysia (LAM) and the Ministry of Higher Education (MOHE). Its main objectives are to spearhead the development of, and to promote excellence in, architectural education, as well as to coordinate architectural academic activities among the public HEIs.

Architectural education in Malaysia began in 1925 with the setting-up of a Technical College. It later became the foundation to architectural degree program which was introduced in 1967. Besides the seven public HEIs, several private HEIs also started to offer architectural degree programs. At the same time, Polytechnics and College Communities also began to offer architectural education at diploma and certificate levels.

With the flourishing of architectural programs in Malaysia, COHAS has successfully conducted a research and published its findings and recommendations in a technical report, titled *The Direction of Architectural Education in Malaysia in 2011*. It is part of an agenda to strengthen and transform the architectural education in Malaysia in order to be competitive in the global market. It is proud to acknowledge that the research was made possible through financial support from the MOHE.

And today, after 87 years of architectural education in Malaysia, COHAS welcomes educators, scholars, academicians and practitioners to the Malaysian Architectural Education Conference (MAEC) 2012 to present their views, debate current modes, and investigate possible new directions in architectural education in Malaysia.

Heartiest congratulations and thank you to the Department of Architecture, Faculty of Design and Architecture, UPM for organising the inaugural MAEC 2012.

Assoc. Prof. Ar. Meor Mohammad Fared
Chairman of COHAS
Head, Department of Architecture
Faculty of Design & Architecture
Universiti Putra Malaysia

Foreword From Chairman MAEC 2012

With multiple factors that pose unprecedented challenges to architectural profession, and the ongoing debates on the appropriateness and relevancy of current architectural pedagogy, it is expected that architectural education in Malaysia will be required to shift towards new directions. The future of architectural education will see a continuing challenge to integrate a critical understanding and approach to the issues and events that will most likely to impact society, architecture and ourselves.

The Malaysian Architectural Education Conference (MAEC) 2012 is a national forum that aims to address these challenges by:

- Bringing together stakeholders from universities, industry and government that are involved in the architectural education;
- Fostering communication and interaction among academics, professionals, researchers, and policy-makers within this sector;
- Reporting on current research and progress, and;
- Identify future opportunities in the fields of architectural profession and education.

Our international keynote speakers Prof. Dr. Ashraf M. Salama from the Qatar University and Ar. Zulhemlee An from the Malaysian Institute of Architects (PAM) have backgrounds in practice, academia and government and focus on design, practice and research.

MAEC2012 is the first architectural education conference initiated by the Council of Heads of Architecture Schools (COHAS). On behalf of the Organising Committee of MAEC2012, I wish to gratefully acknowledge the support of sponsors who made the conference possible: Prestariang Berhad, The Ministry of Higher Education and the Malaysian Institute of Architects. To the Organising Committee, a special thank you for your dedication and commitment to see this conference through.

It is my pleasure to welcome all delegates to UPM for MAEC2012 and I sincerely hope MAEC2012 will be a start of more in-depth discourse on architectural education in Malaysia.

Dr. Zalina Shari
Chairman, MAEC2012

KEYNOTE PAPERS

BEYOND THE CONSUMPTION OF KNOWLEDGE: QUESTIONING OF ANDQUESTING FOR FUTURE FORMS OF PEDAGOGY IN ARCHITECTURAL EDUCATION

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Abstract
This paper responds to some of the negative tendencies that continue to characterize the delivery of knowledge in architectural education. It accentuates the shift from mechanistic pedagogy to systematic pedagogy and outlines the characteristics of each. Building on critical pedagogy and the hidden curriculum concept transformative pedagogy is introduced as a form of pedagogy that can be interweaved into conventional teaching practices. Translating the premises underlying these pedagogies and building on the author's earlier work on design studio pedagogy and the teaching practices involved, a theory that explores the integration of knowledge in architectural design education is articulated. The paper demonstrates how the theory and its underlying components and mechanisms can be applied to both lecture-based courses and design studio sittings. In an attempt to address the challenges architectural education should encounter, the implementation of the theory would offer students multiple learning opportunities while fostering their capabilities to shift from passive listeners to active learners, from knowledge consumers to knowledge producers, while positioning themselves in a challenging future professional world.

Keywords: *architectural education, systemic pedagogy, transformative pedagogy, knowledge integration, transdisciplinarity.*

1. INTRODUCTION

If architecture is created in a field of tension between reason, emotion and intuition, then architectural education should be viewed as training toward the manifestation of the ability to conceptualize, coordinate, and execute the idea of building. This act must furthermore be rooted in humane tradition. However, this mandates a comprehensive understanding of the role of knowledge in architecture while comprehending how to integrate different modes of knowledge production.
This understanding is coupled with the phenomenal and continuous changes that we are currently witnessing. Some of these include: transformations in the structure of contemporary societies, the sustained crises in housing and squatter settlements, the continuous deterioration of the built heritage, the rising complexity of large structures and new building types, the recent interest in environmental conservation and protection, and the global condition many cities are confronting.
While these phenomena continue to exist, demands for multiple types of knowledge are clearly on the rise: knowledge of how to create better environments for poor societies; knowledge of how to involve people affected by design and planning decisions in the process of making those decisions; knowledge of how to protect the built heritage; knowledge of how to design environments that do not compete with but complement nature; knowledge of how to deal with problems associated with special populations that form major parcels of contemporary societies such as children, seniors, the disabled, and the poor; knowledge that responds to socioeconomic and socio-political issues; and knowledge that responds to advances in building and telecommunication technologies. In essence, architecture as an intricate discipline and the complexity of knowledge required for successful practice mandate a new thinking about architectural education and design pedagogy.

2. UNDESIRABLE TENDENCIES IN ARCHITECTURAL EDUCATION

Critical to the introduction of a theory for integrating knowledge in architectural education is an analysis of the underlying reasons for developing it. Building on earlier surveys and studies (Salama, 1995; Salama, 2005), the reasons for introducing a new theory can be revealed in the form of undesirable tendencies in education practices.

2.1. Admission policies and the skills emphasis syndrome

Results of examining over 120 schools of architecture worldwide indicate that some admission criteria are more dominant than others. There is a sustained emphasis on the skills needed for enrolment, while knowledge and critical thinking abilities of applicants as they relate to architecture appear to take a back seat. By and large, admission policies reflect the tendencies of most schools to emphasize skills in drawing and form manipulation, an aspect of architectural

education that continues to characterize it throughout the duration of study at the expense of other pedagogical aspects and learning outcomes. (Goldschmidt et al, 2000; Salama, 2005).

2.2. Idiosyncrasies on knowledge delivery and acquisition

While architectural educators strive to impart the requisite knowledge necessary for successful practice, the way knowledge is transmitted has significant professional and social implications (Salama 1998). Concomitantly, there is an urgent need to confront issues that pertain to the nature of reality ("what") and the way in which knowledge about that reality is conveyed to our budding professionals ("how").Traditional teaching practices suggest that gaps exist between "what" and "how". These gaps are best described as: a) Science as a body of knowledge versus science as a method of exploration, b) Learning theories about the phenomena versus getting the feel of the behaviour of the phenomena, and c) The real versus the hypothetical.

2.3. Research findings on design studio teaching practices

A considerable number of design instructors view architecture as an art of making, not as an act of making. Therefore, developing communication and form manipulation skills appears to be a priority for many. This supports the argument that creativity is defined in terms of creating, inventing, and manipulating formal configurations. Creativity in this sense is limited to only intuition and talent. On the one hand, drawing skills appear to be the most important ability that determines a student's performance as ranked by the majority of instructors surveyed. This fosters an earlier hypothesis that many architectural educators focus on issues important to an audience of fellow architects (Salama and Wilkinson, 2007) and to this audience only (Cuff, 1991), rather than focusing on issues important to their clients and responsive to users' needs.

3. QUESTING FOR FUTURE FORMS OF PEDAGOGY

3.1. From mechanistic to systemic pedagogies

There is strong evidence that a shift in architectural education does exist (Boyer and Mitgang, 1996; Nicol and Pilling, 2000; Salingaros and Masden, 2010; Sanoff, 2003). Such a shift is best expressed from 'mechanistic' to 'systemic' pedagogy. Following the mechanistic mode, the process of educating future professionals is reduced to a large number of disconnected components. Education in architecture is decomposed into schools, curricula, design studios, grades, subjects, modules, courses, lectures, lessons, and exercises. It has not been treated as a whole, nor has it been appropriately conceptualized as part of a process much of which takes place within society; a characteristic of the systemic pedagogy.

The mechanistic orientation of pedagogy results in the treatment of students as if they were machines with the combined properties and characteristics of recorders, cameras, DVD players, and computers. The student is evaluated with respect to his/ her ability to reproduce what he/ she has been told or shown (Ackoff, 1974). In turn, examinations are tests of the ability to reproduce material previously presented to the examined. They are designed to serve the system's purposes rather than the students' needs. In the mechanistic mode, educators make little effort to relate the pieces of information they dispense. In most cases, a course or module in one subject does not refer to the content of another. This emphasizes the notion that knowledge is made up of many unrelated parts, and thereby emphasis is placed on hypothetical assignments rather than real-life issues. Contrariwise, the systemic mode focuses on grasping the relationships between different parts of bodies of knowledge.

In systemic pedagogy alternative concepts are introduced and can be exemplified as follows: some subjects are best learned by teaching them to oneself, some subjects are best learned by teaching them to others, some skills are best learned through demonstration and instruction, and some fundamentals are attained in seminar discussions guided by one specialized in the relevant area. I argue that while the mechanistic mode still prevails in most higher education institutions worldwide, current discussions reveal that there are strong moves toward adopting systemic pedagogy (Salama, 2009). Yet, the objective here is not to replace the mainstream modes of knowledge transmission and knowledge construction, but to complement them in an effective manner.

3.2. Transformative pedagogy—A potential for architectural education

Transformative pedagogy is regarded as mechanism for addressing the gaps of 'what' and 'how.' It refers to the interactional processes and dialogues between educators and students that invigorate the collaborative creation and distribution of power in the learning setting. As a concept, it is based on the fact that the interaction between educators and students reflects and fosters the broader societal pattern (Nagda, Gurin, and Lopez, 2003). Transformative pedagogy in architectural education is about harmonizing the act of creating ideas and solutions with the social and environmental responsibilities that should be embedded in this act. While it is not confined to a

static definition, it builds on the perspectives of critical pedagogy and its underlying hidden curriculum concept.

Critical pedagogy aims at reconfiguring the traditional student/teacher relationship, where the teacher is the active agent—the knowledge provider—and the students are the passive recipients of the teacher's knowledge. Grounded on the experiences of both students and teachers new knowledge is produced through the dialogical process of learning. Pauolo Freire, the initiator of the concept, heavily endorses students' ability to think critically about their educational situation; this way of thinking allows them to "*recognize connections between their individual problems and experiences and the social contexts in which they are embedded.*"(Freire, 1970). In essence, critical pedagogy is viewed as an approach to teaching, which attempts to help students to question and challenge domination, and the beliefs and practices that dominate. The hidden curriculum concept is thus concerned with questions that pertain to the ideology of knowledge and the social practices that structure the experiences of educators and students. It places emphasis on those unstated values, norms and attitudes that stem tacitly from the social relations of the learning setting (Dutton, 1991).

Pedagogues assert that these practices are equally as influential as any structured curriculum. Therefore, adopting transformative pedagogy can help educators interpret the relationship between knowledge and power, between themselves and their students. The premise in this context is that knowledge in any educational setting always reinforces certain ideologies, values, and assumptions about the real world so as to sustain the interests of some groups and their values at the expense of others (Cranton, 1994). In this respect, one must admit that educational settings—whether studios, laboratories, lecture halls, or classrooms—are not neutral sites; they are integral to social, cultural, and political relations that can be found in real life.

The preceding discussion suggests that transformative pedagogy is a form of critical pedagogy and is about understanding how knowledge is produced, what the components of such knowledge are, and what are the learning processes and social practices that can be used to transmit it. It is centred on critical inquiry and knowledge acquisition, assimilation, and production in a manner that encourages students and educators to critically examine traditional assumptions and to encounter social and environmental issues.

4. A THEORY BEYOND THE CONSUMPTION OF KNOWLEDGE

A theory for knowledge integration suggests a different form of thinking that goes beyond typical discussions of modifying architecture curricula, or massaging studio pedagogy and the teaching/learning processes involved. Here, I argue for a comprehensive theory that encompasses a number of underlying theories and concepts derived from other fields, and these differ dramatically from architecture by including the philosophy of science and cognitive psychology. The theory is metaphorically conceived in terms of a triad consisting of three major components: the disciplinary component; the cognitive-philosophical component, and the inquiry-epistemic component (Fig 1). Each of these components encompasses other smaller components integral to the building of the theory itself. Notably, the three components address ways in which knowledge can be integrated, how the desired integration would meet the capacity of the human mind, how such an integration relates to the nature of knowledge, and how knowledge about it is acquired, conveyed, and assimilated.

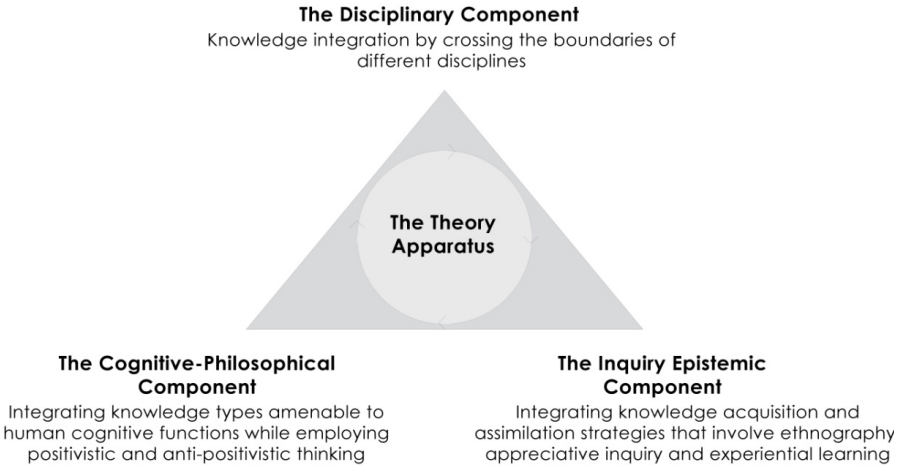

Fig. 1. Components of a theory for integrating knowledge in architectural education (Salama 2008, 2009)

4.1. The disciplinary component: Beyond mono-disciplinarity

Theorists and practitioners have been discussing the issue of architectural knowledge for several decades. Recent years, however, have witnessed intensive debates in built environment literature. Educators agree that there is a high demand for knowledge in architecture. It is argued that: "T*he discipline of architecture needs a rigorous knowledge base by which to support its premises and principles that define the relationship between human and community health, and between building and urban design."* (Boyer and Mitgang, 1996; 66).

Transdisciplinary knowledge entails making linkages not only across boundaries of disciplines, but also between theoretical development and professional practice, addressing real world problems and contributing to their solution. As a practice-oriented approach, it is not limited to a closed circle of scientific experts, professional journals and academic departments where knowledge is produced. Through mutual learning, the knowledge of all participants (from different disciplines) is enhanced, including local knowledge, scientific knowledge and the knowledge of concerned industries, and non-governmental organizations (Nowotny, 2004).

To date, the development of rigorous knowledge has been at the edge of the profession and frequently marginalized as something separate from the profession of architecture, that is: environment-behaviour studies, building sciences, environment-technology studies, etc. As a result, most practitioners are not well equipped or even interested in understanding the value of their professional services. Consequently, the standing of the profession is marginalized in the eyes of the public. I argue here that without research, scholarship and a rigorous knowledge base, the profession cannot take stand on significant health, economic, social, political or ethical issues.

4.2. The cognitive-philosophical component

Integral to the cognitive philosophical component is the way in which we approach designing built environment based on our capacity as humans, and based on the nature of knowledge about the realities we encounter. Therefore, this component is structured in three sub-theories or concepts outlined below:

4.2.1.The split-brain theory

Mind research provides insights into the understanding that we possess two different but complementary ways of processing information. A linear step-by-step process analyzes the parts that make up a pattern, working on the left side of the brain; and a spatial relational style seeks and constructs patterns, working on the right side of the brain (Williams, 1983, Salama, 1995; Salama, 2005). Both sides of the human brain perform cognitive operations, but each is developed or trained for a different mode of thinking. On the one hand, the left side is usually described as analytical, linear, and sequential, moving from one step to the next in a step-by-step manner. This way, it produces knowledge through inferential logic. For example, it deals with number, words, and parts. On the other hand, the right side of the brain is usually described as synthetic and holistic, constructing parts while recognizing their underlying relationships. It does not function linearly, but simultaneously, dealing with images, patterns and wholes. It produces knowledge through intuitive and imaginative understanding.

Linking the split-brain theory to knowledge integration in architectural pedagogy, I argue that architectural education is unique since it requires the full activation of the two sides. It encompasses courses that address bodies of knowledge that are rational, analytical and abstract in nature while implementing them into intuitive and imaginative design activities.

4.2.2. Psychological types and epistemological balance

The psychological types or the epistemological balance that Jung called for matches the concept underlying the split-brain theory (Jung, 1976, 1987). Within such a balance, it is postulated that people can feel, think, perceive, and imagine both as individuals and in groupings. However, it is conceived that some human functions tend to inhibit other functions. Thinking and feeling, perception and intuition, and introversion and extroversion block each other. Each function has its own particular area in which it performs well than in others. According to Stamp (1994), feeling excels at well-being and belonging, thinking excels at distinguishing one's physical surroundings, intuition excels at generating options, introversion produces personal view points, and extroversion enables people to share thoughts and ideas with others. This understanding would have strong implication on the way in which architectural curricula and their contents are structured, and also on the processes and procedures adopted in studio pedagogy.

4.2.3. Philosophical positions

There are two basic philosophies that can be conceived as the basis for understanding architecture and its education: positivism and anti-positivism. Derived from these philosophies, two positions are conceived based on ontology and epistemology. As defined by most dictionaries,

ontology is the branch of metaphysics that deals with the nature of being or reality, while epistemology is the branch of philosophy that examines the nature of knowledge, its foundation, extent, and validity. It examines the way in which knowledge about a phenomenon can be acquired and conveyed.
How these two positions are translated to a practical understanding in architectural education is a conceptual challenge. Positivism relating to ontology adopts the premise that objects of sense perception exist independent of the observer's mind. This means that reality is believed to be objective and available for observation by everyone. Relating to epistemolog, positivism views knowledge as being independent of the observer and as objectively verifiable. Mazumdar (1993) made a perceptive understanding and argued that positivists believe that the best way to learn about a phenomenon is by the discovery of universal laws and principles. In positivism, educators and students see a building as an objective reality with components and parts that everyone can observe, perceive and agree upon. Therefore, adopting the positivistic understanding results in an emphasis on the common properties of buildings or built environment leading to the suppression of multiple view points, thoughts and voices (Salama, 1999).
Reversibly, anti-positivism relating to ontology involves the conception that universal laws and principles do not exist of the observer's mind. This means that reality is perceived by people as individuals and as groups. In epistemological terms, anti-positivism adopts the understanding that individuals and groups acquire different types of knowledge about the same phenomenon. This leads to the conception that individual and group differences are regarded as valid and important mechanisms. Concomitantly, adopting the anti-positivistic view would result in an emphasis upon values, preferences, and lifestyles of people who use the built environment (Salama, 2009).

4.3. The inquiry-epistemic component

The inquiry-epistemic component addresses methods and tools by which knowledge is acquired. Integral to this component are three mechanisms indispensable to knowledge acquisition and assimilation for understanding the relationships between people and their environments, and for developing responsive architecture and planning schemes. These are ethnography, appreciative inquiry, and experiential and active learning.

4.3.1. Ethnography

Ethnography refers to the genre of writing that presents varying degrees of qualitative and quantitative description of social and behavioural phenomena as they relate to the built environment. The work of Hemmensely and Atkinson (1995) and Johnson (2000) reveals that ethnographic methodologies vary from the use of structured observations, to coding and statistical analysis. In essence, Ethnographic studies are based on the premise that any phenomenon and it underlying properties cannot be well understood independently of its context.
In architectural design education, ethnographic studies can be utilized in various forms, from the macro level (macro-ethnography) to the micro level (micro-ethnography). These address broadly or narrowly defined cultural groupings according to the scale of design or planning projects. These perspectives are important components that students need to understand, and their resulting knowledge needs to be incorporated in their design assignments.

4.3.2. Appreciative inquiry

Based on the belief that human systems are made and imagined by those who live and work within them, Appreciative Inquiry leads systems to move toward the generative and creative images that reside in their most positive core — their values, visions, achievements, and best practices (Watkins and Mohr, 2000). In theory, AI is a perspective, a set of principles and beliefs about how human systems function, a departure from the past metaphor of human systems as machines. In practice, AI can be used to co-create the transformative processes and practices appropriate to the culture of a particular organization. In essence, a culture of an organization represents the practices involved and the environment that accommodates them. Contrary to problem solving where the primary focus is on what is wrong or broken, AI focuses attention on what works in an organization and on its physical environment (Hammond, 1998).
Appreciative Inquiry can be applied in either classroom or studio settings. In classroom settings, students can be involved in a process of identifying positive aspects in specific environments or building types, and they can also perform various research assignments and Post Occupancy Evaluation (POE) studies. These represent a radical shift in the way in which POE evaluation studies typically aim at revealing problems. In studio settings, Appreciative Inquiry can be introduced in various pre-design assignments. That will involve participatory design activities ranging from identifying design and project imperatives involving users' representatives, to precedent studies that aim at unveiling positive aspects found in environments similar to the one they are designing.

4.3.3. Active and experiential learning

Contemporary education theorists are calling for moving away from thinking of students as passive listeners to active learners. However, this would seem "easier said than done." The major characteristic of active learning is that students are engaged in individual or group activities during the class session including reading, discussing, commenting, and exploring. While the students carry out these activities, the professor facilitates them, and students can receive immediate feedback (Bonwell, 1996). Notably, in active learning students are involved in higher-order thinking that simultaneously involves analysis, synthesis, and evaluation of a wide spectrum of issues and phenomena. In the context of the university classroom, active learning involves students in doing things and thinking about what they are doing. Theorists agree that students must talk about what they are learning, write about it, and relate it to past experiences.

Experiential learning is contrasted with learning in which the learner only reads about, hears about, talks about, writes about these realities but never comes in contact with them as part of the learning process. Mistakenly, some educators equate experiential learning only with "off campus" or "non-classroom" learning. However, in architectural pedagogy a class in history or theory of architecture might incorporate periods of student practice on theory exercises and critical thinking problems rather than consisting entirely of lectures about theories of architecture and the work of famous architects (O'Reilly, 1999; Salama et al., 2002). Similarly, a class in 'principles of architectural design' or in 'human-environment interactions' might involve critical analysis exercises on how people perceive and comprehend the built environment. Both classes might involve field visits to buildings and spaces where students are in close contact with the environment, exploring culture, diversity, people behaviour, and be part of that environment. All of these mechanisms involve an experiential learning component. Learning through experience involves not merely observing the phenomenon being studied but also doing something with it, such as testing its dynamics to learn more about it. Evaluation as a valuable research vehicle needs to be introduced both in lecture courses, establishing a knowledge base about the built environment that has the capability of endowing students with more control over their learning, knowledge acquisition, assimilation, and utilization in future experiences (Salama, 1999; Salama , 2007).

5. CONCLUSION: PREMEDITATED ADAPTATION OF THE THEORY

While certain aspects of any theory remain conceptual, the components of the theory can be implemented in various forms and at different levels through sound practices. There are a considerable number of practical scenarios that can be introduced in architectural and design pedagogy to employ the theorization proposed. While the disciplinary component aims at knowledge integration by crossing the boundaries of different disciplines involved in the successful creation of built environments, the cognitive-philosophical component endeavours to integrate knowledge types amenable to human cognitive function and the overall human capacity in thinking about or creating built environments. However, through ontological and epistemological thinking it attempts to address the nature of knowledge and the way in which knowledge about it is conveyed, acquired, and assimilated. The inquiry epistemic component targets the issue of knowledge integration by introducing knowledge and acquisition and assimilation strategies that involve ethnography, appreciative inquiry, and active and experiential learning. It is believed that these components go beyond the conventional practices that look at the creation of the built environment only in terms of intuition, imagination, and innate gifts and talents.

The disciplinary component can be accommodated at different levels that range from the knowledge delivery level, to studio level, to degree level (Fig. 2). At the knowledge delivery level, the typical approach is to offer students different bodies of knowledge in lectures while it is assumed that they will be able to implement them in studios. In this context, there is a clear separation between knowledge acquisition and knowledge application. Adopting the transdisciplinary approach may offer a panacea to this typical practice. This occurs by reconciling lectures and studios through the introduction of a "new setting" — an alternative to classroom and studio settings where bodies of knowledge are delivered by different teaching staff, while at the same time students apply what is delivered to them in specific design assignments facilitated by the same staff. Here, the content of knowledge is tailored to address the design tasks students are performing. Such a setting would enable the integration of different types of knowledge into specific design activities.

At the studio level, the transdisciplinary approach can be partially accommodated by introducing graduation thesis projects through transdisciplinary design studios, where students of different disciplines (planning/urban design, landscape architecture, architecture, industrial/product design, engineering, etc.) work in team projects. In this context, the challenge would be to identify projects and processes that can be controlled to meet such a specific pedagogic orientation.

It should be noted that studio processes in the preceding two scenarios need to address the cognitive-philosophical component: the integration of the logical/rational and the intuitive/imaginative capacities of students. As well, they should strike the balance required between different psychological types or cognitive functions introduced by Jung. In this regard, a studio process can be looked at in terms of two major phases: analytical understanding and creative decision-making. Each of these phases is constituted in a number of sub phases and procedures that range from exploration and definition of key issues, to precedent studies, information gathering and analysis, to the development of concepts and schematics.

At the degree level, crossing the boundaries between different disciplines can be accommodated in a transdisciplinary master degree in designing built environments. This would target graduate students and teaching staff from different disciplinary backgrounds. Sustainable planning, design, and development could be the major driver of a degree of this type. Still, the challenge would be to create transdiscplinary knowledge content that can be taught and implemented.

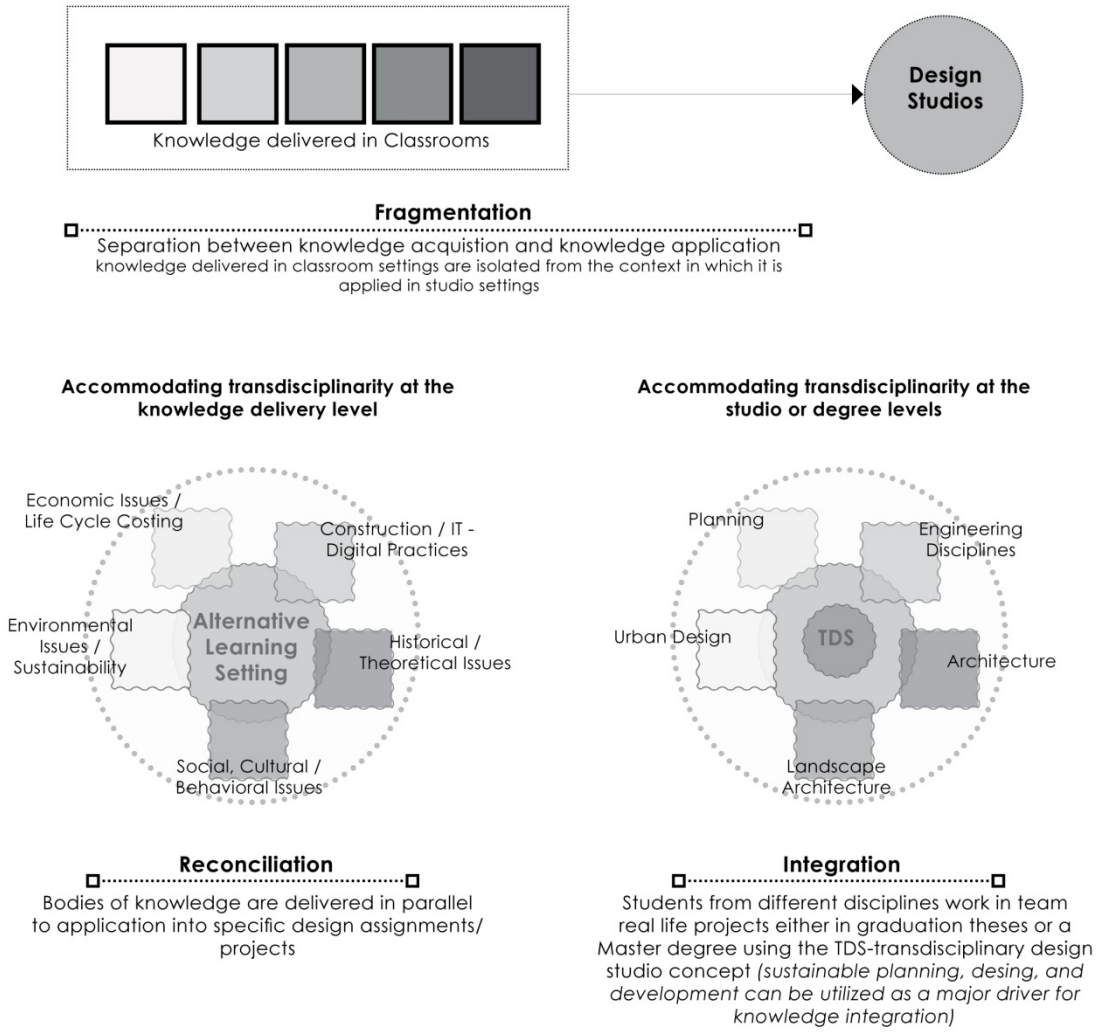

Fig 2. Accommodation of transdisciplinary knowledge in architectural education (Salama, 2009)

The inquiry-epistemic component can be tactically accommodated in a studio setting when integrating three different types of knowledge that theorists called for: knowledge about setting objectives, knowledge about better environments, and knowledge about achieving socio-behavioral goals in design (Rapoport, 1994). For integrating these knowledge types it is essential to employ the three mechanisms of inquiry, i.e., ethnography, appreciative inquiry, and experiential and active learning. It is important to relate these types of mechanisms of inquiry to the studio level, the scale of the project, and the issues involved. This is envisaged when a studio process involves three major components "what" and "who, how, and why". *What* and *who* are characterized by

involving students in proposing human activities and are appropriate for certain types of spaces and buildings, *how* is the act of design itself that is characterized by manipulating forms in response to well articulated and defined spatial needs, and *why* represents students' involvement in exploring why a certain type of space and form is appropriate for a certain type of user population. Again, the act of design in this process should address the cognitive-philosophical component; by integrating the logical/rational and the intuitive/imaginative capacities of students, while at the same time striking the required balance between different psychological types or cognitive functions (Fig. 3).

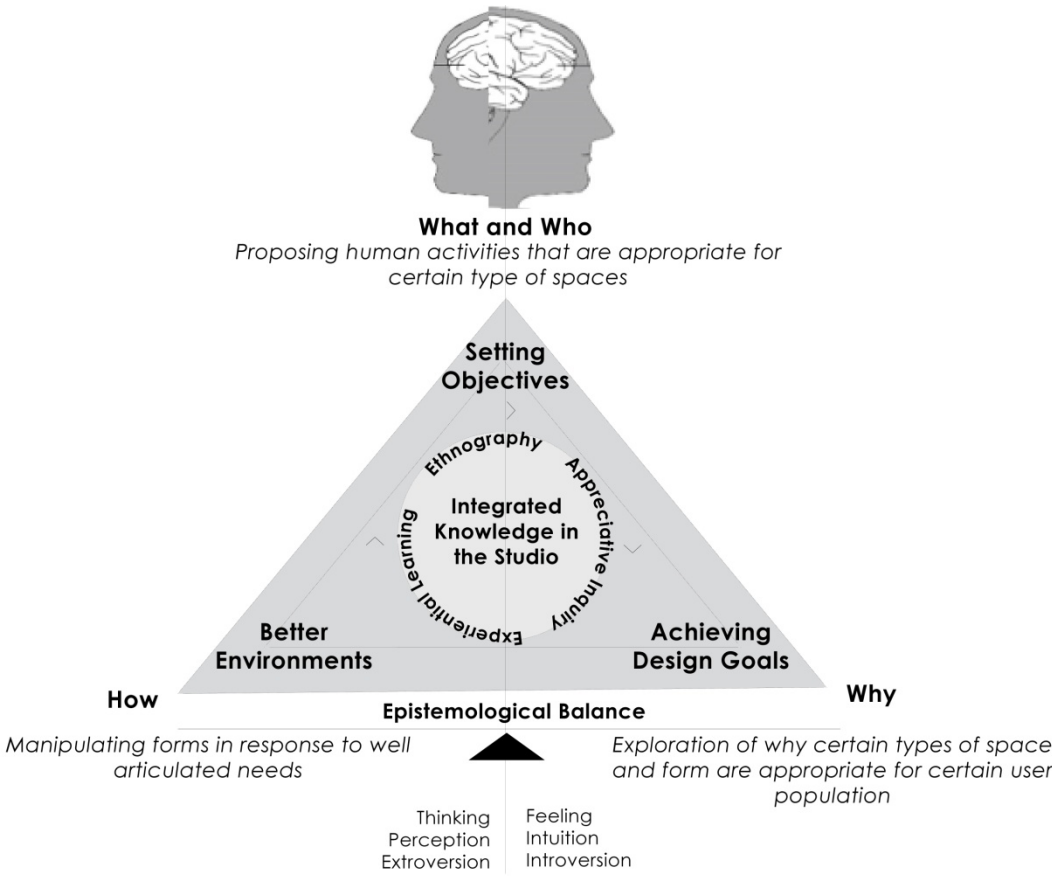

Fig. 3. Accommodation of multiple modes of knowledge acquisition, assimilation and production in architectural education (Salama, 2009)

By adopting the proposed theory for knowledge integration in architectural design education, opportunities for reconciling lectures and studios are available, while literature on different bodies of knowledge is incorporated through both simulated and real life experiences into design teaching practices. Students will be in a better position to understand and appreciate the value of knowledge types derived from other disciplines that are dramatically different from architecture, but are critical to the creation of meaningful environments. The abilities to think globally and act locally, and to search and think critically, will be major components of the formation of future architects. Future architects will have the capacity not just to consume knowledge but also to contribute to its production.

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About The Author

Dr. Ashraf M. Salama is full Professor in architecture and currently the Head of the Department of Architecture and Urban Planning at Qatar University. He is a fellow of the Higher Education Academy-FHEA and the Royal Society of the Arts-FRSA in the United Kingdom. He holds B.Arch, M.Arch, and Ph.D. from the Al Azhar University in Egypt and North Carolina State University, USA (1987, 1991, 1996). He has held permanent, tenured, and visiting positions in Egypt (Misr International University and Al-Azhar University), Italy (University of Naples Federico II), Qatar (Qatar University), Saudi Arabia (King Fahd University of Petroleum and Minerals), and the United Kingdom (Queen's University Belfast). With varied experience in academic research, teaching, design and research based consultancy, Dr. Salama bridges theory and design and pedagogy and practice in his professional activities. He was the Director of Consulting at Adam Group Architects in Charlotte, North Carolina (2001-2004). Professor Salama has written over 100 articles and papers in the international refereed press; authored and co-edited six books: New Trends in Architectural Education: Designing the Design Studio (North Carolina, USA), Human Factors in Environmental Design (Cairo, Egypt), Architectural Education Today (Lausanne, Switzerland), Architecture as Language of Peace (Napoli-Rome, Italy), and Design Studio Pedagogy: Horizons for the Future (Gateshead, United Kingdom). His latest book on Transformative Pedagogy in Architecture and Urbanism (2009) is published by Umbau-Verlag, Solingen, Germany. Professor Salama is the chief editor of Archnet-IJAR; International Journal of Architectural Research, associate editor of Open House International-OHI, editorial board member of Time-Based Architecture International, International Journal of Environmental Research and Public Health-IJERPH, International Journal of Sustainable Built Environment-IJSBE, member of the senior advisory board of LONAARD-London Art and Architecture Research and Design Group, and member of the editorial board of Architects for Peace. Professor Salama serves on the scientific and review boards of several international organizations, including IAPS-the international association of people-environment studies, IAHH-international association of human habitat, cEBs-Center for Environment-Behavior Studies. In addition to his continuous work on architectural and design pedagogy, his latest research focuses on architecture and urbanism in emerging regional metropolises Middle East.

SURVIVING GLOBALIZATION: INVOLVEMENT AND CONTRIBUTIONS OF THE MALAYSIAN INSTITUTE OF ARCHITECTS (PAM)

Ar Mohd Zulhemlee bin An
PAM Honorary Secretary & Chairman Education Committee.

Abstract
Globalization has reached our shores and brought with it changes to the way we conduct architecture practice. The big multi-national architecture firms are setting up offices all over the world in the pretext of free trade and a level playing field. With their technological advancement and superior financial background, multi-national foreign firms seem to have the advantage to expand their businesses into developing countries where economies are still growing and the construction industries are still vibrant. Even with the local statutory that governs and protects the architecture profession in our country, the foreigners are able to syphon jobs away from our local architects. With the opening up of the profession in 2015, will our local architects be able to compete with the "big boys"? What is PAM currently doing to ensure the survival of our local architects in our very own country? How are the current and future architecture students in our country being prepared to participate in the globalization process or are they going to become mere spectators? How is PAM positioning itself to assist in promoting our local architects in the international market? These are among the issues highlighted in the paper to challenge the paradigm of the local architecture fraternity and education programs.

Keywords*: Globalization, multi-national architecture firms, architecture students, PAM*

Background of PAM

Pertubuhan Akitek Malaysia or PAM, was formerly known as the Institute of Architects Malaya which was founded in 1920. In 1947 the name was changed to the Federation of Malaya Society of Architects which was allied to the Royal Institute of British Architects. The name Pertubuhan Akitek Malaysia was registered with the Registrar of Societies in 1967 to reflect national sovereignty, with the formation of Malaysia in 1963. Currently PAM membership comprises of 2,274 corporate members, 1,256 Graduate members, 28 Associate graduate members, 23 academic members and also 1,076 student members.

As the national professional institute representing architects in Malaysia, PAM plays an important role in promoting the knowledge, study and practice of architecture. PAM also serves as a platform for members to network and share professional experience among themselves through programs and events organized by PAM. Some of these programs organized by PAM are the Continuing Professional Development (CPD), Datum:KL the annual international design conference and Design Lecture Series. Through PAM, members voice their collective views in matters relating to the profession. Members represent PAM on many committees either on the government or the private sectors on matters that affected the profession as well as matters pertaining to the construction industry. Over the years PAM have managed to build good rapport among all stakeholders including the allied professions, and have supported them in addressing issues of mutual interests.

The status and the integrity of the profession is highly regarded by the public, since PAM is promoting good and responsible architecture which is beneficial to the safety and health of the public and contributing to the sustainability of the environment.

Architecture Services and Globalization in Malaysia

The economic power is shifting from the West to the East. China is currently the second biggest economy in the world after the United States of America. India with her vast resources and big population is fast becoming another economic power. More and more professionals from the West are currently looking for opportunities in Asian countries, due to the slow economic growth, and the economic woes being faced in the European countries and in America. According to the latest

data from tradingeconomics.com, the 2012 GDP Growth for the abovementioned countries is as follows:

Country		Quarter 1	Quarter2
1.	China	8.10%	7.60%
2.	India	5.30%	5.50%
3.	United States	2.40%	2.30%
4.	Germany	1.70%	0.50%
5.	France	0.33%	0.27%
6.	United Kingdom	-0.20%	-0.50%

To compare the above figures with the 2012 GDP Growth in Malaysia and a few of our neighboring countries:

Country		Quarter 1	Quarter2
7.	Malaysia	4.90%	5.40%
8.	Indonesia	6.30%	6.40%
9.	Phillippines	6.40%	5.90%

On September 5, 2012 The Star reported that CIDB expected the construction industry to secure up to RM120 billion worth of projects in 2013, mainly in the oil and gas and also transportation sectors. On September 4, 2012 Philip Inman an economic correspondence with the Guardian, a UK based newspaper wrote that "figures from the construction industry in August showed that the housing activity at its lowest since the beginning of 2012". To quote the article further, "Tim Moore, senior economist at Markitt said, "August data reaffirms that UK construction firms are suffering a prolonged downturn in new work and there is little evidence to suggest an imminent rebound in output levels".

Due to the slow growth in the construction industry in their home countries as evidenced in the above mentioned article in the Guardian, we are seeing a lot of professionals from the west setting up practices in all over Asia, and Malaysia has not been spared either. Currently there 32 numbers of multinational architecture practices registered with LAM, out of the total 1434 architecture practices registered with LAM. Most of these multi-national practices have substantial financial strength from their parent organizations, while the majority of Malaysian architecture firms are small, to medium size (1082 numbers of sole proprietors, 99 partnerships, 32 MDP and 221 body corporates), and most of these local firms will be facing a challenging task if they were to compete with the bigger and financially stronger foreign firms. Traditionally, the bulk of the works done by the Malaysian firms are mainly job commissions from the government or local developers or clients. For firms that have done work overseas, the amount of overseas work is still small compared to their local jobs. For example, one of the bigger firms in Malaysia which has been quite active in the international market has recorded a decline from 25% to 5% volume in their international jobs. Currently not many Malaysian firms are venturing into the overseas market due to several factors. Based on the survey done by PAM a few years ago, the number or architecture firms doing overseas jobs is less than 5% of the overall number of firms in the country.

The architecture practice in Malaysia is still adequately protected by the existing Architect Act 1967. Under the Architect Act Clause 10(3) "only a citizen or permanent resident of Malaysia may qualify for registration as an Architectural Graduate or Architect". However, there is a provision under Clause 10A(1) that "permits temporary registration of a foreign architect, who is a consultant to a project, fully financed by a foreign government, or implemented under a bilateral agreement between governments". As such there is the possibility that a big part of the architecture fraternity in Malaysia is still under the impression that there is still adequate work to be distributed among the architecture firms in the country, as the number of foreign architects who can practice in Malaysia is limited by the provision of Clause 10A(1). And the same portion of the architecture fraternity is probably still oblivious to the fact that international architecture firms have been actively soliciting for jobs from our local clients since the early 1980s. This has been happening since there is a

loophole in the Architects Act. The foreign architects have been practicing as "designers", working on the preliminary design stage of the project and partnering with a local architect to carry out the remaining stages of the work including the submission to the local authority and supervision of the construction works. This can happen to all kinds and sizes of projects, and LAM is powerless to stop this practice from proliferating. There is no provision under the current Architect Act which can prevent the foreign architects from practicing as "designers". PAM members are concern with this development, and the current PAM President has taken the initiative to write to selected Government Linked Companies to encourage the GLCs to recognize the capabilities of our local architects and architecture firms by giving them equal treatment and opportunity to participate in developments being carried out by the GLCs. However, one can't put the fault only on the clients for engaging foreign architects to come up with the initial design or the design concept. Equally at fault are the local architects who have agreed to be the submitting architects on behalf of the foreign architects. When there is a genuine need for a joint venture between a foreign and local architect, PAM encourages a healthy joint venture between the local and foreign architects, especially in projects where there will be transfer of knowledge and technology from the foreign architect to the local architect. Both the foreign and local architecture firms at the start of the project can identify the roles and the contributions of their respective firms at every stage of the project from the initial design until the completion of the project. This type of partnership is beneficial to both parties as they would be able to share their resources as well as their knowledge and experience and at the same time enriching the architecture scene in our country.

It remains to be seen how long the Board of Architects would be able to resist the external pressure calling for our country to open up the architecture services sector, before LAM finally yield to the forces of globalization. Currently foreign architects are allowed to hold up 10% of the share in a local company, and in the near future the foreign architect can be the majority shareholder in a local company, if the proposed amendments to the Architect Act are approved by Parliament.

Therefore, our local architecture firms have to be prepared to compete with the foreign architects who are already in our country and those who are eyeing our shores. In order to compete with the foreign firms either locally or internationally, the Malaysian architecture firms need to develop their skills and knowledge to be at least at par if not better than their foreign counterparts. The local architecture firms should be more conversant with the laws and regulations in our country which govern the profession and the construction industry to enable the local firms to have a slight advantage over the foreign architecture firms for projects in our country. The local architecture firms need to also develop their technical skills, and to update their knowledge of the new technology available so that the local architects would not be handicapped by the technological advancements which are usually invented in the developed western countries. As more and more clients are looking at the architecture of the develop countries as an indication of progress, the local architects must familiarize themselves with the development of architecture in the develop countries. The intention is not to copy, but to understand the principles behind the idea and how the principles could be applied in our local conditions.

For the Malaysian architecture firms to venture into a different country or market, they must be familiar with the conditions that affect and influence the architecture of the particular area. Culture, history, climatic conditions and the local architecture practices and the laws which govern the profession in that particular country must be thoroughly researched before venturing into the new market. This is the same set of knowledge and key skills that need to be inculcated into the current and future architecture students to prepare them to compete in the international stage. Where necessary the current curriculum needs to be tweaked so that the information regarding globalization and its impact on architecture practice can be disseminated to the current students. By getting the students prepared to face globalization at an early stage, an attitude of a "global" architect can be developed. The "global" architect is competent and confident with the skills and knowledge that he or she possesses, to practice in any parts of the world, and he and she has the desire to venture out into new or existing markets overseas, compared to those architects who prefer the familiar surroundings at home.

PAM's Affiliations with International Architecture Organizations.

Since 1967 PAM have been actively involved and participated in programs organized by international architecture organizations such as Architects Regional Council ASIA (ARCASIA), International Union of Architects (UIA), Commonwealth Associations of Architects (CAA), Eastern Regional Organization for Planning and Housing (EAROPH) and Asean Architects Council (AAC).

PAM's objectives in associating itself with these international organizations are to:
1. To promote the recognition of the architects role in society
2. To keep itself abreast of the development of the architecture profession internationally
3. To represent PAM members at national and international level, and to promote PAM members works to the international scene
4. To present PAM's view on matters of mutual interest in relation to the profession
5. Promote interaction and discourse amongst architects, and to pave the way for PAM members to participate in international events and markets
6. To promote the advancement of architecture and the architecture profession.

Malaysian architects working overseas are highly regarded for their knowledge, skills and also demeanor. However as a "brand", the Malaysian architect is not yet a household name. Realizing the situation PAM has taken upon itself to promote Malaysian architects into the international markets, by affiliating itself and actively collaborating with the following international organizations:

International Union of Architects (UIA)

The International Union of Architects (UIA) was founded on the 28th June 1948 to unite architects from all over the world. The initial delegation during the founding was from 27 states and has now grown to 124 key professional organizations of architects from countries and territories. The UIA is now representing about 1.3 million architects all over the world, and promoting their activities for the advancement architecture and its profession.
PAM's application to UIA was accepted in 1972, and from that day onwards PAM has been actively involved in many events organized by UIA and PAM has even hosted a number of UIA events. In recognition of the significant contributions made by PAM representatives in UIA, several PAM representatives have been appointed to hold official positions under UIA's various programs:
i. In 1978 the UIA Education Commission Group IV was formed and the Secretariat was transferred from Australia to Malaysia. Malaysian architect Lai Kok Kun was appointed as the Secretary for the commission.
ii. In 1978 PAM was appointed as the regional coordinator for UIA Congress in Mexico, with Ikmal Hisham Albakri appointed as the Chairman of the committee to coordinate the representatives of the congress.
iii. Malaysia was selected to host the first UIA/CAA Regional Meeting in 1981 with the theme "Architectural Education and the Changing Needs of Practice for National Development", which was attended by 150 delegates from 33 countries.
iv. In 1984 PAM and Malaysia was featured in the special issue of UIA's International Architect magazine.
v. Prominent Malaysian architect and PAM Past President Kington Loo was appointed as the Vice President for UIA Group IV in 1978, 1980, 1981 and 1982.
vi. PAM hosted the UIA Regional Forum in 2007
vii. PAM assisted the organization of the 8th Design and Health Congress in 2012
viii. The current Vice President for UIA Group IV is Dato Seri Esa bin Mohammad.

Architects Regional Council Asia (ARCASIA)

ARCASIA was formed in September 1970 to forge closer rapport and working relationship among six country institutes, India (IIA), Sri Lanka (SLIA), Pakistan (IAP), Malaysia (PAM), Singapore (SIA) and Hong Kong (HKIA), to resolve urgent issues affecting member countries. Currently ARCASIA

members have grown into seventeen national architectural institutes, and PAM is proud to be one of the six founding members.
PAM has been very committed to the cause of ARCASIA, and has been sending delegates to all ARCASIA events, except in Lahore 2010, due to security concerns. PAM representatives have contributed to the growth of ARCASIA, and have been providing leadership since ARCASIA's founding to achieve its objectives. The following are list of PAM's and it's representatives notable achievements in ARCASIA:

i. In 1972 PAM was selected to host the First Conference of the ARCASIA Group under the theme "The Expanding Role of the Architect in the Building Industry".
ii. In 1974 in recognition of PAM's leadership in ARCASIA, the Secretariat was moved to Malaysia. Kington Loo was appointed as the chairman of the secretariat and Lai Kok Kun as the secretary.
iii. Dr Kenneth Yeang was elected as the Vice Chairman of ARCASIA.6 for the term 1984/5.
iv. In 1992 PAM was nominated to publish ARCASIA's inaugural magazine "Architecture Asia", which PAM is still responsible to publish to date. PAM came up with the e-version of the magazine in 2011 to widen its circulation as well as to keep up with the advancement in information technology..
v. PAM hosted the ARCASIA Architecture Students Jamboree at the MARA University of Technology in 2000.
vi. During the 16th ARCASIA Forum 2011 in Danang, Vietnam, Ar Tan Pei Ing was elected as President Elect ARCASIA for the term 2013 to 2014. Ar Tan Pei Ing will take over the Presidency of ARCASIA in Bali in October 2012.

PAM recognizes that the future of the profession lies in the hands of the current group of students and the future students of architecture. Even though in a few of the architecture programs, an element of overseas study tour or overseas project is injected into the curriculum, not many students have the opportunity to meet up with overseas students to work together and to exchange knowledge as well as to have exposure to the architecture and culture of different countries. PAM believes that the students would benefit from the overseas exposure, which will help the students to experience and understand how architecture is shaped in the different cultures, climatic conditions and other local factors. With the current climate of globalization, these students must also be given adequate exposure to the international architecture scene for the students to understand how the local architecture practice is influenced and affected by globalization, and how the different countries are responding to the challenges posed by globalization. Due to that PAM have been sponsoring Malaysian students to take part in architecture events overseas such as the ACA Student Jamboree since 1984. This year the ACA Student Jamboree will take place in Bali, Indonesia and PAM have already registered 5 students to represent Malaysia in the event. The selected students are requested to prepare a presentation to their fellow students of the experience in the ACA Student Jamboree, to share the exposure and knowledge that they have gained from attending the event. With this program, more local students would be able to benefit by getting an overview of the current status of architecture profession and architecture education in neighboring countries and the relevant issues being addressed during the program.

Asean Architect Council (AAC)

The Asean Architect Council (AAC) objectives are to facilitate the mobility of architecture professionals within ASEAN, to enhance exchange information of the best practices on standard of architecture education, professional practices and qualifications. The AAC also promotes the spirit of cooperation, technology transfer and fair distribution of resources among ASEAN nations. The above mentioned objectives are based on the Mutual Recognition Arrangement on Architecture Services signed by ASEAN Economic Ministers on the 20th November 2007. Currently there are ten member countries in the AAC namely Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam.
Under the auspices of the Asean Architect Council (AAC), PAM has helped to promote to PAM members the Graduate Internship Exchange Program (GIEP), whereby an architecture graduate can apply for placement of internship (industrial training) in another ASEAN participating country.

The objective of the GIEP is to facilitate cross border mobility for graduates, as another opportunity for architecture students to gain experience working in a different culture and environment which will help to enrich their knowledge in architecture, and to help prepare the students with the experience of working in a different country. Currently besides Malaysia, the other ASEAN countries which are participating in the program are Singapore and Thailand.

Venice Biennale 2010

For the first time ever, Malaysian architects have taken part in the world's largest and most prestigious architecture festival. PAM was able to organize 37 exhibitions by 29 architects and architecture students, which was named "RE/MIXED". During the 10 weeks long event, the Malaysian Pavilion received 44,656 visitors and positive comments from the visitors. Following from the success of "RE/MIXED" at the Venice Bienalle, PAM had received invitation from the Department of Architecture, School of Science and Technology, Meiji University, Tokyo, Japan to exhibit "RE/MIXED" during the UIA Congress 2011. The exhibition held in Tokyo was well received with 2,250 visitors for the period of 4 weeks.
This year the 13th Venice Biennale for Architecture will be held from the 29th August 2012 until the 25th November 2015. Twenty Malaysian architects are participating in this year's festival to showcase their design talents, marking the second successive participation from our country.

Cityscape Global

Cityscape Global is an annual international real estate event, and has been an important meeting point for players in the real estate industry. PAM participated in Cityscape in 2005 as an umbrella body representing Malaysian architects, bringing together 7 architecture firms to showcase Malaysian architects' works to the real estate professionals attending the exhibition. As a reference for potential overseas client and as a tool to promote the Malaysian architects, in 2009 PAM has come up with a directory of Malaysian architects namely Architects Malaysia, which comprises of 1,388 Malaysian firms with a list of their experience. Currently the e-version of the directory is available online.

Conclusions

Over the last few years, realizing that Malaysia will finally have to bow to the demands from other countries to open up the architecture services sector, PAM has been busy organizing CPD talks to update PAM members on globalization and its effect to the local profession. The opening up will be gradual, starting with the participation of architects from the ASEAN countries by the end of 2012, and culminating with the total opening up of the architecture services sector for the rest of the world by 2015.

What does all this have to do with the architecture education system and also our current group of students? PAM would like to encourage that the education system to teach our students to think BIG for their future careers. The students must look beyond our shores for their future. Plant the vision into our students that they are "global architects", and their talents and expertise is required in all parts of the world. The whole world is the stage for our architecture students, after their graduation to express themselves and to make a mark with their contributions to the progress of the architecture profession. The education system needs to instill into the hearts of our students the confidence to compete at the international level, and to be among the best in the world. Currently the presence of Malaysian architects in the international market is still very low. Not many of our students make it a point to look for work overseas after graduation because there is adequate well-paying job opportunity in Malaysia. But this mindset has to change, if we want to compete with the rest of the world. We need to develop the desire within our students to be more adventurous, and to explore the opportunities which come with globalization.

While some quarters would lament that globalization would lead to brain drain from our country due to better pay scale overseas, PAM is of the view that it will be beneficial for these students to

work overseas for a few years to gain valuable experience and to enrich their knowledge of architecture. At any point in their careers Malaysian architects who are working overseas can come back home to apply the experience and knowledge that they have acquired from overseas, and contribute to the development of the architecture profession in our country. What PAM would like to encourage is that after setting up successful practices in Malaysia, our local architects make strategic plans to export their services into other countries, and to open up their architecture practices in other countries. There are certain areas such as mass housing in which Malaysian architects are very familiar with, which they could share with architects in the other parts of the world. The strength and expertise of our local architects need to be identified and promoted as the branding of our Malaysian architects, so that a niche area can be secured by our architects. Their counterparts from the develop nations have been exporting services and setting up practices in other countries for many years. Even architects from our southern neighboring country have been actively exporting their services and also setting up practices in other countries for many years. While it is admirable for our architects to choose to contribute loyally to the development our country, at the same time it is also commendable for our architects to come out of our comfort zones to venture into new markets and contribute to the development of architecture internationally. PAM believes that with concerted effort from all stakeholders the branding of the "Malaysian architects" would be positively established overseas, making Malaysian architecture practices more mobile in the future with the whole world as the market.

No doubt there would be our local architecture talents who might decide to migrate to other countries for good, at the same time we can also consider to attract talents from other countries into our local architecture fraternity to fill up the positions left by our local architects. With the progress of technology, including information technology, the world has become a smaller world. We should take this opportunity to attract architects from our neighboring countries, and beyond to work together with us, to share their experience and expertise, to make the architecture in Malaysia richer without compromising our local culture and conditions. PAM believes that the interaction between different cultures in any architecture organization will only lead to better architecture solutions. This is due to the different views and solutions which will be available from the different nationalities and cultures, when looking at a particular design problem. This will advocate engaging discussions based on each teams members experience, education background, culture and approach. This situation of having lively professional interactions is very common in multi-national architecture firms which usually employ staff from different nationalities. And due to this unique advantage they have been able to come up with creative and progressive architecture and at the same time able to adapt their practices into any countries local conditions and regulations. As the evidence of the merit of collaborations between different cultures, several competitions organized by PAM were won by local architecture firms which collaborated with overseas firms.

We need to always look out for the positives that come with globalization, because we will not be able to stop globalization. It is already happening and it is up to us to select the roles that we want to play, and to make sure that we don't lose our identity in the process.

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SUSTAINABILITY IN ARCHITECTURAL EDUCATION

THE ROLE OF ARCHITECTURE IN PRODUCING URBAN QUALITIES FOR SUSTAINABILITY: IMPLICATIONS FOR THE FUTURE OF ARCHITECTURAL EDUCATION

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Abstract:
Architecture has historically evolved into an interdisciplinary subject dealing with design, engineering and psychology. The contemporary tendency in both professional practice and education to view architecture mainly as a form of art has led to the neglect of its holistic dimension in producing the built environment. Thus, the different approaches to how architecture can affect the development of sustainability need to be taught by introducing a comprehensive framework, which is built on all fundamental factors within the production of urban qualities. This paper therefore explores a comprehensive and multi-layered teaching framework by relating the space theory of the French sociologist and philosopher Henri Lefebvre to the contemporary discussion about sustainability. Henri Lefebvre distinguished three main dimensions producing space, known as conceived, perceived and lived space. All three dimensions play a significant role in producing the three main urban qualities, which can be categorized in terms of urban efficiency, urban diversity and urban identity. An attempt is made to identify the distinct role of architecture in developing these urban qualities that are essential for sustainable urban growth. It is the position of the authors that the teaching of architecture for sustainability cannot be reduced to a series of lectures about ecological design and the integration of sustainable technologies. In fact, a more holistic view of architecture and its role within urbanism has to be delivered by instructors and practiced by the students through structured experiences that range from macro contexts to micro scales and those in between, where the ultimate objective is to graduate professionals capable of positioning architecture in its contextual realities. Thus, the teaching of architecture for sustainability needs to be based on an open philosophical framework asking the essential questions of space and time.

Keywords*: sustainability, urban qualities, identity, efficiency, diversity*

Introduction: Sustainability and Contemporary Architectural Education

The use of the term "sustainability" has a rather short history and often refers to the definition made at the Brundtland Commission of the United Nations in 1987: "*Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs* (United Nations, 1987)." Due to a rapid increase in environmental damage caused by human developments, endangering the livelihood of future generations, the term sustainability was initially used with a main focus on ecological balance. Another significant step in defining the general terminology of sustainability was made at the 2005 World Summit, when economy, society and environment were defined as the three pillars of sustainability (United Nations, 2005). According to this more holistic view, economic, social and environmental demands should develop in balance in order to establish sustainable growth. Thus, economic growth, which does not endanger social peace and ecological balance, was seen as the main challenge to sustainable development. Today, the terminology of sustainability is widespread and used in all disciplines while the main focus differs depending on the viewpoint of the specific discipline. While environmental engineers are concerned about damage to ecosystems, sociologists are engaged in analyzing the impact of immigration and multiculturalism on coherent social structures.

Architects have always worked in interdisciplinary realms, but due to their engineering background the use of the term sustainability has strongly emphasized the technical aspects required to construct ecological buildings. As a result, sustainable architecture is often taught in universities as a side subject or specialized program dealing with modern technologies and climate-appropriate design rather than as an integral component of the curriculum. The main responsibility of architects is to function as a moderator dealing with the demands concerning the design of a building in order to find the best compromise between clients, actual users and society as a whole (Salama, 2009). Therefore, architecture students need to be prepared for this demanding role equipped with a more holistic approach that caters to the various parties involved. Worldwide, curricula are currently addressing this reality through a variety of different courses and studios that promote interdisciplinary thinking. The main focus of teaching in architectural classes, however, remains on the object, the building itself, without enough emphasis relevant to the role of architecture in a

wider context. Thus, creativity and technical know-how are highly desired and promoted while research about how buildings are perceived by potential users, including investigations about social and cultural backgrounds, are usually neglected in curriculums worldwide (Salama, 2008, p. 101).

This paper therefore introduces a framework for the teaching of architecture for sustainability from a holistic perspective focusing on the role of buildings in the urban context. The one-sided view of architects as artists with an engineering background can only be replaced with a more holistic perspective when the definition of their work is underpinned by a philosophical basis. In this regard, architecture students need to learn more about the philosophical, psychological and sociological dimensions of their future profession and how they can play a proactive role in promoting sustainable development. Thus, the starting point of any holistic framework regarding the role of architecture within sustainability has to be human beings themselves and how they produce space. In essence, a framework is presented based on the work of the French sociologist Henri Lefebvre, who is often referred to in urban and social sciences. The authors translate his work from a holistic scale to an urban and architectural scale in order to illustrate the applicability of his recognitions regarding the production of space.

1. The Role of Architecture in Producing Urban Qualities

1. 1 The Theory of Space Production

In order to create a more holistic framework for the teaching of sustainability within architectural studies, a theory of how built environments are produced must be used as a basis. The work of the French sociologist and philosopher Henri Lefebvre has had a large impact on the contemporary understanding of space as a product of complex 'social superstructures' (Lefebvre, 1991, p. 85). In his work *Production of Space* (*La production de l'espace*, 1974), he argues that space cannot be understood as a simple collection of elements because a society's space is actually a product that has been created through its own individual spatial practice. In order to explain his idea of social space Lefebvre developed his frequently quoted triad of perceived, conceived and lived space (Fig. 1).

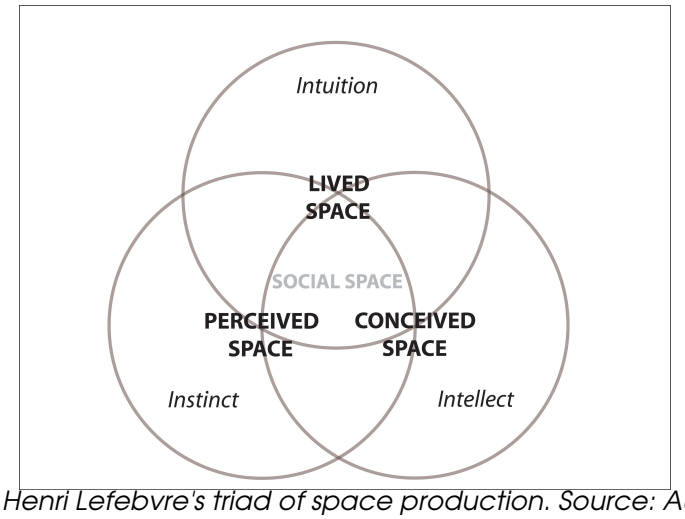

Fig. 1: Henri Lefebvre's triad of space production. Source: Authors.

Firstly, he defined 'conceived space' as the space conceptualized by scientists, also known as 'representations of space'. These representations are abstract as they are rooted in the principles, beliefs and visions held by practitioners, decision-makers and others who are in a position to impose their personal notion of 'order' on the concrete world and so create a practical impact on space within social and political practice (Lefebvre, 1991, p. 41). Conceived space is thus based on knowledge and science in combination with ideology (Lefebvre, 1991, p. 233).

Lefebvre defined 'perceived space' as the space of 'spatial practice'. He defined it as the space where movement and interaction take place, where networks develop and materialize. Thus, it includes both daily routines on an individual level and networks as the result of collective movements. He maintains that the specific spatial practice of a society can only be evaluated empirically by analyzing and studying the structure of its networks (Lefebvre, 1991, p. 38). Due to the

fact that spatial practice is empirically observable it is also referred to as the readable or visible space and can be seen, described and analyzed on many levels (Lefebvre, 1991, p. 413).

Thirdly, 'lived space' is discussed by Lefebvre as the unconscious, non-verbal direct relation of humans to space. Also known as 'representational space', it is directly lived through associated images and symbols (Lefebvre, 1991, p. 39). Thus rooted in the imagination, it is essentially subjective, a passive experience wherein the outer physical space resonates with the inner imagination. Specific locations within a given vicinity can, for example, become focal points due to their position and status within the representational space of the particular community of people who use that vicinity (Lefebvre, 1991, p. 45).
Beyond the three elements briefly described above, the production of social space as a whole has a direct impact on the environment and in the case of cities it materialises into the built reality. Lefebvre himself emphasised the direct use of his perceived-conceived-lived triad (also known as the first ontological transformation of space) within the process of understanding spatial developments. He never understood it as an abstract model reduced to comparative studies of ideologies (Lefebvre, 1991, p. 40).

1.2 The Production of Urban Qualities

In the case of a city the conceived space is mainly formed by conscious decision-making processes within urban governance. The main responsibility of urban governance is the supply of an efficient urban structure by implementing guidelines and regulations in the form of policies and physical planning. These legal frameworks for urban developments are in turn based on visionary decision-making regarding overall development goals and strategies.
While urban governance is most responsible for the supply of an efficient urban structure, it is the various users of space themselves who shape the urban environment according to their requirements. This demand-driven development is needed for the urban quality of diversity, which is essential for economic growth and flexibility. In most service-oriented economies three main parties active in spatial practice can be distinguished – developers, companies and inhabitants.

In addition to the conscious planning of individuals and the collective spatial practice, the third dimension of space production is the identification of inhabitants with space. This identification is the main basis for social consolidation because it is rooted in a long-term commitment from inhabitants to the space. The reasons for a close intimacy between inhabitants and urban environments are best described in images – the image of liveability, the image of success and the image of cultural values. These three images cooperatively create the identification of a society with its surroundings, which is the basis for the urban quality of identity.

Consequently, three main urban qualities can be distinguished, which in turn are the basis for sustainable urbanism. The supply of an efficient urban structure by urban governance is key to improve the ecological balance of cities. The urban diversity created by the spatial practice of developers, companies and inhabitants is the basis for economic growth and flexibility. Last but not least, the urban identity created by the identification of all social groups with the urban environment is essential for social peace. The model in Fig. 2 illustrates the triadic principles of all the components that produce the urban environment, its qualities and sustainability factors.

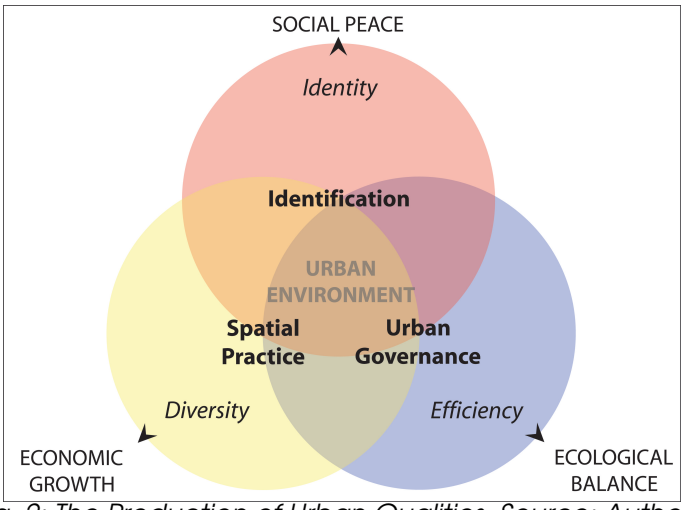

Fig. 2: The Production of Urban Qualities. Source: Authors.

1.3 The Role of Architecture

In comparison to other disciplines architects need to understand the production of space comprehensively since their work lies profoundly in the coordination of all the factors that produce a new space. Architects need a basis of scientific knowledge, for example, about construction techniques, communication and observation skills when they design a building and a sense of intuition to choose the images expressed by forms and colors. On their own architects can be seen as managers of the process of producing a space on a small scale. They have to develop the design of a building by integrating three main qualities that include ecological design, user responsiveness and meaningful images. These three qualities can be referred back to the conceived, perceived and lived triad. Thus, architects need a wide knowledge base in order to decide on the right construction techniques, they need to observe people's behavior and communicate with potential users in order to integrate their needs and they need the intuition to combine design elements into a legible and meaningful ensemble.

If an architect succeeds in integrating ecological design, user responsiveness and meaning in a project, he/she automatically contributes to all three previously mentioned urban qualities. Thus, by using adequate construction techniques for ecological buildings an architect plays a significant role in enhancing urban efficiency. When an architect designs a building that serves the purposes of individuals as well as communities, he contributes to urban diversity. An architect can also play a significant role in developing urban identity if his/her design reflects the subjective preferences of a society. Thus, architects play an important role in developing built environments that are ecological, diverse and meaningful (Fig. 3).

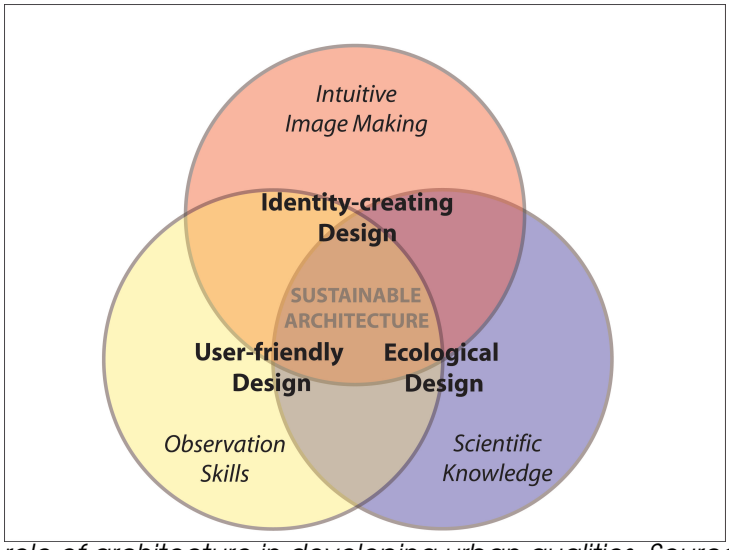

Fig. 3: The role of architecture in developing urban qualities. Source: Authors.

2. Teaching Architecture for Sustainability

2.1 Scientific Knowledge for Ecological Design

Architecture cannot be taught without introducing the key issues relevant to architectural history, the basics about the profession itself, and the main construction techniques. In order to increase their awareness of ecological design students need to learn about historical contexts because building design in the past was a result of reactions to climate conditions. Furthermore, it is important to offer content about the techniques that can be used to create energy-efficient buildings, taking into account climatic conditions, as well as building materials and new technologies. Architectural students need to be encouraged to investigate the various fields of ecological design. Based on the theory of space production outlined earlier it is important to deliver each ecological design aspect with reference to its role in a wider context and how it contributes to a more sustainable development. Students need to learn that ecological design is not a specialized topic but a basic challenge of the profession itself. It is also important to cover the financial aspects involved, including low-budget solutions.

2.2 Research Skills for User-Responsive Design

One aspect that is often neglected in current architectural curricula is the teaching of skills to understand the impact of buildings on actual users. Architecture students need classes where they study human behavior by observing people in public buildings and places. One important field is Environment Behavior Studies (EBS), which can be defined as the systematic examination of relationships between human behavior, cultural values and the physical environment (Moore, 1979). Therefore, various observation techniques have to be introduced to students in order to provide them with tools for their own individual research. These observation techniques should be combined with interviews of users and general analyses of the built environment itself so that students develop their awareness of how buildings affect human behavior. In this regard, it is important that students learn to distinguish the general impact of buildings within the urban context and the impact of building layouts on the actual users within a building. Thus, it is crucial to select representative buildings and public places to be studied by students. These observation studies should be written up in essays in which students exercise and develop the ability to analyze information and draw conclusions from their analyses.

2.3 Image Making for Meaningful and Identity-creating Design

In addition to teaching the scientific knowledge basis as well as promoting research skills for the design of user-responsive architecture, various design classes are needed to train the artistic intuition of students for creating sustainable environments. Art is often taught in an isolated way as a source of inspiration without teaching the impact of forms and colors on human psychology. In order to design buildings that contribute to the urban quality of identity, architects need to train their abilities for intuitive image making. In this regard, students need to research and experiment within design studios to understand the impact of certain color combinations and forms and the meanings they evoke with relevance to a specific group of people. Based on the framework of Lefebvre, three main images can lead to humans self-identifying with a space – the images of livability, success, and cultural values. Architecture students need to learn to balance between these images in relation to the chosen location and its context. Thus, these design classes cannot be entirely practiced with a focus on pure artistic expression of the students themselves and their own inner worlds. Architecture students need to learn about their responsibility in how they affect society with their design choices.

3. Proposal for an Integration of the Framework

Contemporary architectural studies generally integrate all aspects to develop the complex set of skills needed by today's architects. However, they have mainly focused on theoretical knowledge disseminated in lectures and design classes taught in studios. The encouragement of students to investigate built environments and how they impact users only takes place as a side subject despite its significance for user-responsive design. Furthermore, art classes are often taught detached from the actual impact of design choices on the image-making process and thus the creation of urban identity. As architects need to work within all three spaces (conceived, perceived and lived) to produce sustainable structures, the delivery of the curriculum should balance between theoretical knowledge, empirical research, and creative design. The following five suggestions offer initial steps as to how this balance can be achieved within a typical curriculum leading to a professional degree in architecture.

1) Introducing the theoretical framework in lectures

By introducing the triad of space production architectural students are made aware of their future role in enhancing sustainability. Thus, it is recommended that this framework be introduced as early as possible in a series of lectures at the beginning of the course. These lectures should encourage students to read more about theories of space production and provide them with a list of main literature. They also should involve discussions and in-class debate in which students voice their ideas relevant to the framework.

2) Providing more extensive courses about ecological design

If an ecological design course is not yet part of the curriculum, it is highly recommended that one be established that introduces various methods of constructing more ecological buildings. It is important that students learn about building materials and their application in certain climatic conditions as well as construction techniques that increase energy efficiency. Furthermore, new technologies relevant to the urban context, such as gray water usage, district cooling, and heat pumps, should be introduced. It is highly recommended that seminars be held where students themselves have to investigate and discuss aspects of ecological design.

3) Integration of Environment Behavior Studies (EBS)

Specific courses should be introduced to help students investigate the built environment via observation techniques. First, students need a series of lectures that introduce how certain techniques are used and what the purposes of these techniques are. These courses can be taught in groups, with each group focusing on a selected range of buildings and public spaces. The main purpose of Environment Behavior Studies is to develop an empirical basis for how buildings affect human behavior in order to improve the students' ability regarding user-responsive design.

4) Reconfiguring the direction of design courses

Art and design fundamental classes should be modified towards the teaching of a more conscious process of image making. Therefore, a series of lectures should be included in the curriculum that offer knowledge about the various ways that the expression of environments impacts human psychology. Their main focus should be to develop the students' skills in using the various images by giving them specific design tasks. These tasks can either be focused on concrete buildings or abstract spaces. Other forms of art, such as film making or stage design, can be integrated in the teaching of a more conscious sensibility about image making.

5) Promoting integrative design projects in studios

Design projects are often carried out detached from other subjects leading to the oversimplification of key design parameters. Thus, it is recommended to emphasize the equal integration of the variables that affect that development of a design project. When students design a building, they have to integrate their theoretical knowledge as well as their empirical knowledge based on their own research. Furthermore, the design and its purpose of image making have to be put in the context of the actual realities of the project's context.

Conclusion

The framework presented in this paper based on Lefebvre's theory of space production emphasizes a holistic understanding of the architect's role in the development of sustainable environments. In this respect, Henri Sanoff states that architecture should be based on knowledge and awareness of people needs and it should not be based just on the creative impulse of the architect (Sanoff, 2003). Thus, teaching architecture for sustainability has to be based on a holistic view of society and its needs. By developing a curriculum based on a space-production theory, architecture students learn to understand their particular role in making design decisions. They will be prepared to work in interdisciplinary realms since they can gain insights into how other professions interrelate in the production of space. By implementing a general framework that connects the topic of each taught module within a larger picture of space production, including a philosophical discourse, a more integrated understanding of architecture can be transmitted to students rather than simply teaching a piecemeal series of topics. Subsequently, students learn to understand the role of each knowledge segment in a macro context and thus a systematic pedagogy is introduced.

The most important aspect that will shift teaching towards creating more awareness about sustainability is the encouragement of students to focus on the built environment and its context in society. One would refer here to the statement made by Habraken when he argues "*Teaching architecture without teaching how everyday environment works is like teaching medical students the art of healing without telling them how the human body functions. You would not trust a medical doctor who does not know the human body. Knowledge of everyday environment must legitimize our profession*... (Habraken, 2003, p. 32)."

Due to rapid urbanization worldwide architectural students need to be prepared to understand the various conditions of their future profession. Architects play an important role in shaping cities but their awareness of the city as a whole is often limited. Urban qualities are dependent on architectural developments and thus the skill of architects in integrating efficiency, diversity and identity within each single building. Architecture is one of the very few transdisciplinary professions that has its importance in mediating between various needs and interests. Due to economic circumstances today's architects usually have limited time to extensively explore the environment. Therefore, it is crucial to raise their awareness of key aspects and to train them on a certain set of skills to comprehend complex contexts. Teaching architecture for sustainability is thus equal to training integrative decision making based on theoretical, empirical and intuitive knowledge.

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A PROPOSED METHOD FOR DETERMINING THE PEDAGOGICAL APPROACH USED BY ARCHITECTURE EDUCATORS IN UNIVERSITI TEKNOLOGI MALAYSIA

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Abstract
Adopting green technology, buildings management, building preservation and distortion of buildings relates to architectural education in Malaysia. The Malaysian Government have a dream of implementing National Technology Policy, in realizing the national goal to achieve this National Green Technology Policy. Researches have been carried out in design course content, especially related elements of the environment and design content, components of sustainable design and on the content of the studio program. Few researches have been carried out in pedagogical aspect of Architecture. This paper expresses a proposed method of an on-going post graduate research to determine the pedagogical method use by lecturers in the department of Architecture, Universiti Teknologi Malaysia (UTM). This research has been carried out using the Qualitative method of research with Delphi technique as the methodology. First proposed two pilot surveys were carried out involving the educators and students; the result of the pilot survey would form the major part of the research questions which would form the second round Delphi method questionnaire. Throughout the designation study years for Architectural programme they have only 2 main courses and 2 elective courses related to sustainable design out of 35 core courses and 10 electives for the architectural students to choose from. Findings from the literature reviewed and the pilot studies carried out it shows that 20 different categories of pedagogy are used by UTM staff. The study would be subjected to a second round of Delphi method concentrating on the Staff only to streamline the pedagogy that would be suggested for an effective incorporation of components of sustainable design in the curriculum of UTM.

Keywords; *architecture, educators, method, pedagogical approach, UTM*

1.0 INTRODUCTION

1.1 Introduction and Background

In Malaysia, the government has taken proactive steps in solving this energy problem by having governmental policies and bases on sustainable development in the Seventh Malaysia plan by Government of Malaysia in 1996. National green Technology policy launched in 2009, targets 4 sectors, namely energy, buildings, water, waste management and transportation. For the building sector, this policy outlines the following: "Adopting green technology, management, building preservation and distortion of buildings" This statement relates to architectural education in Malaysia and architecture must take reasonable steps in realizing the national goal to achieve this National Green Technology Policy (Malsiah, 2011).

This study will talk on only active component of environmental sustainable design, how the architectural educators in Universiti Teknologi Malaysia teach their students the active component and how the students incorporate what they learnt in theoretical courses to their design studio. It will consider only educators that are specialized on sustainability and pedagogy.

The effective pedagogy study would be tested on the fifth (5) year students only. The study would not involve the other year student.

2.0 LITERATURE REVIEW

2.1 Role of the Architectural-Educators

A design teacher has many roles to play. He is the educator. He is, usually, the author of the program. He is the mastermind of the project details and its other aspects. He is the guide if the project deliberations need visitation to site and case studies. And, finally, he is the client to his students. He keeps full control over the sailing of the Design Ship. This multi-disciplinary role requires him to deliberate, debate and enter into a perceptive dialogue with students on the issue of Creative Design Development. It is here that the Hidden Curriculum becomes manifested (Anis,

2002). Within his many roles he has to use various pedagogies to impact knowledge and effective learning environment.

2.2 Sustainable Design Components

Abdul Malik & Abdul Samad, (2009) state components of sustainable design as passive active and activities-post occupancy while Manisha Singh, (2010) refers to these components as Key components for sustainable design are ecology, economy and social/culture. Although these components as highlighted by Abdul Malik & Abdul Samad and Manisha have similarity in that most of the elements found in both list have similarity for most elements are synonyms.

Table 1: Sustainable/Green building Component

	Passive	ACTIVE	**Activities-Post Occupancy**
	Location	**Rainwater Harvesting**	Low Energy Office Equipment
	Orientation	**Day Lighting**	Recycling Programs
	Shape/Geometry	**Wall and Roof Spray**	Staff Education Programs
	Envelope/Institution	**Low Energy M & E System**	Campaigns and Competitions
	Sun shading		
	Community programs		
	Natural Ventilation		
	Policing		
	Sustainable Materials		
	Green Roofs/Landscaping		

Source; adopted from (Abdul Malik & Abdul Samad, 2009)

2.3 Definition of pedagogy and Pedagogy in Architecture

In the middle age in Europe, monastic schools of Europe developed Pedagogy where learners and learning were observed based on monks in the teaching student skills (McAuliffe, et al., 2009). "Pedagogy is the practice where shared body of knowledge is achieved through framed teaching. This knowledge comprises experience, proof, Know- how of moral purpose and an effective shared transparent of values" (Pollard, 2010).

The following are list of pedagogy adopted from UNC 2012; it listed 150 pedagogies and 30 strategies for education innovation (Nair 2004) were critically reviewed to sort out those that are related to pedagogy in Architecture and choose the ones that relate to housing design. Not all will be used at a time. Present situation will lead to which to use, or after using one and the objective of the lesson is not achieved then another will be selected to use so as to achieve the aim. For instance particular sustainable building was discuss in a class so that students should design sustainable housing, it will not be very clear to the students without visiting the case study.

Table 2: List of Pedagogy adopted from UNC 2012 & Nair 2004

Lecture method	Class discussion	Desk crit (Individual)	Presentation by a panel of instructors
Presentation by students	Expert guest critics	Field trip	Seminars
Peer critique	Group critique	Class projects	Individual projects

Research	Case studies	Use of chalk/white board	Surveys
Use of diagrams, table, graphs, and charts by instructor	Peer teaching	Use of technology and instructional resources	Visit an employment agency

Source; author field work

Salama, (2010) stated that Pedagogy in Architecture has both positive and negative tendencies the negative tendencies are that design concept and finishing is what is expected from the student. The finish product is what matter the process the student arrived at it is of no concern. The students are been rewarded based on the best looking project; this is because there is no clear cut goals and objectives from the beginning of the design approach and the instructors assume the master and students have to believe the master approach. While the positive tendencies are discussions are encourage and the transformation of student and permits learning about the process of changes in a dynamic environment (Salama 2010). Design course is unique to architecture education because it usually taught in a special place called the studio (Wade, 1977). Studio, here is a place or space in fixed position. Usually Design courses in Design-based education as such architecture, landscape architecture, interior design, graphic designing and fine arts such as have a studio space for Design courses. In most architecture schools, studio-based course is a course that has the highest credit, a heavy workload and long-time commitment from instructors and students.

2.6 History of Design studio in Malaysia

Idea of design studio in the architectural education as a form of collaborative learning was first developed in the 19th century in France by Ecole des Beaux Arts students (Wade, 1977). Most of the formal activities in the school consist of theoretical lecture and design competitions monthly and just some time allocated for the tutorial Design. Architectural education in Malaysia has been following the model of architectural education RIBA (UTM Department of Architecture, 1975). By the use of studio for learning and teaching of design course is a typical in architectural education in Malaysia.

3.0 METHODOLOGY

3.1 Method

The study was carried out using the Qualitative method of research with Delphi technique as the methodology to be employed. First two pilot survey were carried out involving the educators and students the result of the pilot survey would now form the major research question which would be the second round of the Delphi method. The research has been conducted by using pilot interview on the Architectural educator's and Survey Questionnaire on the fifth Year students. Both the Delphi and the surveyed questions have been analysed with Statistical Package for Social Science (SPSS) for the quantitative (questionnaire) the interview content analysis.

3.2 The main research tool (Qualitative)

The Delphi techniques are experts' judgements gathered through successive iterations of a questionnaire, constituting rounds. It has been a seasonal method of research analysis as reported by (Landeta, 2006) who has carried out research extending the research initiated by Gupta and Clarke (1996), showing the use of the Delphi method from 1965 through 2004. This method provide a reliability and generalizability outcomes, ensured through iteration of rounds for data collection and analysis, based on the principles of democratic anonymity and participation.

4.0 RESULTS

Throughout the designation study years for Architectural programme they have only 2 main courses and 2 elective courses related to sustainable design out of 35 core courses and 10 electives for the architectural students to choose from. This method is expected to bring out the form of pedagogy use by UTM staff in their pedagogical approach so as to highlight methods that can be used to effectively incorporate components of sustainable design in the curriculum of UTM. This method is expected to bring out the form of pedagogy use by UTM staff in their pedagogical approach so as highly method that can effectively incorporate components of sustainable design in curriculum of Universiti Teknologi Malaysia. Findings from the literature reviewed and the pilot studies carried out;

it shows that 20 different categories of pedagogy are used by UTM staff, as shown in table 2 above. The study would be subjected to a second round of Delphi method concentrating on the Staff only to streamline the pedagogy that would be suggested for an effective incorporation of components of sustainable design in the curriculum of UTM.

5.0 DISCUSSIONS

5.1 Research Approach or Design

Presentation of round one Delphi results Respondents asked to reconfirm or modify their responses made in the first round Delphi survey Ranking of the rated characteristics/features in the proposed pedagogical framework and using the Relative Importance Index (RII). Summarized agreed list of the ideal pedagogy for translating components of sustainable design in a hierarchy and their corresponding ratings.

Table 3; Taxonomy of Delphi Inquiry

	To measure the level at which architectural educators translate sustainable design components to students in Universiti Teknologi Malaysia			
	Objectives	**Method**	**Analysis**	**Remarks**
	To identify and list the pedagogy used by Architectural educators to teach sustainable design components in Universiti Teknologi Malaysia	**Interview**	**Context method**	Importance Index Ranking (RII) technique. For final analysis
	To assess the degree of usage of sustainable design components by the fifth year (5th) Universiti Teknologi Malaysia students, in their studio work	**Questionnaire**	**SPSS**	

Source; authors field work

While the second round of the Delphi method which will be done later is a qualitative (interview) which would be analysed using the relative importance index (RII).

5.2 Ranking of the features/characteristics in the proposed pedagogical framework in an hierarchical format and using the Relative Importance Index (RII)

The rankings that were provided by the Delphi respondents using the five point Likert scaling were combined and then converted into relative importance indices for each of the features/characteristics, by adopting the relative importance index (RII) ranking technique.

$$RII = \frac{\sum W}{A \times N}$$

Where W: Summation of the weighting to each feature/characteristic
A: Highest ranking (5)
N: Total number of respondents for that factor

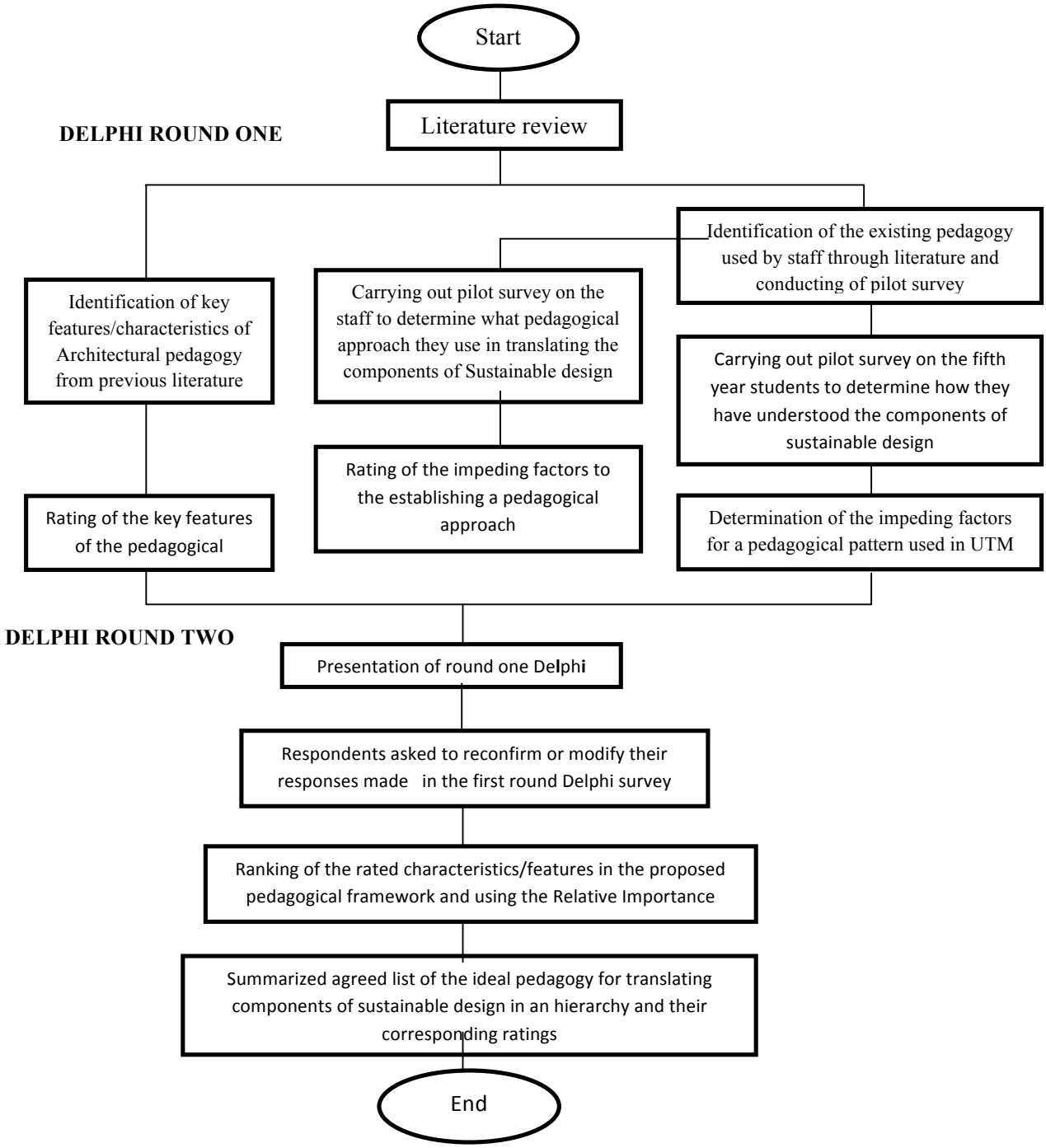

Fig 1: Research Process Flow Chart; a Schematic Flow Chart of the Proposed Research Method Using Two Rounds of Delphi Technique Source; authors field work

6.0 CONCLUSION

From the study carried out the present Architectural programme curriculum in the university does not deal with sustainable design issue effectively. So the pedagogy cannot be pointed out for sustainable design, only for general architecture. Therefore this study is vital because it will come out with a frame work to enhance the pedagogy of sustainable design in Universiti Teknologi Malaysia effectively. Throughout the designation study years for Architectural programme they have only 2 main courses and 2 elective courses related to sustainable design for the architecture student.

7.0 ACKNOWLEDGEMENT'S

The authors will like to acknowledge Dr. Malsiah of Universiti Teknologi Malaysia (UTM) for Providing Most of the materials for this work and the Staff of Universiti Teknologi Malaysia (UTM) and 5th year students who gave their time for the interview sections and answering the questionnaires'

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INNOVATION IN STUDIO TEACHING

INTEGRATED APPROACH FOR YEAR ONE ARCHITECTURAL DESIGN-AND-BUILD STUDIO

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ABSTRACT
Communicated modules in architectural education target, in the first place, enhancing and developing students' understanding of design requirements, via improving their innovative capabilities. Architecture students are expected to practice the integration of gained knowledge that affect the architectural design-construction-use phases, obtained through all taught modules, into their design projects; such knowledge would include construction technologies, ecological considerations/technologies, socio-cultural influences, tangible/intangible heritage, building regulations…etc.
Achieving such integration, several approaches have recently been employed in different architectural pedagogical systems all over the globe. In United Kingdom, as an example, the integrated process within architectural design studios is an essential requirement that is stressed by both the Royal Institute of British Architects (RIBA) and the Architects Registration Board (ARB).
This paper displays the University of Nottingham's approach in teaching core 'Integrated Design in Architecture' modules. The proposed study focuses mainly on the most recent integrated design-and-build project (functional cardboard shelter) undertaken in the undergraduate architecture course's Qualifying Year, at Ningbo Campus, in China. The project employed a learning-by-doing approach, where the project's brief employed non-ordinary conditions for the students to think of design basic requirements; via employing only cardboard as construction material.
The paper analyses the outcomes of the project, compared to its objectives; measures the effect of the students' experience upon their designs, by comparing anonymous sample design work before and after conducting the shelter project.

Keywords: *integrated design, architectural design studio, architecture, design, Nottingham, architectural pedagogy, innovation, design and build.*

1. INTRODUCTION

"I had to make the model using the building's actual materials just to learn what the reflective qualities would be like." Mies Van Der Rohe (talking about his glass-and-metal working model of his 1917 *Friedrichstrasse Tower (Steele, 2008)*

Architectural design-studio pedagogy, in our contemporary higher education institutes, is mainly based on the "desk crits" approach, where groups of students are assigned to a studio teacher, who oversees the students' work both individually and in groups (Dinham, 1987). This approach is claimed, here, to limit the transferred design skills, through the learning process, to tutors' individual skills. Thus, more interactive and engaging approaches are required to broaden the horizons of knowledge-gain and skills development in design studio teaching.

This paper demonstrates the "design-and-build" approach, adopted by the University of Nottingham, as an approach that engages architecture students in a more dynamic and creative pedagogical manner. In particular, the paper focuses on the most recent case of its design-and-build cardboard shelter project. The project is assigned for Qualifying Year students at China campus. The paper analyses the different transferred skills gained through the two-week project compared to those gained through the traditional desk-crit approach.

2. ARCHITECTURAL EDUCATION IN BRITAIN- A BACKGROUND

In nineteenth century England, the technical and industrial development resulted in the separation of artistic conception and realisation, which was claimed to challenge man's creative activity, and urged the generation of 'profession' for architecture, as for other activities. This was marked by the introduction of public examinations, which was a key feature of Victorian Britain, in general, to accredit specialists serving the needs of industrialisation in many aspects of society (Cunningham, 2005). The Royal Institute of British Architects (RIBA) was established in 1834 to define and introduce an examination in Architecture, which became compulsory to those wish to be members from 1880s.
Opposing the Arts and Craft movement, dominating Europe at that time, which sought to stem the threat of progressive mechanisation to craftsmanship and individual expression, reunite the creative arts and realise again the total work of art, the UK started to develop its own trend in

architectural education. Consequently, a new social order was introduced, which envisaged total design of the living environment for the masses; an educational philosophy arising from these new perceptions was implemented in the Royal College of Art, formerly known as the South Kensington School.

In his thorough study, "notes on education and research around architecture", Cunningham (2005) describes how traditional atelier pedagogy in architecture has been guided only by individual perceptions of teachers, who were transferring their ideologies and skills to their students. The Architectural Association (AA), established in 1847 as a reaction against the architectural establishment, and the only surviving independent school after the Second World War, had an educational format closest to the Beaux Arts, where ideas are freely exchanged. This was before the recent engagement of practitioners teaching in its studio units, which had a great influence on its educational format. Despite this change, the AA, with few other architecture schools, such as the Bartlett and the University of Westminster, in the UK preserved their reputations for fostering both design and theoretical exploration.

In general, British architectural education system has been known for its conservative approach that reflected the British social structure and values. Consequently, its educational preferences, in general, affected architectural pedagogical philosophies, which were shaped by linear analytical models upon which British universities have historically based their prospects.

2.2. Design and Build Experience at the University of Nottingham

The University of Nottingham has been developing a strong approach for employing Design and Build architectural design studios for strengthening, not only the students' understanding of different skills required for architectural design practice, but also to foster the University's and its students' social involvement, and emphasising the important roles of both the architect and the educator in serving communities, on both levels, nationally and internationally. The following are examples of projects carried out by undergraduate architecture students at the University of Nottingham:

Figure 1. Nursery School Project, Klerksdorp, South Africa
(source:
http://www.nottingham.ac.uk/engineering/departments/abe/undergraduate/profiles/nurseryschoolproject.aspx)

In September 2008, 180 Year 2 students were briefed by the charity *Education Africa* to design a sustainable nursery school at Jouberton, in South Africa. The brief was for a four-classroom nursery school with an office, kitchen, toilets and sheltered external spaces. The nursery replaces a dilapidated 'shack' that served as a pre-school for around 100 children.

In December, the strongest three proposals were selected for further development. Between January and March 2009, a group of thirty six students, twenty eight 2nd years and eight 5th years, developed the project in detail through the final construction drawings and schedules of materials.

In March 2009, the students, two tutors and two volunteer architects flew to South Africa to construct the new school. The construction took seven weeks.

Following the success of Project Jouberton, the Department of Architecture and Built Environment decided to return back to South Africa, in 2010, with its new and more social challenging students' project "The Project Limpopo", in the rural northern Limpopo province; with the provision of community-run crèches, and designed and constructed by architecture students.

The final designs have been chosen in January 2011. Then, a construction team of students, supervised by two staff, travelled to South Africa, in March, for carrying out the construction, which developed over six weeks.

During the project, it was recognised that risk assessments and skills training were required, which were undertaken in conjunction with the University requirements, to ensure safe working practice. However, this resulted in some operations to likely be beyond the time (Deane, 2011). This suggested introducing architecture students, early in their Qualifying Year, to developing some of the required skills for design-and-build projects, which is illustrated in the following section.

Figure 2. (Left) Project Limpopo Figure 3. (Right) Construction study model

3. YEAR ONE DESIGN-AND-BUILD SHELTER (A CONSTRAINED FUNCTIONAL HUB) PROJECT AT UNNC

The Shelter Project is a joint project between the architectural design studio module and the Integrated Design 1 module. The latter is a predominantly lecture-based module that introduces students to the idea of a context of integrated building design; by bringing together the disciplines of architectural humanities and theories, building construction and technology, as well as environmental design in a holistic design approach. The module runs in parallel to the studio module. Through practical exercises, the module is designed to link taught lecture modules with studio design project work.

3.1. Module's Education Aims and Learning Outcomes:

Integrated Design module aims to introduce the fundamental principles of design as well as touching on methodology and approaches relevant to a contemporary architectural forum. The module's objectives are not conclusive, but introductory and stimulating to independent student enquiry. The broad base from which students start their enquiry is to allow development in key areas of interest for each student. By bringing and joining together an historical and theoretical understanding of architectural technology, the module seeks to support the fully integrated design approach of teaching, which the Department is keen to promote.

Learning Outcomes: These learning outcomes are developed through a regular programme of design exercises, reviews and criticisms and a portfolio review.

On completion of the module students are expected to be aware of:
- the relationship between technology and architectural design from a theoretical and historical perspective
- the importance of an integrated approach to architectural design
- the contribution that structural, constructional and material considerations make to design of a building
- the influence of the appropriate selection technical solutions on creative design and on the creation of a sustainable environment.
- the relationship and importance of technology and architectural design
- the way integration exists both in the historical and contemporary context

Students should also demonstrate the ability to:
- communicate their understanding of construction and structures through a critical appraisal of the integrated approach to design
- determine the appropriateness of architectural and technical solutions

3.2. Project's brief and teaching approach

This project marks the start of Spring Semester; it aims at integrating imaginatively the knowledge and experience gained throughout the First Semester and introduces students to designing for a public client rather than a specifically defined client as in the first semester. Also, the project stresses the cognition of space by experiencing the design through real-life scale models. Also, the project introduces students to the concept of employing/considering real materials (on a limited scale), which is expanded to include more real-life building aspects in their following year.
The required design project is a shelter for hosting only one function (can be more than one function that are related to the same theme), to be carried out by only one person.
Groups of 5 students each are to jointly design and build a shelter in a period of 10 days.

The projects were asked to respond to the following constraints:
- The volume of shelter should be from $2m^3$ to $2.5m^3$;
- The function should be decided by the group members, and it should suit the dedicated space volume;
- The space can be used from the inside and/or the outside;
- ONLY cardboard sheets are permitted for constructing the shelter;
- The used form and structure should respond to the design concept, functional ergonomics, and construction materials;
- The construction of the project will take place in the SEB Atrium, which should be considered as a constrained environment that the design should respond to; and
- The construction process of the project should start on 8.00am and ends no later than 15.00pm on the submission day, which requires a planning ahead as part of the design process.

The constructed projects were marked on the following:
- The appropriate choice of suitable function to the determined project volume and used material;
- How thorough the analysis of the chosen function is;
- How effective the design concept is;
- How well the design responds to the functional ergonomics;
- How successfully the design has developed through model-making;
- The submission of design process panels that clearly illustrate both initial ideas and the design as it develops, together with the precedents that have inspired the design;
- How well the project responds to the daylight throughout the day;
- Accurate and correctly drawn orthographic drawings;
- The functionability of the constructed shelter (ability to function); and
- The accurateness of construction within the determined time-span.

Expected learning outcomes of The Shelter Project are:
- To decide a spatial function;
- To analyse the requirements of a general client doing a specific function;
- To understand the relationship between the user, function, and space;
- To explore the consideration of using specific material for construction and its consequences;
- To develop design skills (spatial, formal & material integration); and
- To further develop presentation and graphic abilities.
- To develop an understanding of functional requirements, and to develop a unique design brief for a general/average client;
- To design an ergonomic and functional space; identifying & synthesizing user's demands;
- To design an exciting space which responds to the brief;
- To communicate effectively the design intentions / ideas through models, graphics and verbal presentations; and
- To develop a sense for structure and materials consideration in design.

4. ANALYSIS AND DISCUSSION

Constraining the materials to only commercial cardboard sheets, which is not treated for construction purposes, and the construction site being an indoor atrium, were meant to provide non-traditional circumstances and building environment, so students have to put more effort into

studying, analysing, and synthesising their construction context and properties of materials; not only depend in their decisions on data from design handbooks.
This section analyses six projects; discussing the projects' outcomes in response to the projects aims, and their effect on the students' design skills.

4.1. Team management

Working as a team towards achieving a design task was a new experience for the participating students. It was essential to identify the required skills for achieving the assignment, and match it to their individual skills; so they allocate appropriate tasks to the most suitable candidates.

4.2. Function selection

Each group was required to decide a suitable function to be accommodated within 2.5m3 of volume, and also can employ cardboard as a construction material. It should be mentioned here that the time allocated for decision-making varied from one group to another; depending on several factors (e.g. members' harmony, engagement, enthusiasm, seriousness, etc.).
It was clear that working in group, especially when all members were encouraged to participate in discussions, urged them to discuss the suitability of functions in much more details; no decision was taken for granted as in traditional individual studio work- thus they spent more time convincing each other, which produced functions that are engaging with the students' contextual understanding, more realistic, and more interesting.

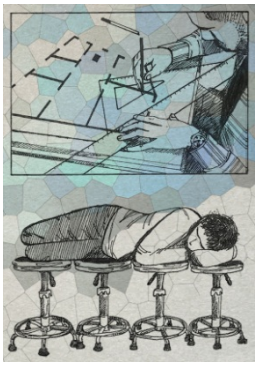


Figure 4. Accommodation hub for architecture students

The six projects' functions analysed here are: accommodation hub for architecture students; relaxation hub; temporary accommodation for homeless people; meditation hub; 'refuge for soul' hub (stress-relieving); and a reading hub.

Figure 5. (Right) Relaxation hub

Figure 6. (Top) Refuge for Soul hub

4.3. Functional ergonomics and spatial analysis

Working in groups enriched the discussion about spatial requirements for each project. It was realised that they also developed a better understanding of the functional ergonomics.Students had to consider variations between the physical ergonomics of different group members, which appeared in changes applied to the projects' initial formation during their early design stages.

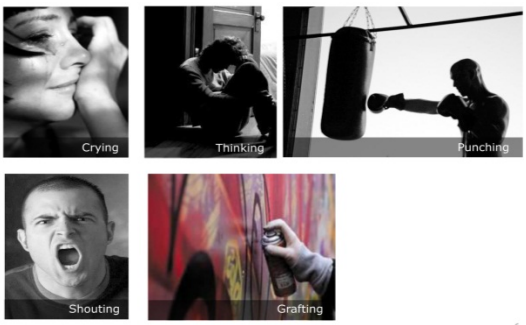


Figure 7. Functional ergonomics study of the stress-relieving hub

4.4. Form-creation

Form creation, in the six analysed cases, can be classified as either following concept (which might or might not be directly connected to function) or serving the determined shelter's function, as follow:

4.4.1. Form follows concept:

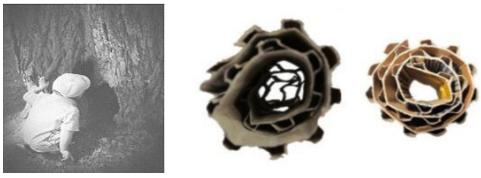
The first case is the cocoon (the accommodation hub for architecture students); the concept symbolises the starting life of architecture students, who prepare to grow into butterflies, and aims to create a space separated from its surroundings.

The second case is the 'womb': the reading hub. The concept also is trying to symbolise the function; where it links between the embryo's position, getting fed in the mother's womb, to the brain being fed by knowledge.

The third case is the 'tree-trunk' housing the stress-relieve hub. Although transformed a bit from the inside to respond to the accommodated functions, which consequently affected the external form. The group was very keen, as much as they could, to keep the tree-trunk clear in their final design; as their concept started with, recalling childhood memories/stories.

Figure 8. The cocoon- an accommodation hub for architecture students

Figure 9. The Womb- Feeding the growing mind

Figure 10. 

The Tree- stress- relieving hub

4.4.2. Form follows function:

The first extreme example was the homeless shelter, where the students' group started with identifying the required functional activities and their ergonomics requirements, concluding the three main zones: sleeping, eating, and dressing (with suitable storage), which resulted in the three design zones that created three responding volumes/spaces. The students' mission afterwards was to decide the most appropriate spatial organisation for the three volumes. It is worth mentioning here that students tried to superimpose a concept that matches their approach, "the puzzle" (descriptive, rather than a guiding concept).

The second case is the meditation 'pyramid'. The students chose a simple form that just accommodates the ergonomics requirements, and reflects the pureness of accommodated function. The form developed later to represent the project's original concept, 'reflection', where day-light was employed to provide sky reflected image on the atrium's reflective ceramic flooring.

The last case can be classified as following both form and concept; as the group decided to employ the concept of 'relaxing cubic cave', where they created a complex mesh of intersecting

cardboard sheets that represent the cave, while carving a relaxing seat inside that is completely informed by an explicit physical ergonomic study of relaxing positions.
In general, the main remark on all groups was that: up to the form decision stage, the process wasn't different from that followed in traditional studio desk-crit approach. The decisions were based on model studies, and did not consider construction materials to be used, which is discussed in the following section in more details.

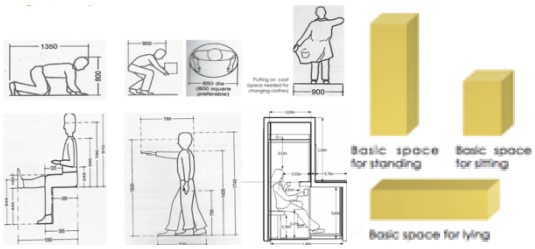


Figure 11. Homeless shelter- the three functional zones

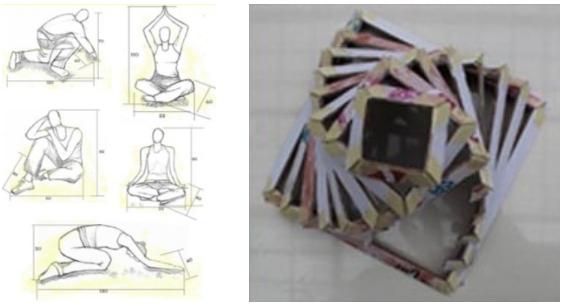


Figure 12. Meditation Pyramid- functional-fit-form

Figure 13. Cubical cave- combining function and concept informing the form

4.5. Structural and material considerations

Structural and material consideration was one of the main new challenges students were required to face during this project. Cardboard was only experienced as a scaled test models, which was the first problems that students had to go through. All groups, with no exception, fell into the trap of using the same material for their initial 1:20 scaled test model-making, which gave them confidence, on such small scale, that their structure systems were strong enough to carry their designed forms. This created many construction problems for most of the groups. Materials, previously calculated depending on their estimation from the test-models, were found insufficient, thus instant design solutions were required to overcome such problems.

Due to the paper-length limitation, only two examples are displayed in this paper, showing design solutions students suggested in two of the projects, and a third case that shows a successful choice of structure system that helped overcoming the construction material's weakness.

4.5.1. Re-distribution of loads

The first case suffered a simple collapse at one corner of their model while construction, because of one person fell down; resulting in materials leaning to one side under its own weight. The group decided to solve this problem by adding supports (buttresses) to transfer some of the load outside the original form, to an adjacent wall (flower-box).

4.5.2. Adding inner structural system

Although the project performed a creative form with an innovative daylight use, and introduced a unique joints' design between the form's horizontal layers (beams) forming the twisted pyramid, this group suffered a severe failure due to over-thinking the external form (as usually happens with most of Year 1 students). Students did not develop a strong supportive inner structural system to support the external shell. The design depends on the form to carry its own load, as the case of the scaled model. After the collapse of the initial 1:1 shelter construction, the students had to analyse the reasons for failure and solve it out, which coast them an extra weekend of hard work. As a solution, they added a base (foundation) and supporting posts to carry the loads of over-hanging beams inside the form, without affecting the meditation activities taking place inside.

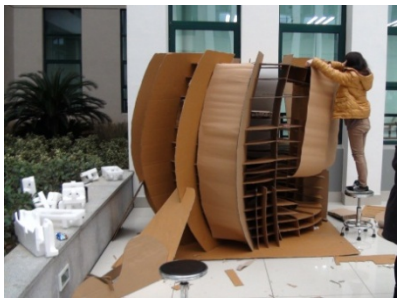


Figure 14. (Left) Using buttresses to transfer extra loads
Figure 15. Foundation and inner posts

4.5.3. The super 3D mesh

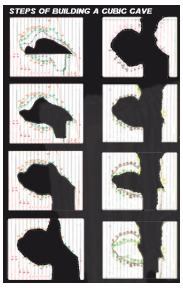
Based on a previous experience from an assignment they carried earlier that year, as well as precedents study of equivalent structures, a group of students decided to build up their structure as a massively intersecting perpendicular cardboard sheets (forming a rock), and carve a cave inside. The process of designing the complex mesh structure, and collecting it took them a long time (which will be discussed in the next section), but definitely the results were guaranteed of a very strong structure that has been displayed for publicuse for more than 5 months, while maintaining its efficiency; evenly carrying and distributing the loads, while overcoming the material weakness problem by the self-strengthening structure system.

4.6. Time and construction management

From the most important skills that students have developed through this project were team-work and time-management. Students had to finish constructing their projects within seven hours, which meant that they should prepare a cutting list and construction management plan, with construction drawings explaining in details how different parts should be cut and fixed together.

This process saved the students a lot of effort during construction, and minimised the errors they could have faced. But most importantly is that students appreciated by practice/doing the importance of accurate drawings and management of team work.

It has been recognised that the gained skills students have had during this project obviously improved their performance and were reflected in their work on the comprehensive design project that followed.



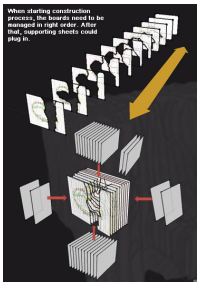


Figure 16. (Left) complex mesh of cardboard sheets
Figure 17. Example of a construction plan

5. FINAL STATEMENT

Design-and-Build studio projects have proven a successful architectural design studio approach at the University of Nottingham's campuses in both UK and China. It was proved that this approach helps students develop skills that are not easily taught through the traditional desk-crit tutorials; such as team-work, construction planning, material testing, health and safety, etc.

The use of cardboard as a limited construction material proved to emphasise the importance of studying the characteristics of the employed building construction materials and their suitability to building site's environment; and how such characteristics can be improved by the designed form. This is considered as a preparation for more in-depth study of diverse use of real building construction materials to be followed in their Year 2 studies.

Finally, this paper doesn't suggest the design-and-build approach as an alternative to the traditional design studio, which still has its own advantages that cannot be gained through design-and-build projects (e.g. working on large-scale project designs- mega structures or urban scale as examples). However, the paper illustrates the advantages of the Design-and-Build as a complementary approach in parallel to traditional architectural design studios, and recommends more testing of the approach application in architectural design studio pedagogy to be followed; in order to improve and gain the most advantage of such practical approach for teaching architectural design.

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DESIGN DISTINCTIVENESS: DESIGNING FOR PEOPLE AND PLACE AS A WAY FORWARD

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Abstract
This paper presents a conceptual framework for the proposal and development of the design distinctiveness of the Bachelor of Science (Honours)(Architecture), a 3-year undergraduate architecture programme, at Taylor's University. The Bachelor of Science is a relatively 'young' programme. As this year marks the fifth year of the programme, the School is developing a strategy to clarify its position and create a unified view of the School's direction. The School of Architecture at Taylor's University proposed for a distinctiveness through architectural design studios that centers on 'sustaining humanity', i.e. designing for people and place within the context of contemporary built environment. With the core focus in architectural design studios (from Years 1 -3), the distinctiveness focuses on contemporary architectural responses and place-making to site-specific or contextual conditions of place. The paper begins with a brief summary of architectural pedagogies or ideas that had influenced the study of architecture. Subsequently, it depicts the proposed conceptual framework for architectural design studios, and reflections on its implementation. The purpose of this paper is to provide a platform for discourse on the conceptual framework in order to develop a robust and meaningful direction for learning architecture.

Keywords*: design distinctiveness, place-making, design studio*

1.0 Introduction

Design studio is universally accepted as a place for educating the next generation of architects. It is the learning environment by which knowledge of architecture is integrated and practiced both creatively and pragmatically. Having said this, the philosophy of design studio is thus important in positioning and articulating the direction of the School. The author of this paper has the opportunity to develop distinctiveness within the architectural design studies with the expectation to clarify the position and create a unified view of the School's direction. The process of developing the design distinctiveness went through debates and reflections by a team of studio coordinators that formed the basis of this paper.

This paper adopts an action research paradigm as the method of inquiry. Carr and Kemmis (1986) stated that action research is a form of self-reflective enquiry undertaken by the researchers in social situations in order to improve: 1) the rationality and justice of their own practices, 2) their understanding of these practices, and 3) the situations in which the practices are carried out. The process of developing the design distinctiveness has gone through few central areas. The design curriculum and its progression from one semester to another, and its integration to other streams of architectural studies have been developed to achieve a strategy to clarify the position and create a unified view for the Bachelor of Science (Honours) (Architecture) programme. The paper begins by giving a brief history of architectural pedagogies or ideas that had influenced the study of architecture before reflecting on the challenges of nowadays architecture education and the local context. Finally, the paper depicts the proposed model, and reflections on its implementation.

2.0 Architectural education, a brief summary

Architecture education, globally and regionally, has been influenced by established Western models. In the early 19th century, the "Ecole des Beaux-Arts" became synonymous with architectural education in France, England and eventually America. The educational process centred on the student's engagement in an atelier, or studio, under the supervision of a patron, a practicing architect or member of the Ecole faculty. (Michael, 2008) While remnants of the Beaux-Arts atelier system remain in almost every school of architecture, the contemporary design studio is equally influenced by the Bauhaus curriculum and Modernist philosophy that combined theoretic education (a primary course and composition theory) and practical training in the educational workshops. (The Bauhaus Dessau Foundation, (online)) Between 1951 and 1957, a group of young men came to teach at the University of Texas, School of Architecture in Austin. These "Texas Rangers," as they later came to be called created a teaching program, postmodern by nature, which proposed that a workable, useful body of architectural theory could be derived from an ongoing critique of significant buildings and projects across history and cultures. (Caragonne, 1995) Other influences are like: Vhutemas in the twenties, the Russian counterpart of Bauhaus; and problem-based learning in the eighties conducted in Newcastle, Australia.

Remnants of these schools of thoughts echoed in architecture schools today with diverse focus areas. For example, prominent universities in the United Kingdom such as Architectural Association (established in 1847) draws teaching staff from progressive international practices allowing for continual exploration of architectural graphics and polemical formalism that formed its forte, while the Bartlett School of Architecture (established in 1841) emphasizes its strength of its multidisciplinary nature.

Whilst maintaining the idea on holistic studies on architecture, the emphasis is also quite diverse in the architecture education conducted in Malaysian universities. For example, Universiti Teknologi MARA (UiTM) curricula encompass holistic training, with emphasis on the importance of students' responsiveness towards the environments, in addition to the scientific-and-technological approach of the curricula; Architecture program at Universiti Teknologi Malaysia (UTM) aims at nurturing students' creativity, understanding of the nature and demands of design activities, skills in visual communication, knowledge of various architectural theories, and abilities in professional practice as well as an appreciation of the values of scientific research. Its curriculum is oriented to produce graduates with skills in design and architectural technology; Universiti Sains Malaysia (USM) carries through a multidisciplinary nature of the construction-based education to meet the needs of the developing nation.

From a regional perspective, many schools leaned towards the issue of environmental sustainability. In the recent 2010 issue of FuturArc, its main feature titled 'Educating Architects for the Future' by Robert and Brenda Vale, captured the approaches of varied architecture schools in different countries, grappling with the current issues of sustainability and the ethical role of architecture in this respect. For example, in Hong Kong University sustainability forms the core in the Master and Doctoral programmes; in Binus University, Indonesia, the Green theme is implemented in the design studio; in National University of Singapore, practices an educational position that postulates design as a state of mind and framework towards holistic and integrative solutions. Sustainability forms the intersection in three broad areas of inquiry: historical/theoretical and critical studies; urban studies; and design technology studies; in King Mongkut's Institute of Technology Ladkrabang, Thailand, the school endeavors to teach students not only the functional and spatial aspects of design, but also how to serve the betterment of dwellings, and the eradication of social issues and global environmental problems as a whole.

Nowadays information technology has transformed many trades and practices. In the education sector, e-learning and distance self learning are becoming a trend. Amidst these conditions, architecture schools and programmes are defining a position to move forward in teaching and learning architecture. Within the backdrop of the current transient change and challenges, the School develops a strategy to clarify its position and create a unified view of its direction.

3.0 Sustaining humanities, the conceptual framework

The Bachelor of Science (Honours) (Architecture) is a 3 years undergraduate pre-professional architectural programme. This programme provides an integrated and interdependent study programme that combines the disciplines of science and art and elevates their conceptual underpinnings to discover key factors in societal, cultural, technological, environmental, ecological, historical, political, economical and artistic developments, leading to the development and application of appropriate solutions to encounter the demand of rigorous shifting paradigms in Malaysia and to embrace the challenges of a dynamic 21st century global society.

In such a dynamic and creative field, architecture is taught as a holistic place-making process that goes beyond function. Architectural Design Studio modules form the core of the curriculum. Being design oriented, the architecture design studios within the Bachelor of Science (Honours) (Architecture) programme guides students to practice design relevant to its time and place, its people and its culture. The architectural design studios also lean towards design solutions that integrate knowledge from cultural and history studies, environmental studies, technological studies as well as practice in an interdisciplinary and holistic approach. While delivering the knowledge and competencies of the undergraduate architecture degree, the School, upon its fifth year running this programme, seeks to develop a strategy to clarify its position and create a unified view of its direction.

The philosophy and the conceptual framework of the design studies

As the 21st century unfolds, it appears that architecture is no longer fashioned by any prevalent style. How can architecture respond to its *zeitgeist or the spirit of its time*? The design distinctiveness gleans from the educational position of 'sustaining humanity'. (Commonwealth Association of Architects, (Online)) Designing for sustainability has been a fundamental issue for architects in our time within the global and regional contexts. In line with the current discourse on sustainability, this programme positions itself as an avenue to engage architects, through the design process, for they are realizing social well-being in the built environment. The emphasis on 'people-centered' approach discourse provides a platform for problem solving environmental and social issues. While the major goal of environmental sustainability is taught in the core modules within the Environmental and Technology studies and their integration to design, the design studies emphasizes the goal to connect people with the environment (place). It upholds the believe that architecture can create better places, that architecture can affect society and humanity, and that it can have a role in making a place civilized by making a community more livable.

This philosophy is translated progressively from the undergraduate (Bachelor of Science) to the postgraduate (Master of Architecture) degree. As the theme of sustaining humanity is broad, the undergraduate level grapples with the notion of place-making as the ethical function of architecture at a fundamental level, i.e. designing for people, place and time within the regional and global context. While the undergraduate level emphasizes on place-people relationship in design, the postgraduate level grapple with the philosophy of sustainability with different lenses: for example, through the lens of science and technology it can be examined with scientific mode of inquiry that predicts the energy usage and carbon footprint; through the lens of sociology and humanities it can be studied with social research methodology that focus on how to address a society's beliefs and values that drive sustainable development.

The implementation of the conceptual framework within the design studies

The architectural design studios are designed to emphasize on contemporary approaches and design responses towards the act of place-making. Students undergo a design process that engages in dialogue with a situation, through which, an objective understanding of the situation could be established and that solutions could be based on and emerged from. Every design is an exploration of ideas that is meaningful to the local conditions of place—its people, its natural and built environment, its history and traditions and relevant contemporary issues of environment and technology. The complexity of programme and context is incremental (beginning with the individual, to a space, and to an environment (natural, rural, suburban and urban), and carefully integrated environmental and technology studies from Semester 1 to Semester 6 as illustrated in Figure 1:

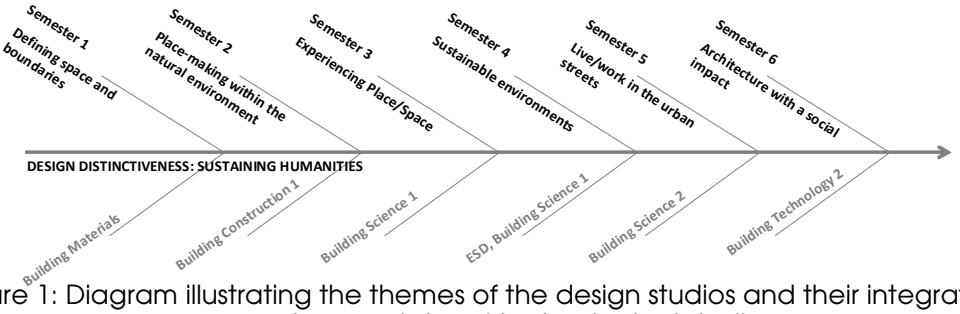

Figure 1: Diagram illustrating the themes of the design studios and their integration with environmental and technological studies

Year One: Place-making and the self

Year One provides basic knowledge and skills for architectural design. It introduces basic design terminologies, the generation and articulation of design concepts/ideas and the importance of design process in the architectural design. The emphases is on the developing architectural compositions which sufficiently demonstrates the concept of place-making for a selected user.

Semester One emphasizes the *inhabitation of space by the self that concentrates on the internal conditions of space*. This studio introduces the basic design principles of architectural design and takes into account basic awareness of program, materials, structure, construction, and the site in the act of space-making for one inhabitant. Students undertake a series of studio-based exercises and assignments that introduce the basic principles and methods in design thinking through the design a basic object to a full-size space. The first project deals with the interpretation of the 'self'

and an introduction to design through the process of making an object; the second project grapples with the issue of scale, space and basic awareness of assembly through a collaborative exploration of study models and the construction of a 1:1 space; and the third project involves the design of an individual space grafted into an existing simple architectural space. This final project explores the perceptual qualities of space, and the considerations of scale, proportion and anthropometrics. This module is integrated with Building Materials which requires students to explore material selection in their design work. The purpose is to inculcate awareness of understanding materiality in relation to user and context, in which the material is seen as part of design to create the spatial quality – effect of light and shadow, texture and color.

Semester Two investigates the *relationship of user to the natural environment*. It aims to inculcate awareness of architectural solution in relation to context and time (basic construction and technology). Students will undertake a series of studio-based exercises, beginning from a simple shelter to a small free standing building. The first project requires students to design a shelter within unique and distinctive natural landscapes (the cliff, the beach, the lake, forest…). Students begin the project by 'learning from precedents' in terms of the architectural compositions of solids, planes, lines and frames. Subsequently, students are required to translate it into a simple shelter for individual habitation within the natural landscapes. Subsequently in the final project, through vigorous prototyping from Project 1, students are required to design a small free standing dwelling (which has one significant room) for a particular user in a simple context. Emphasis is given to the interpretation and synthesis of the user, simple site and function in architectural design. This module is integrated with Building Construction 1 to instill awareness of buildability in design. This is the first attempt students tackle a complete building, a proper architecture.

Year Two: Experiencing place and context
Year Two emphasizes the importance of context or place in architectural design. It introduces the concept of experiencing and designing places with unique tangible and intangible characters and designing for a small group of users/community within the suburban conditions.

In Semester Three, the studio focuses on the *poetics of place and the experiential qualities of space* in architecture. Students are introduced to, firstly, an exploration of spatial typologies and poetics in architecture; and secondly, the concept of neighborhood (town and village). In their preliminary design work, students engage with studies and design of different spatial typologies (i.e. linear, spiral, spine, centric, etc) for a simple dwelling space which explores the idea of architectural tectonics and experiences. Subsequently, the major project involves the design of a small scale community building (e.g. gallery, small library) in the suburban condition which engages with the spirit of place inherent within the site, the site topography, history and socio-cultural events. The design work explores the plan-section integration to achieve architectural form that is tectonically expressive, functional and responsive to its site. This studio is integrated with Building Science 1 to instill awareness of considerations of thermal comfort by exploring strategies that reflect the climate and context of the building.

Semester Four emphasizes *sustainable environments*. In this studio, students explore design by harnessing environmental qualities and conditions for sustainability within the given contexts with two projects. The first project involves precedent studies on design projects which are responsive to the environmental conditions and sustainable issues, leading to the design of small simple building. This small building will allow students to focus and explore the environmental poetics of the building enclosure that respond to the basic natural context such as the sun, wind, heat, energy issue, and the existing context (structures and landscapes). Using the ideas and studies in Project 1, students then explore a larger project for a selected community of users (which has clustered built forms for example school, research centre, small health service centre) for a specific community of users. This includes the complexity of the programme, site topography and vegetation, socio-cultural events, and variety of passive strategies for sustainable design. The design work should contribute to and merge harmoniously with environment and the site, and provide the best of experiences for the community of users. Students are required to demonstrate applications of knowledge gained from Environmentally Sustainable Design and Building Science 1 modules from prior semesters.

Year Three: The users in the Urban Space
Year Three emphasizes the importance of design as a response to the urban conditions and characters. As the final year of the Bachelor of Science (Honours) (Architecture) programme, students should demonstrate their ability to provide resolution and integration to creatively problem solve design problems that integrates the knowledge of theory and cultural context, environment and technology, and communicates an understanding of current legislation and cultural imperatives.

Semester Five explores the *live/work issues responsive to the contextual conditions and character of the urban streetscape*. Students undertake a studio-based exercise which deals with urban infill within a dense urban street environment. The two major parts of the studio are a) urban contextual study and b) architectural design development. The final outcome is an architectural design that is responsive to its urban street character. In their preliminary design work, students engage with urban studies and strategy/concept development to develop a design brief for the live/work programme and massing studies responding to the urban street condition. Subsequently, the major project involves the design of a live/work scheme which engages with the spirit of urban place and the everyday life of the urban community. The design work explores the plan-section-elevation relationship to achieve an architecture that acts as a vibrant infill exploring the maximum potential of the urban space. The intentional complexity of the design studio will enable students to begin to explore their own architectural position. This module is integrated with Building Science 2 module where students are required to consider lighting and acoustics in their design. The objective of integration is to re-assert the need for environmentally responsive design.

Semester Six forms the culmination of the B Sc. (Honours) (Architecture) programme. This capstone project is based on the theme of *architecture with a social impact and the resolution and integration* of technology, environment and cultural context in architectural design. Progressing from the urban issues of live/work, the design studio extends students development of architectural position and design brief in proposing strategy to resolving social issues pertinent within the conditions of the urban landscape (for example issue of elderly, neglected communities, school, youth centre). Students propose and develop a programme that address the social needs of a particular urban place and provide interaction and connection of people in the urban space. In doing this, students are required to explore and integrate sustainable strategies of recent times. Subsequently, students produce detailed design of a selected portion of design. The design work is to be supported by a comprehensive written design report of approximately 5000 words.

4.0 Implementation, its challenges and advantages

One emergent observation of the students' works is site-specific and people-specific architecture. This is in line with our aim to produce sensitive designers and place-makers that are responsive towards conditions by which they are designing for. It avoided what many would call 'form for form making sake', as forms and spaces are in dialogue with conditions of people, place and time. One of the challenges faced in the implementation of the design studies lies in the selection of contextual conditions (sites) for design projects and tasks. In order for students to response to the contextual conditions, the conditions need to be rich, varied, and meaningful. If not, the response will be meaningless and superficial.

The distinctiveness of the design studies which is aligned to the curriculum does not stand a lot. Their efficiency and effectiveness is very much dependant on the teaching and learning environment and pedagogy to support the distinctiveness of the design studies. The teaching and learning pedagogies are still very much rooted in the conventional architectural learning methods and environments. While there are mechanisms in place to cultivate multiple teaching and learning methods (problem-based, simulation, authentic, case studies, generative) through the Taylor's Teaching and Learning Framework, critical attention needs to be channeled to the teaching and learning environments. The School is taking an initiative to further define learning environments according to the plan themed 'Learning Studio' that comprises of two components, namely learning space and learning programme. It aims to define the pedagogical approaches and the different usage of studios according to different levels of interaction and engagement for different levels of teaching and learning.

The implementation of such design distinctiveness impacts on the overall design and delivery of the Bachelor of Science (Hons) (Architecture) programme. With the aim to set a unified direction for the school, the greater challenge is how to align the modules to support such distinctiveness.

5.0 The way forward

This paper presented a conceptual framework based on people and place-centered approaches to design studies in architecture education. It suggests the need for emphasis on the vital role of architecture as a catalyst for the sustaining humanity (society and environment). Within such imperative, the development of the conceptual framework into the practice and pedagogies of design education is a balancing act, a balance between learning outcomes (syllabus), teaching and learning (environments and methods), and designing assessments. It is tedious exercise to align

the conceptual underpinnings of the design education to the multiple learning styles of current generation of students, the new methodologies and technologies of teaching pedagogies, the requirements of the Ministry of Higher Education, professional bodies, and the University, and the transient and changing nature of our global and regional built environment and its discursive forces.

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INTEGRATIVE LEARNING IN ARCHITECTURE DESIGN STUDIO

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Abstract
Design studio is the core subject in architectural courses or education programs at the higher learning institutes or universities in Malaysia and in other countries. Supporting subjects such as Building Technology, Architecture History and Theory, Environmental Science and Building Structure are structured and organized to contribute knowledge and information for design studio work and output. Therefore, a balance and co-ordination has to be sustained between design studio and the supporting subjects throughout an architectural course to ensure effective learning. This paper outlines important aspects in design studio learning and suggests several aspects for effective subject integrations in architecture course.

Keywords: *architectural education, design studio, integrative learning*

Introduction

Architecture covers a wide range of aspects which include aesthetic, structural, environment and community aspects. Therefore architectural education is a multi-facetted field due to the complexity of the social and cultural aspect normally associated to it. Architectural education is not restricted to the physical building design but also incorporates value systems, philosophy, sustainability, site context and other related areas. Diverse subjects other than Design Studio offered in any architecture courses reflect the complexities inherent in the architecture field. Integration of these diverse subjects with the Design Studio is very important as the architecture program offered should be capable of producing innovative, creative and holistic architects who are sensitive to the needs of society, environment and technology.

Design Studio as the Core Subject in Architecture Course

Design Studio is the most important subject in an architecture course with the highest credit hours per week. Other subjects such as Building Technology, Architectural History and Theory, Environmental Science and Communication have to serve Design Studio projects in every semester throughout an architecture course (Figure 1). In general, Design Studio is meant to provide students with an expertise and knowledge necessary in producing innovative, creative and competent design solutions. The main objective of Design Studio is to develop students' imagination in design and allow them to produce architectural designs that balance between poetic and pragmatic considerations. Design Studio provides architectural students with the skill to work under both intuitive and practical contexts. In Design Studio, students express their architectural ideas and creativities through myriad communication techniques and methods in the forms of drawings, physical models, computer models, photography, video clips and other mediums.

Figure 1: Main subjects which supports Architecture Design Studio.
(Source: Nik Lukman Nik Ibrahim, 2012)

Learning in Architecture Design studio

Credit hours for Design Studio normally range between six to eight hours per week. For an example, at the Faculty of Architecture, the University of Sydney and in most other universities in Australia, Design Studio consists of at least 6 credit hours per week. One hour is usually allocated for a lecture session and another five hours dedicated to a studio critic session. The lecture is normally given by the studio coordinator, assisting lecturer or an invited guest who can provide information related to the design project. The role of the Design Studio critic session is for ensuring that the design process is well-informed thus satisfying the project's requirements.

Design Studio at the Department of Architecture, UKM also follows this basic architectural education system. Beginning with a basic and elemental design project in the first year, the students progress and complete their Design Studio in the third and the fifth years with building projects of greater complexity.

Design Studio Integration with the Support Subjects

In order to ensure architectural students are well equipped to undertake Design Studio each semester, the support subjects in the architecture course need to be well-integrated with this core subject. For an example, the second year architectural students at the University of Tasmania and the University of Sydney, Australia are required to be sensitive to the environmental and social contexts of the design projects given to them. Therefore, the students are exposed to modern and contemporary Australian architecture study in Architecture History and Theory subject. Similar integrative approach is taken every semester throughout the architecture course. In the third year, technical aspects become more paramount in design therefore assignments and project in Building Technology are normally integrated with Design Studio. Figure 2 shows the integration between Design Studio, Architecture Communication and Architecture History subjects in the first semester, first year at the University of Sydney. The two supporting subjects are not only integrated with Design Studio work but also related to each other.

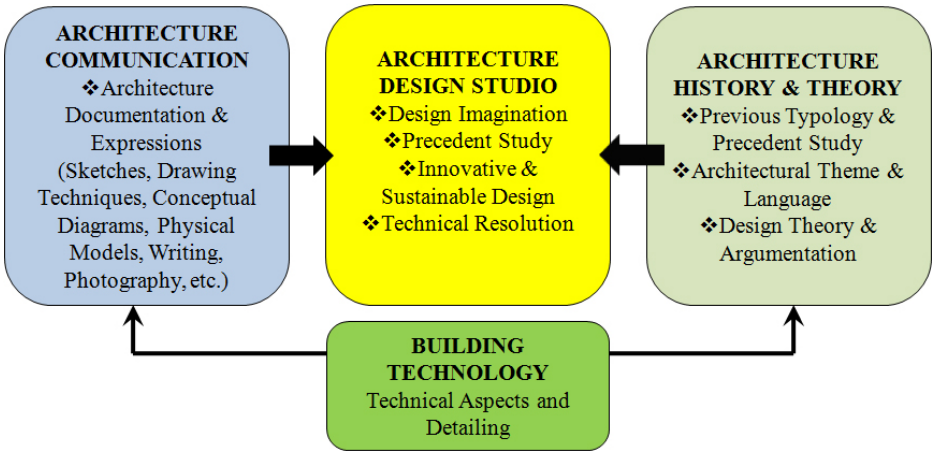

Figure 2 Integration and connection between the core subject and two supporting subjects in the first year of the architecture course at the University of Sydney.
(Source: Nik Lukman Nik Ibrahim, 2012)

The product of good integration between architectural subjects is illustrated in Figure 3. Lessons in building documentation and detailing obtained in the Architecture History subject and Communication subject are utilized in presenting design detailing of students' proposal in Design Studio.

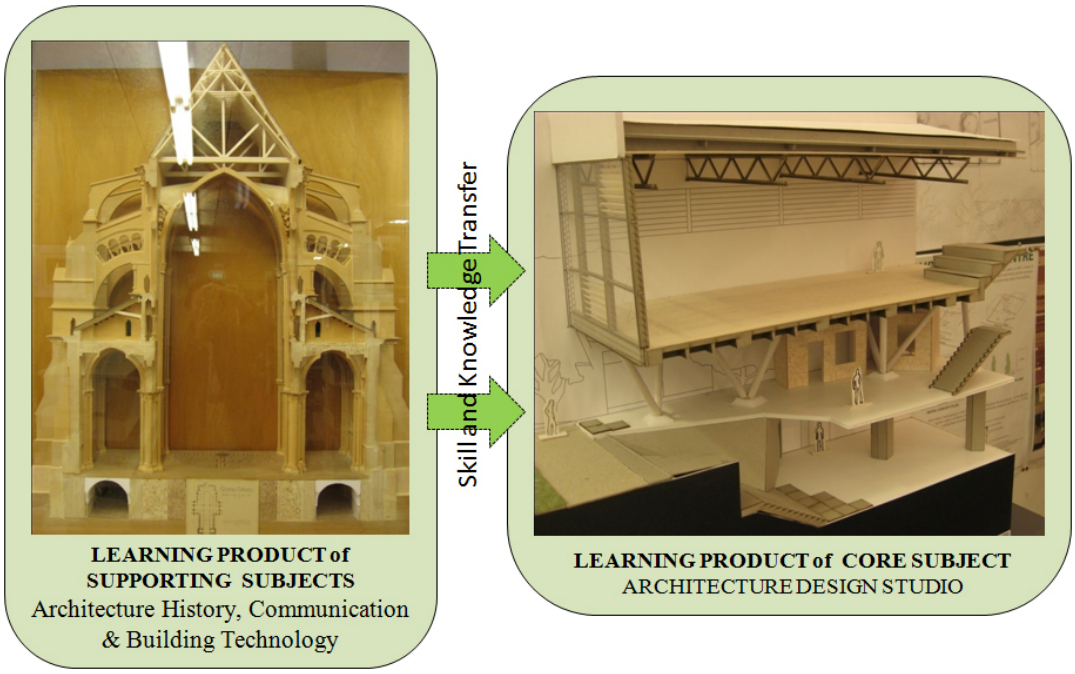

Figure 3 Skills and knowledge from supporting subjects can enhance student performance in Design Studio. (Source: Nik Lukman Nik Ibrahim, 2012)

Categories and Emphasis of Integration

In general there are two ways by which supporting subjects can be incorporated in the design studio learning; via direct integration and indirect integration (Figure 4). Direct integration refers to a scenario when the supporting subject's assignment is embedded in the Design Studio's work. For an example, in order to submit a design project, a student has to complete a detailed drawing of the main structural element which has to be conceptualized and developed in a Building Technology assignment. The supporting subject assignment and the work in design studio are mutually dependent and this usually happens in the concurrent semester. Indirect integration refers to a scenario when knowledge and skills obtained from the supporting subjects are then utilized indirectly the design studio work. This can include presentation and model making skills obtained from Communication class, conceptual and theoretical knowledge from History and Theory class as well as technical awareness obtained from Building Technology class. The integration is usually subtle and it may not take place in concurrent semester when the subjects are taught. The utilization of the acquired knowledge and skills from the supporting subjects is sometimes deferred, such as taking place in the next semesters but the contribution from the subjects can be very obvious and definite.

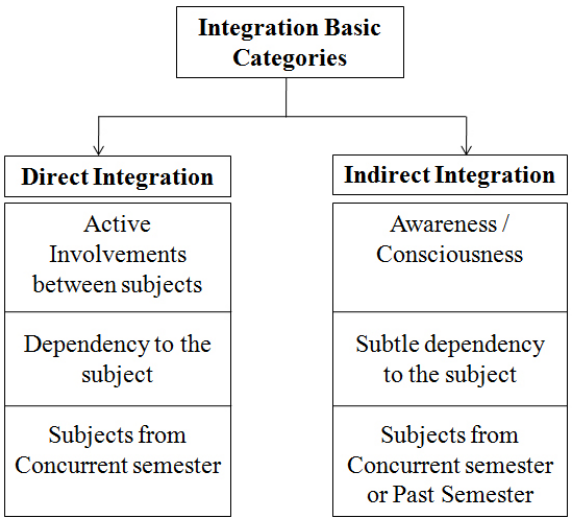

Figure 4 Categories of integration. (Source: Nik Lukman Nik Ibrahim, 2012)

Table 1 below shows the supporting subjects which are integrated with the Design Studio at the University of Tasmania, Launceston, Australia. In the first year, Design Communication is usually emphasized for integration as students are driven for creativity and graphic proficiency. In the second year, integration with History and Theory and Building Technology is emphasized as students are required to be sensitive towards place and context as well as building construction and services. Usually Building Technology is more emphasized in the third year just before graduation to ensure design proposals are technically competent and pragmatic. The actual emphasis can be summarized by Figure 5.

Table 1 Subjects usually integrated with Design Studio at the University of Tasmania, Australia.
(Source: Nik Lukman Nik Ibrahim, 2012)

Year / Semester	Design Studios	Subjects Integrated with Design Studio
1 / S 1	Design Studio 1	Design Communication 1
1 / S 2	Design Studio 2	Design Communication 2
2 / S 1	Design Studio 3	History & Theory 3 & Building Technology 3
2 / S 2	Design Studio 4	History & Theory 4 & Building Technology 4
3 / S 1	Design Studio 5	History & Theory 5 & Building Technology 5
3 / S 2	Design Studio 6	History & Theory 6 & Building Technology 6

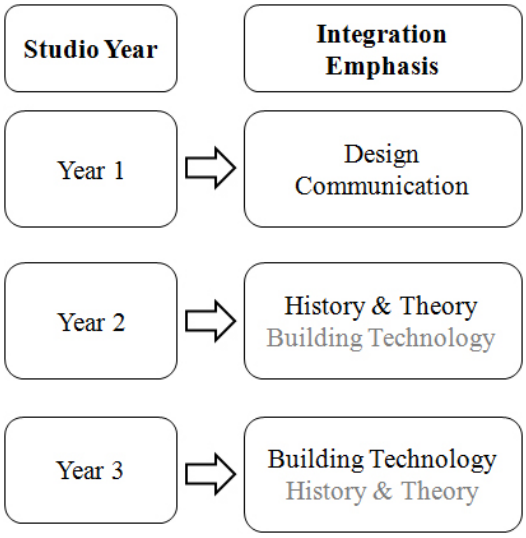

Figure 5 Emphasis of subjects in design studio integration throughout the years
(The subjects in grey indicate lesser emphasis than the one in black).
(Source: Nik Lukman Nik Ibrahim, 2012)

Attributes of Subjects Integration: Pragmatic, Critical and Creative Learning

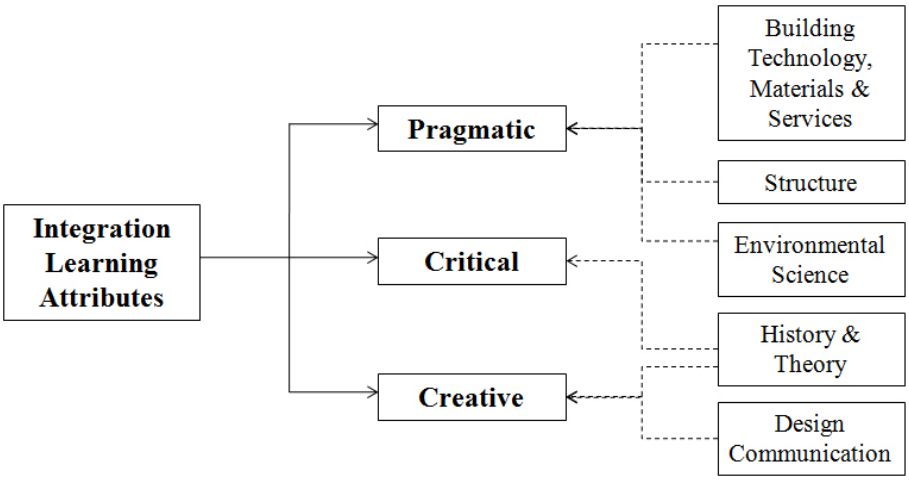

Figure 6 Learning attributes integration showing respective subjects contributions to the attributes. (Source: Nik Lukman Nik Ibrahim, 2012)

Pragmatic, critical and creative thoughts are the main criteria for architecture students learning in Design Studio. These attributes are the outcome of supporting subject integration with Design Studio. Tentative relationship between subjects and the learning attributes is shown in Figure 6. In general we can relate pragmatic thinking to subjects such as Building Technology, Structure and Environmental Science, critical thinking and creative thinking to History and Theory subject and Communication subjects (Figure 6). Although the relationship shown in Figure 6 is not accurate, it is indicative to the integration necessary in Design Studio.

The synthesis of the three modes of thoughts is very important in architecture design work. The hierarchy and balance between these three modes of thoughts change in accordance to Design Studio levels or years. In general, creativity is emphasized in the early years especially in the first year studio while pragmatic thinking is more prioritized in the third and in the upper years. However, this does not mean creativity is not important in the upper years or pragmatic considerations are less important in the lower years. The balance between these three modes of thoughts is actually necessary throughout the architecture course.

Architecture students have to be able to think pragmatically in Design Studio. Pragmatic thinking enables students to conceptualize the constructability and workability of their architectural designs or proposals. Pragmatic thinking can be represented by technical knowledge necessary for constructing the design proposal in the real world and ensure fulfillment of its functional requirements, structural strength, cost effectiveness, safety, comfort and other requirements.

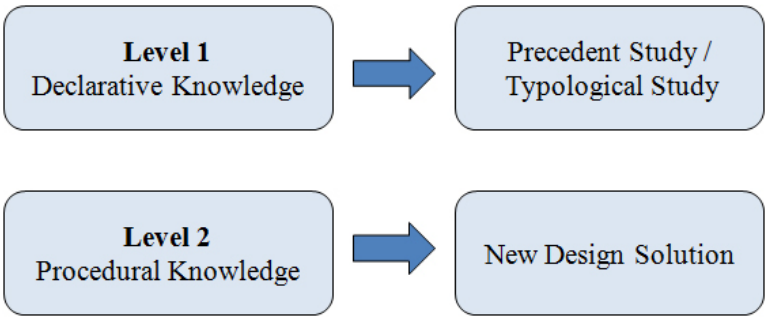

Figure 7 Levels of knowledge indicating critical thinking stage in Design Studio based on the category suggested by Anderson (1993)

Critical thinking is not only important in architecture Design Studio but also in many other fields of study. According to Postman and Wagner (1972), the role of higher learning institutes is not only to provide educational information to students but more importantly to prepare them to be critical towards whatever things they learn. A similar opinion is expressed by Letiche (1988) who suggests every student to acquire the skill of 'learning to learn'. Anderson (1993), a psychologist divides

knowledge obtained by students into two levels; declarative knowledge and procedural knowledge (Figure 7). Critical thinking according to Anderson can only be attained when a student achieves procedural knowledge. Critical thinking in Design Studio can be said to have been achieved when the architecture students manage to produce new design solutions after mastering previous building types and design solutions.

Kneedler (1985), a psychologist, outlined the process of creative thinking. Figure 8 indicates the three processes based on Kneedler's model which is representative to the processes of critical thinking obtained by students in Architecture Design Studio.

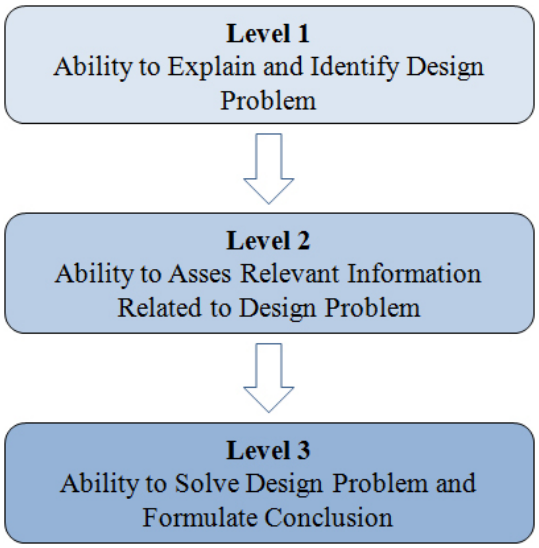

Figure 8 Three main processes towards critical thinking in Architecture Design Studio based on Kneedler (1985)

At Level 1 (Figure 8), architectural students are able to identify the design problems of their projects. At this level students can compare design issues in the precedent study with the ones they found at the site and subsequently select relevant information which can be utilized in the design proposal. At Level 2, architectural students are able to evaluate merits of all the information acquired in order to resolve the design problems. At this stage, they are able to demonstrate the ability to address the hierarchy of issues. At Level 3, students can produce design proposals which are actually design solutions for the problems addressed. The proposal should demonstrate adequate evaluation and responses to the issues resolved. At this level, the students should also be able to predict the effects of their proposals.

Creative thinking is different from critical thinking. Psychologists are not united in their opinions about the process for attaining the skill of creative thinking. According to Sternberg (1985) a psychologist, creativity is produced through utilization of knowledge in a new format or structure. Creativity depends on a broad range of knowledge but it possesses additional qualities of its own; one of which includes the ability to break or depart from a generally known solution. Creativity also includes the ability to restructure a problem in order to achieve a totally new solution. One of its manifestations is the cerebral phenomenon known as the 'sudden solution'. According to psychologists, 'sudden solution' is obtained through the process of incubation of ideas (McInerny & McInerny, 1994). It is a solution achieved via the unconscious thoughts after we leave and stop thinking seriously about a problem for a while. In architecture Design Studio, this process is not an alien phenomenon and has been experienced by many students. Therefore, the process is regarded as highly important in producing creative design works.

Pragmatic thinking ensures the constructability of the design proposals produced by architecture students. In the other hand, creative and critical thinking enable architecture students to achieve novel and new design solutions in the Design Studio. Integration of these modes of thoughts in design studio is highly important.

Bloom Taxonomy in Design Studio

The Bloom Taxonomy can be utilized to map up Design Studio learning objectives achieved through integration with other subjects. Table 2 depicts the Bloom Taxonomy together with the level of qualities which can be attained at the various stages in architecture Design Studio. Conforming to this 'checklist' at appropriate stages of a design project ensure students' capability in producing new and original design solutions.

Table 2 Bloom Taxonomy in Architecture Design Studio.
(Source: Nik Lukman Nik Ibrahim, 2012)

Categories	Explanations	Learning in Design Studio
Knowledge	Knowing the information taught	Knowing the design requirements
Comprehension	Showing understanding of the material; interpreting, restructuring knowledge	Understanding the objectives of the design requirements
Application	Using the information to solve problem	Using the information to execute design or to solve the design problem
Analysis	Critical thinking: identifying cause & motives; making deduction based on facts; making a hypothesis	Critical thinking: identifying /analysing the effectiveness of design components; making design decision based on facts
Synthesis	Original thoughts: original proposal	Proposing new & original design solutions without borrowing literally from precedents
Evaluation	Evaluating merit of the idea, bench marking, formulating conclusions	Evaluating the merit of the proposed design solution (e.g., the effectiveness of space configurations, etc.)

Figure 9 demonstrate a schematic concept of the relationship between the levels of knowledge in Bloom taxonomy and the integration attributes adapted from Anderson. We can generalize that knowledge of application is the minimal requirement for pragmatic thinking in Design Studio. For critical thinking this normally extends to the ability to make analysis. In order for creative thinking to take place in design studio the student at least should be able to synthesize the knowledge they attained in supporting subjects. Of course in reality all these different levels in the Bloom Taxonomy are important for each pragmatic thinking, critical thinking and creative thinking. Figure 9 only demonstrates an idealized schematic concept of these relationships.

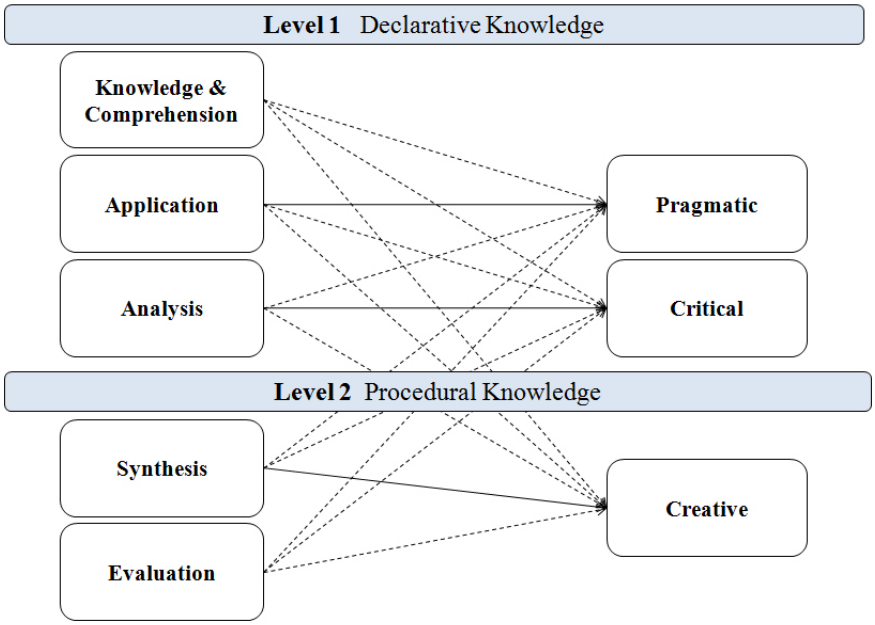

Figure 9 Relationships between Bloom Taxonomy and Anderson's categories.
(Source: Nik Lukman Nik Ibrahim, 2012)

The concept can be extended as roughly demonstrated in Figure 10. Creativity takes longer time to develop in architecture students' consciousness and thoughts as it involves incubation process. Critical thinking needs a good mastery of knowledge and analysis but it may take lesser time for the students to acquire it. Pragmatic thinking in the other hand is more straightforward and requires much shorter time for the students to attain it

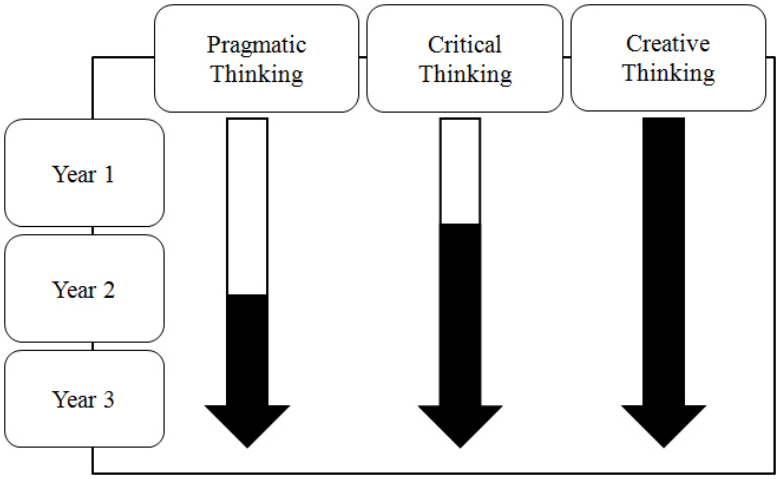

Figure 10 Emphasis of pragmatic, critical and creative thinking in design studio years.
(Source: Nik Lukman Nik Ibrahim, 2012)

Conclusion

Design Studio requires an integrative syllabus to ensure an effective learning process for architecture students. All supporting subjects in an architecture course have to be properly integrated to ensure conducive learning in Design Studio which imparts pragmatic, critical and creative thinking at appropriate levels. Part of the learning objectives in architecture Design Studio is in producing students with critical, creative and pragmatic knowledge. This paper suggests a conceptual framework for the integration between supporting subjects and Design Studio which is vital in an architecture syllabus. This framework is central to the ongoing improvement work on the current architecture syllabus in UKM.

Acknowledgement

The author develops the conceptual framework for an integrative architecture syllabus based on the literature and his architectural education and experience at the University of Tasmania and the University of Sydney, Australia.

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EXPERIENTIAL LEARNING: THE KUCHING PROJECT

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ABSTRACT
This paper discusses on a final project of third year Architecture module. The project selected was the Habitat for Humanity (HFH) regional office in Kuching, Sarawak. The studio tutors has posited the idea of bringing studio outside the classroom and implemented Student-Centred Learning (SCL) towards another milestone. The project has allowed the development of exploration studio outside the classroom approach. The project was divided into two parts; which the first part the students were involved in a design proposal for the needy, brainstorming on the idea of new possible layout, requirements, alternative design with costing awareness and subsequently, the students are exposed to a real hands-on construction of housing for needy in Jalan Matang Kuching, Sarawak. While the primary motivation underlying this project is to promote innovation in studio project, a substantial component of the study involved gaining a broader perspective of humanistic approach in architectural thoughts and awareness among the students outside their comfort studio room. The state of the art of the studio project has been explored by bringing it outside the studio context, working in a group, meeting tight deadlines, exploring contexts and concepts within short amount of time and preparing the students for an industrial environment for their future. This auspicious project specifically focuses on graduating students of final year Bachelor of Design (Architecture) UPM with the noble intention to request of their balance in producing architectural products and to invoke their thinking and maturity in response to real deal. Thus, the outcomes of the project provide i) the insight of the two weeks trip to Kuching, Sarawak, ii) the design proposal of the Habitat House for the needy and iii) the development of the final design of HFH regional office in Sarawak with the final outcomes of the design proposal. In summary, the project will highlight on the issue of architectural for humanity aspects and contributes to the innovations of education and studio projects for architectural education in Malaysia.

Keywords: Innovations in architecture studio projects, habitat for humanity, experiential learning, collaboration

INTRODUCTION

Design studio being the core subject in Architecture Education provides a platform to learn and experience significant issues in built environment such as housing. It has always been regarded as the most vital domain by the students and academicians. In March 2012 recently, the tutors in the final year of Bachelor of Design in Architecture Program in UPM, have proposed to change the routine of learning architecture in studio and implemented the Student-Centred Learning (SCL) method by taking it outside and linking studio activities with the community and other organisations. This has resulted to a collaboration between a local architectural firm in Sarawak, which is actively involved in Habitat for Humanity's (HfH) work, together with the 3rd year Design Studio from UPM.

STUDENT-CENTERED LEARNING (SCL) IN ARCHITECTURAL EDUCATION

In order to cope with technology diversity, Universiti Putra Malaysia (UPM) strived to venture into the most effective teaching methods to provide the best for their students. One approach identified by its Centre for Academic Development (CADe) is the Student-Centred Learning (SCL) teaching approach. SCL is a teaching strategy whereby students are key players (CADe, 2011). Students are involved actively in the teaching and learning processes. One of the approaches in SCL is Project Oriented Problem Based Learning (PoPBL), a method that uses projects as the concentration of teaching.

In architectural education, project based learning is not new, especially in the design studios. This method is being used worldwide in any architectural schools and throughout all the years of undergraduate studies in architecture. The traditional design studio methods however, are being brought up to a higher milestone by integrating them with outdoor learning environment (Rodriguez and Gonazalez Bohme, 2009). There are a few approaches to design studio teaching and learning processes, which will be highlighted in the next section.

DESIGN STUDIO EDUCATION

Design Studio teaching method is known to comprise two components, inside classroom teaching and site visits. However, these two methods should be effectively integrated (Rodriguez & Gonazalez Bohme, 2009). It should also be conducted in a creative (McMahon and Kiernan, 2011; Wang, 2010) and interactive (Demirbas and Demirkan, 2003) environment where ideas are conceived, developed and shared. In order to achieve this, the learning environment should be brought outside the conventional studio setting (McMahon and Kiernan, 2011) and have activities which emphasised on collaboration and participation (McMahon & Kiernan, 2011; Forsyth, Lu & McGirr, 2000). This collaboration and participation method has become so popular that the combination of university outreach with experiential education for students was coined as "service learning" (Forsyth, Lu & McGirr, 2000).

The methods and approaches mentioned above are found to be more effective as students do not tend to associate the project with assignments, which they usually implement strategic learning to strive for marks instead of a holistic learning experience (McMahon & Kiernan, 2011). In their research, McMahon & Kiernan also found that such informal learning activities could engage, excite and encourage students to become more pro-active in their own teaching and learning experiences. By providing a creative environment, the teaching and learning process in design education has become more rigorous and more academically respectable (Wang, 2010). Apart from that, there were statistically significant differences between the performance scores of students having diverse learning styles at various stages of design process (Demirbas & Demirkan, 2003).

Based on the motivation above, The Department of Architecture UPM has engaged efforts to organized activities that can benefit the most intellectually and personal development outside of the classroom design studio by having a collaboration with a non-profit organization and also participation with the community. This is enhanced through The Kuching Project with the final year students of Bachelor of Design (Architecture) UPM.

THE PROGRAM IN KUCHING, SARAWAK

Understanding what affordable means is not a rocket-science. But when it is coupled with the term housing, affordable gives a wider range of perspectives and definitions to different people. Educating architectural students what affordable housing involves make it more challenging. In order to have the understanding of the term affordable housing, a program was organised which takes into account both immerse in the actual place and going through a rigorous brainstorming exercise in a design workshop.

The Kuching Project was split into 2 related programs which are:

1. A community involvement as site workers under the supervision of a non-profit organisation, in this case, we have had the chance to link with Habitat for Humanity (HfH) in Sarawak Chapter.
2. An intensive design workshop in exploring the possibilities of alternative designs for Habitat House and cost reduction exercises with a few local architectural firms involved spearheading the design tasks. This is led by Design Network Architects.

Both programs were conducted simultaneously for the entire 10 days. Each of the program has different sets of goals. The first one is clearly seen to increase awareness in hard skill through construction as volunteers on site. Whilst the second program aims to develop the soft skill on designing sustainably using local resources. Collaborating design projects between students and practices or community partners will encourage informal dialogue between them through an open platform (McMahon & Kiernan, 2011). This dialogue was made possible with the involvement of Malaysian Institute of Architects (PAM) Sarawak Chapter, by giving the students the opportunity to have a critique session at their place. This form of collaboration can also be called service learning as it provides programs to make education more relevant to students and outside communities and at the same time offers useful services to the public while offering these students, who are future professionals, vital skills for working with people, particularly for those in this profession (Forsyth, Lu and McGirr, 2000). Without doubt, students who expend more effort in a variety activities benefit the most intellectually and in the personal development domain (Astin, 1993; Chickering & Reisser, 1993)

IMPLEMENTATION

Due to the number of students and the maximum capacity of logistics on site as well as the rented seminar room, the batch was split into two different groups. A schedule was formulated to ensure that both groups will get the chance to experience both site work and the design workshop equally. Refer to Figure 1.

	GROUP 1	GROUP 2
Day 1	visit job site (40 pax) and workshop briefing by leader	
Day 2	group 1 to job site	group 2 to workshop (evening crits)
Day 3		
Day 4	group 1 to workshop (evening crits)	group 2 to job site
Day 5		
Day 6	group 1 to job site	group 2 to workshop (evening crits)
Day 7		
Day 8	group 1 to workshop. (evening crit)	group 2 to job site
Day 9		
Day 10	final summing up and preparation of material	
Day 11	final crit at PAM centre (short presentation by student leaders)	

Figure 1: Schedule during the Program in Kuching, Sarawak

Each set of program has a yardstick to measure students' capabilities of absorbing information, digesting and synthesising it at the same time and commitment on site work during the Kuching Project. For site work, the construction progress are recorded and documented using audio visual aids. Each of the construction stage were carefully planned and documented as indication of students' ability to systematically plan site work and administer limited construction resources. While the design workshop was monitored using regular evening critiques with the involvement of local architect.

1) Site Work (Jalan Matang, Kuching, Sarawak)

The Habitat House

The first program which involves site work, was fully supervised by one of the HfH's site supervisors. UPM was given a privilege to construct a 20'X30' Habitat House for a family in Kuching that is under the management of HfH Sarawak Chapter. The students were fortunate to be given task to build the footing of the house until the ground beam stage. Considering the given two weeks duration, the progress of work is an 'eye-opener' towards the students involved.



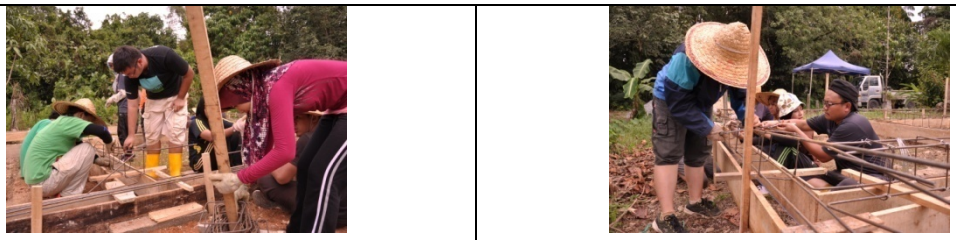



Figure 2: Volunteering for construction work at job site under HfH supervision

2) Design Workshop (Harbour View Hotel, seminar room)

The title for the workshop is "Designing for a Sustainable Living". Architects from local firms namely, Design Network Architects, INTODesign Lab and Atelier Timur were involved as tutors. The students involved in brainstorming sessions, discussion, presentation and debate with the assigned tutors.

The Project Brief

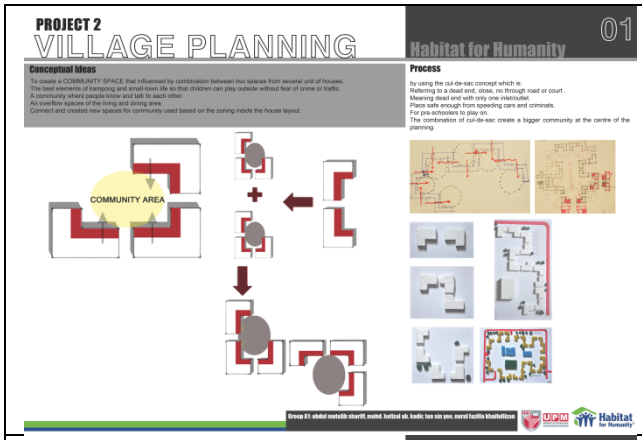
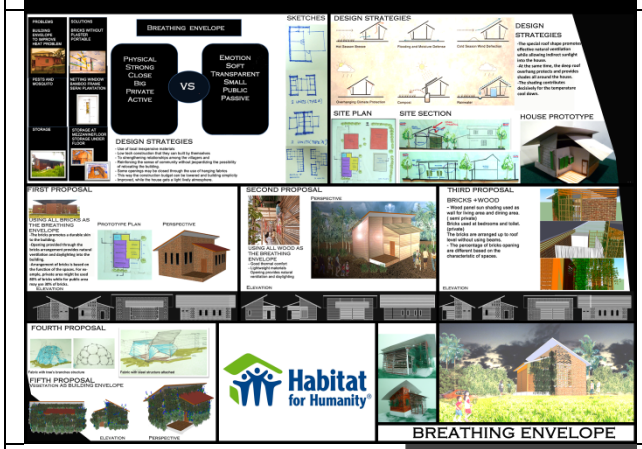
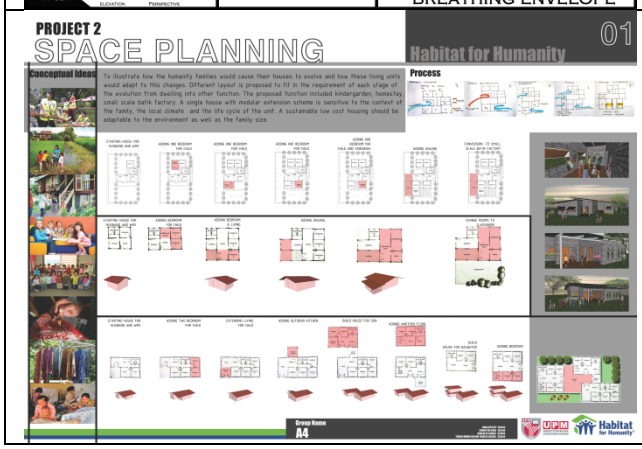
The project brief was formulated to challenge the idea of existing Habitat House designed by HfH from macro scale till to the detailing of using local resources. The site given is next to the site location of HfH with considerations to existing environment, therefore a quick observation and site survey was required to identify the strengths and weaknesses. This site analysis is necessary as it can provide useful resources for the design stage, apart from advancing the students' ability (Tanaka, Yamamoto and Kimura, 2008). The planning demands a proposal of a village format that reflects social sustainability and logistics such as public transportation and schools. Hence, a site study is conducted to assist the students in associating the site with the recent social needs, which they are expected to undertake when they are out in the architectural profession (Tanaka and Kobayashi, 2007).

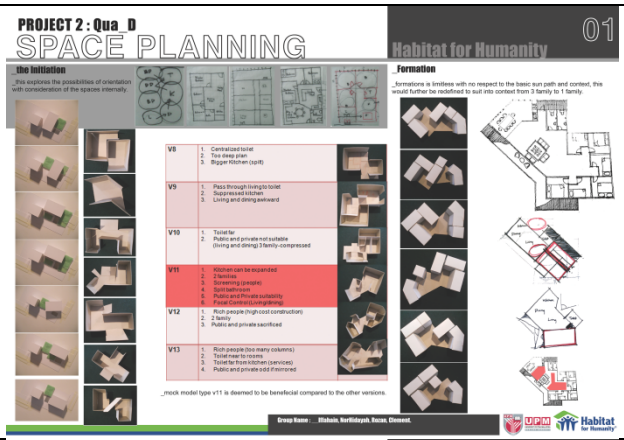
The Outcomes

All designers seem to work best when their individual ideas and contributions to a team effort are utilised. Designers are nature synthesisers and expect to see the uniqueness of their ideas expressed as part of a whole. The mental activity of creativity begins by combining and recombining the current experience in job site, lecture inputs from an architect's experience in community architecture, tutorials at the end of the day and comprehensive discussions on aspects of designing sustainably for a Habitat House.

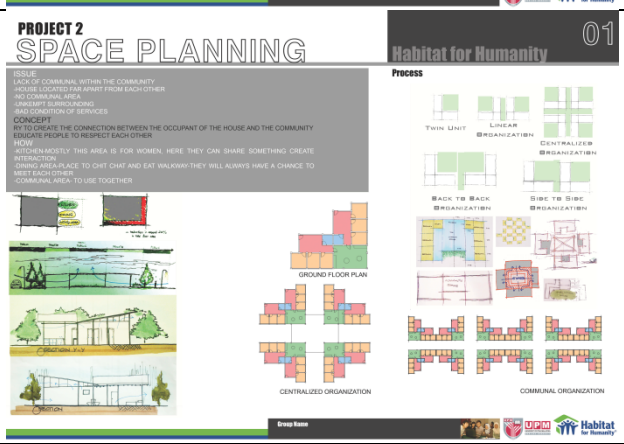
In the aspect of conceptual design, students have managed to exploit the present Habitat house as a vehicle to understand design, construction methods and costing to propose a solution for future habitat houses on issues such as research and design (R&D) for core housing, planning of shared facilities, understanding local acceptance of building materials, the house in context of the village and community. The students have also designed a specific component of a house to enrich the present condition. Each group has attempted one small aspect of the homeowner's daily life; such as sleeping, cooking, studying, washing, eating, earning additional income and designed a part of the house to improve the current situation.

The following images in Figure 3 illustrates the results that was prepared and presented to Pertubuhan Arkitek Malaysia (PAM) Sarawak Chapter at the end of the workshop. A group of local professional architects were involved during the crit session giving and throwing in constructive ideas and comments.

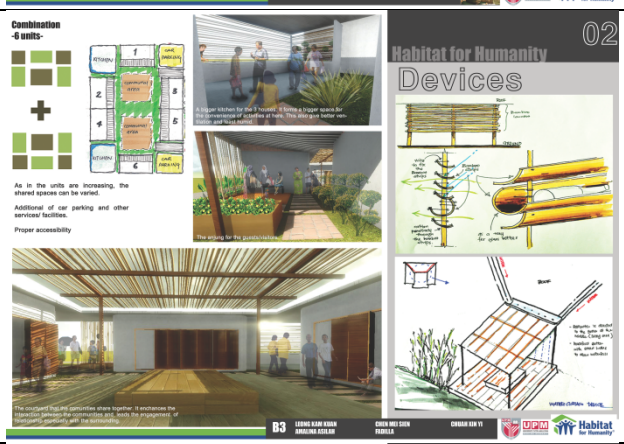
	GROUP A1: Looking into the planning aspects of clusters of units with certain determined shape of the house.
	GROUP A2: Spaces planning for a house are determined and reorganized with many alternatives to maximize good ventilation and daylighting which seems to be two of the major problems in low-cost housing
	GROUP A3: The envelope or outer layer of the house is studied to give not only decent elevations but durability of materials when used in different situations and locations of the house.
	GROUP A4: Another study on space planning in relation to social aspects and needs. How spaces evolved and what is required and how that requirement should be responded in design.



GROUP B1:
Internal space planning in relation to orientation of sun path and its surrounding context.



GROUP B2:
Looking into space planning among the units creating communal spaces for clusters of houses.



GROUP B3:
Specific devices that are made of local materials using low technology to create a functional component that adds value to the house.

GROUP B4:
Multi functional components in the house that are interchangeable to suit the lifestyle of the family.

Figure 3 Students' final presentation after the workshop

CONCLUSION

How relevant are all these activities outside the normal studio routines? What do the students engage from all these experiences? The most vital thing is that they 'learn to dare'. Apart from their natural language acquisition the students learn things in immerse way, they observe, learn, practice, and at the end of the day, they feel the struggle and importance meaning of affordable housing especially for the needy. This initiative also aids integration, collaboration from the students with the community. The students come into contact with the local people in a natural way, taste the same food and sweat on the fieldwork together, thus uplift the barrier to all. We believe that by exposing the exercise towards graduate-to-be students, will give them an insight and greater sense of accomplishment in helping out the community and the less fortunate. The other part, the students now understand the construction process even more and although some of the work seems challenging to them, it wall all worth it because it pays for a good cause.

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PROJECT ORIENTED PROBLEM BASED LEARNING IN ARCHITECTURE DESIGN STUDIO IN BACHELOR OF ARCHITECTURE PROGRAM, UPM

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Abstract

Project-oriented Problem Based Learning (POPBL) is a Student Centred Learning (SCL) methodology in which it provides complex tasks based on challenging questions or problems that involve the students' problem solving, decision making, investigative skills, and reflection that majorly include teacher facilitation. It is focused on questions that drive students to encounter the central concepts and principles of a subject hands-on. The question or problem comes first whereby new knowledge is constructed on the foundation of prior knowledge. The pedagogy applied in the architecture design education is very much adopting the approach and techniques used in the POPBL. This paper attempts to document and describe the teaching practice used in the Department of Architecture, Faculty of Design and Architecture, University Putra Malaysia (UPM). The module is implemented in the Bachelor of Architecture (Part II) program. The phases and the running of the POPBL module are designed for the year five architectural design studio course which consists of about twenty students. The POPBL is run for two semesters consecutively and the unique module had been employed since the inception of the Bachelor of Architecture Program in UPM in 2004. It is found that the teaching of the architectural design studio is mirroring the POPBL methodology effectively. Based on the cooperation and collaboration that can be witnessed amongst the students and the interview with the lecturers involved, it can be deduced that the design module is successful in producing better result in the learning outcome and its project objective. The students' soft skills are enhanced tremendously since they were immersed in active and deep learning during their process of learning.

Key Words: *Project Oriented Problem Based Learning, Design Education*

Introduction

This paper attempts to document and describe the architectural design teaching practice used in the Department of Architecture, Faculty of Design and Architecture, University Putra Malaysia (UPM). The module is implemented in the Bachelor of Architecture (LAM Part II) program. The phases and the running of the POPBL module are designed for the year five architectural design studio course which consists of about twenty students. The POPBL module is run for two semesters consecutively and this unique module had been employed since the inception of the Bachelor of Architecture Program in UPM in 2004.

Project-oriented Problem Based Learning (POPBL)

Project-oriented Problem Based Learning (POPBL) is the teaching methodology that falls under the category of student centred learning (SCL). It provides complex tasks based on challenging questions or problems that involve the students' problem solving, decision making, investigative skills, and reflection that include teacher facilitation, but not direction.
It is focused on questions that drive students to encounter the central concepts and principles of a subject hands-on. In POPBL students learn from these experiences and take them into account and apply them to their lives in the real world.

The uniqueness of POPBL can be seen in its approach that promotes and practices new learning habits, which primarily involved active learning and deep learning. Students are given real world problems and they have to think in original ways to come up with the solutions to these real world problems. It is very challenging but yet this process helps with their creative thinking skills by showing that there are many ways to solve a problem. In ensuring that the problem is challenging and mind boggling enough for the students, the question or problem is organized around an open-ended driving question or challenge. Most of the time the process of learning will start with a topic centring on significant issue, debates, questions and/or problems.

Being the young adult learners, the students need to be made aware of the expectation as to make it easier for them to internalize their new knowledge. The facilitator needs to satisfy and create the need to know or the need to learn the new materials, essential content and skills.

Showing the vision of an end product or presentation in the beginning of the learning process could be an attempt to create the need to know or the awareness of those learning needs.

The students are always making new inquiry or creating something new, be it an idea, interpretation or a new way of displaying what they have learned. Most importantly, POPBL requires critical thinking, problem solving, collaboration and various forms of communications. Most of the times they need to use the higher order thinking skills, work as a team and contribute to a group effort. Dealing with young adult learners, facilitators should allow some degree of student voice and choice.

The role of facilitators in POPBL includes providing regular feedback and incorporating revision from time to time with the students. Arranging for group presentation, where the peer review or critique can take place could also be beneficial in the learning process. Allowing the students to do presentation, whether in their group or to the rest of the class can boost their confident, both for the presenter and the peer themselves. The ultimate would be asking the students to do a public presentation, where the public can be invited to be the audience. This will prepare the students to public scrutiny and critique, thus making them to be more prepared and having more in-depth knowledge of their presentation.

Figure 1: Peer Review process

As mentioned earlier, POPBL utilizes higher order in the cognitive skills in the cognitive domain (bloom's taxonomy). The activity that takes place in the learning process of POPBL promotes the level of 'application', 'analysis', 'synthesis' and 'evaluation'. In the new bloom taxonomy cognitive domain the level of 'evaluating' and 'creating' are predominantly applied.

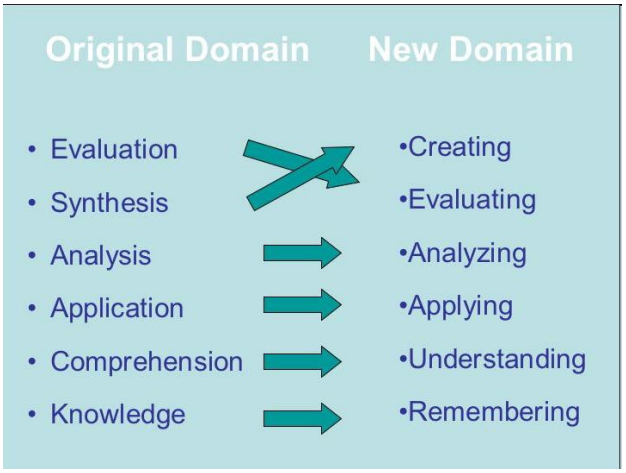


Figure 2: Revised Bloom taxonomy (Pohl, 2000)

The program

The POPBL module is introduced in LAM Part II of the Architectural Program in University Putra Malaysia. The Bachelor of Architecture Program started in 2004 and the Comprehensive Architectural Studio 1 and 2 are the main studio course/subject in the program. It is an 8 credit

hours subject with the studio face to face 16 contact hours. There are 20 students in the program. The cities that have been chosen for this particular POPBL module described in this paper are Pekan and Kuantan. Before this, several other town were selected such as, Melaka, Taiping, Kuala Terengganu, Kuching, Alor Setar and Kuala Kedah. These Malaysian cities are chosen based on their importance as the capital cities, administrative towns or their colourful historical backgrounds.

The POPBL Module

As mentioned earlier, the students are given a city, in a particular state in the country. The first requirement stipulated in the brief of the project calls for the students to study the historical background of the city, to understand the various events and factors that have shaped its physical development to the present day and to identify relevant urban design issues. The second requirement states that the students need to analyze proposed development plans in terms of urban design issues, incorporating current and future needs of socio-cultural, economic, environmental as well as heritage considerations.

Subsequently, the third requirement calls for the students to prepare the project brief and schematic design of a selected building typology within the proposed development study. Finally, the students need to explore the application of sustainable design approach and other relevant state of the art design techniques and technology.

As described in the POPBL learning approaches, the students work in teams to study the historical back ground of the city, the local heritage and lifestyle, and subsequently to make critical analysis and identify potential developments in a selected action plan area for the city, as proposed by the local authority.

The POPBL Approach

Types of approaches used in conducting POPBL module are divided into three main methods. The first method is based on a fictional character where a student is given a character, such as the engineer or surveyor, to act on. Pretending to be someone, students are given a problem to solve based on the character that they are given. The solutions to the same problem are varied based on the character that they are playing due to the concern and responsibility held by the character. This method basically widens the thinking perspective of students in solving a problem by considering various factors affecting the decision making. Similarly, the second method is through the process of simulation where a student is required to think as a person involved in the process of decision making. In applying this method, a student must have a general knowledge of the role that is given to them, for example, an engineer. With this understanding, a student will try to analyse and solve the problem according to the expertise and this method will benefit the student to think in detail according to the profession given to the student.

The third and most preferred method is based on a real or authentic problem. This method requires students to fully participate in acquiring and analyzing information and proposing a solution to the problem surfaced from the analysis process. The 'problems' in POPBL are typically in form of 'cases', narratives of complex, real-world challenges common to the discipline being studied. There is no right or wrong answer; rather, there are reasonable solutions based on the acquisition and comprehension of facts that have been critically thought. Therefore, in implementing this method, students must have required skills and knowledge before they are able to tackle the problem.

This method has been implemented in the LAM Part II Architectural Program of University Putra Malaysia involving Year 4 and Year 5 students. As stated earlier, Pekan, in Pahang was selected as a project 'problem'. The area needs to be developed and at the same time addressing the problems encountered at the chosen site. The students have to propose the best project or the most suitable development to be constructed in their proposed site. Due to this, several sites are selected by the students around Pekan District. The problems encountered are varied from one area to the other depending on the community. In revealing the problem encountered by the community at the site, acquisition of information is very critical.

Information acquisition is a significant process in POPBL since many of future decision makings are based on the information gathered. In this process, students must be able to acquire sufficient information as a source of knowledge in uncovering the problems facing the community. This can be done through various methods involving the cognitive and affective learning process. In the

cognitive learning process, information acquisition is mostly related to the facts based on the recorded data and this requires mental skills. The affective learning process, on the other hand, requires the students to be at the site to create an awareness of the existing environment by experiencing the real context. Case and precedent studies are some of the examples in which affective learning process can be applied. All of the information resulting from the learning processes needs to be recorded and analyzed and this requires the manual or physical skills in which the psychomotor aspect of learning process will take place.


Figure 3: Site Visit & Investigation

With the information gathered and investigation conducted, the ill-stated problem of the site can be revealed and necessary proposal addressing the issues can be recommended. This will result in a report production describing the investigation conducted and explaining the issues concerning the community. Based on the issue faced by the community, the students are required to propose a development of the site to tackle the issue arising from the investigation conducted. This involves the production of the model together with a visual and verbal presentation explaining the measures that have been taken in improving the area through the development proposed.

Phases of Work

Basically, the running of ARC4002 (Advanced Architecture Studio 3) course can be divided into four phases that stretch over 14 academic weeks. It is held in the penultimate semester of the Bachelor of Architecture program and students are expected to identify and develop their thesis project that will be presented in their final semester.

- Phase I (4 weeks) – Team work

Early in the First Semester of their 5th Year, the students together with their Studio Coordinator and Lecturers will visit a chosen city that has been agreed upon by the Department of Architecture. For the First Semester 2011, they visited Kuantan (the capital city of Pahang) and Pekan (the old royal city of Pahang). Split into two group, the students conducted an in-depth study on the historical background of Kuantan and Pekan in order to understand the various events and factors that shaped both cities physical developments up to present day and to identify relevant urban design issues pertaining to both cities.

Figure 4: Pekan District: Site Investigation of existing public facilities

Students also studied the Draft Local Plan District of Kuantan, Draft Special Area Plan of Kuantan Town Centre and Draft Local Plan District of Pekan. They analyse the various proposed developments, in terms of urban design issues, incorporating current and future needs of socio-cultural, economic, environmental, as well as heritage considerations.

Figure 5: Cultural & historical district for heritage consideration

Discussions and briefings were held with Municipal Town Planners, relevant Authorities, subject matter experts, local folks and professional architects from Kuantan and Pekan.

Figure 6: Relevant authorities

Figure 7: Community and people observed

From the data collected and analyses, students constructed a site models and produced masterplans for Kuantan and Pekan. They presented their findings to panel of assessors from Department of Architecture and professional architects who are practicing in both cities. They identified strategic concepts and potential developments for Kuantan and Pekan which will lead to Phase II of the coursework.

Figure 8: Briefing by relevant professionals

- Phase II (2 weeks) – Individual work

During Phase II and the subsequent phases, students worked individually. From the group analyses and potential developments identified during Phase I, students identified a proposed project that they wish to pursue for their thesis project and identified a project site either in Kuantan or Pekan. They developed project justifications and analyses, and site analysis of their chosen site.

Figure 9: Local activities for consideration

For an example, a student who has chosen to propose a cultural center, would visit and find information on the cultural industries available or to be promoted on the site. An interview with the artisan would be part of the data gathering involved.

Figure 10: Local industries to be preserved or developed

- Phase III (8 weeks) – Individual work

In Phase III, upon approval from the Studio Coordinator and Lecturers, students worked diligently on their identified proposed project. They refined further their project identification and justifications and conducted precedent studies or case studies of similar building typology of their identified proposed project. The students also developed their individual project briefs, design strategies and options, and ultimately their schematic designs. During this phase the Studio Coordinator will assign Panel of Supervisors consisting of Lecturers from Department of Architecture to each student by mutual consent. The Supervisors are expected to assist the supervision of the students' works throughout the semester and the next semester.


Figure 11: Presentation to panel or supervisor

- Phase IV (12 weeks) – Individual work

During the semester break in between First Semester and Second Semester, students developed their individual designs. They attended progressive critiques which have been agreed upon with the Studio Coordinator and Supervisors. By the time the Second Semester began, the students are ready with their schematic design proposal presentation. With minor tweaking, students are expected to proceed with their design developments and ultimately their final presentation in ARC4003 (Comprehensive Design Studio) course.


Figure 12: Presentation & Collaboration with professionals

The Program (timeline or milestone)

Example of progress and scheduling for the semester according to the work phases.

SEMESTER'S PROGRAMME

Week	Days/Dates	Activities/Content	Other
1	Dec 24	Project Briefing	PHASE I
	Dec 27	Historical/Heritage	PHASE I – Input lecture
2	Dec 31	Historical/Urban Design Issues	PHASE I
	Jan 3	Briefing on Area Action Plans Site Visit/ MPKT Briefing (Jan 4, 5, 6, 7)	PHASE I – Input lecture
3	Jan 7	Site visit	PHASE I (Design lecture)
	Jan 10	Awal Muharam	
4	Jan 14	Analysis of Urban Design Issues	PHASE I
	Jan 17	Analysis of Urban Design Issues	PHASE I - CRIT
5	Jan 21	Strategic Concepts/Potential Developments	PHASE I
	Jan 24	Strategic Concepts/Potential Developments	PHASE I
6	Jan 28	Strategic Concepts/Potential Developments	PHASE I
	Jan 31	Report Presentation –Seminar (Yr 4+5)	PHASE I – Assessment (40%)
	Feb 4 Feb 10	MID-SEMESTER BREAK	
7	Feb 11	Project Identification/Justifications	PHASE II – (Design lecture)
	Feb 14	Project Identification/Justifications	PHASE II
8	Feb 18	Precedents Study	PHASE II
	Feb 21	Precedents Study	PHASE II
9	Feb 25	Precedents Study Presentation	PHASE II - (Design lecture)
	Feb 28	Precedents Study Presentation	PHASE II - CRIT
10	Mar 3	Project Brief Development	PHASE II
	Mar 6	Project Brief Development	PHASE II
11	Mar 10	Project Brief Development	PHASE II - CRIT
	Mar 13	Design Strategies/Concept	PHASE II
12	Mar 17	Schematic Design	PHASE II
	Mar 20	Maulidul Rasul	PHASE II
13	Mar 24	Schematic Design	PHASE II
	Mar 27	Schematic Design	PHASE II - CRIT
14	Mar 31	Schematic Design	PHASE II
	Apr 3	Schematic Design	PHASE II –Submission
15-17		REVISION / FINAL EXAMINATION	**Assessment (50%)**
18	Apr 28, 29		**Portfolio review**

5

Table 1: The semester timeline

Assessment and Assessment Rubric

Assessing the achievement of the learning outcome of the POPBL approach is done progressively rather than just one time assessment reflecting the continuous effort made by the students. This is to ensure that the work is done in stages and the student has gone through each of the process in developing the project. In this module, the distribution of mark consists of urban contextual and identification of the design issues (40%), building schematic design (50%), technical pre-assignment (5%) and initiative, attitude and participation (5%). These are the areas that will be assessed throughout the course which will be done progressively through several crit sessions. During crit sessions, feedbacks are welcomed not only from the crit panels but also from the students. To assist the students in this project occasional discussion meeting with the lecturers were held weekly where students were required to present their work progress. This exercise helps to improve the critical thinking aspect of the student as well as their ability to convey their ideas effectively.

PROJECT: "URBAN DEVELOPMENT: KUALA TERENGGANU"
Assessment Stage1: 31st January 2008

Name of Student/Group: .....

OBSERVATIONS AND COMMENTS:

Rating	1	2	3	4	5	6	7	8	9	10	Remarks
1. BACKGROUND INFORMATION											
2. URBAN DESIGN ISSUES											
3. ANALYSIS OF ISSUES											
4. STRATEGIC CONCEPTS / POTENTIAL DEVELOPMENT											
5. PRESENTATION TECHNIQUES											

OTHERS COMMENTS:

Assesser: .....

PROJECT: "URBAN DEVELOPMENT: KUALA TERENGGANU"
Assessment Phase 2 :*PROJECT IDENTIFICATION AND BRIEF DEVELOPMENT*
14TH April 2008

Name of Student: .....

OBSERVATIONS AND COMMENTS:

Grading	F	C-	C	C+	B-	B	B+	A-	A	Remarks
1. PROJECT JUSTIFICATION										
2. PRECEDENT STUDIES										
3. PROJECT BRIEF DEVELOPMENT										
4. DESIGN STRATEGIES/OPTIONS										
5. SCHEMATIC DESIGN										

OTHER COMMENTS:

OVERALL	

Assesser: .....

Table 2: Assessment Rubric

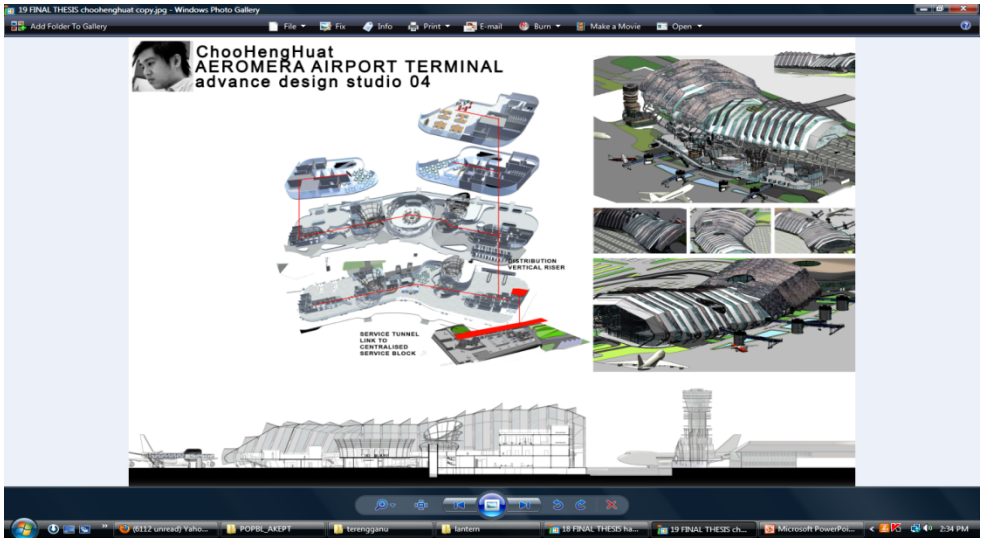
Teacher's and Student's role

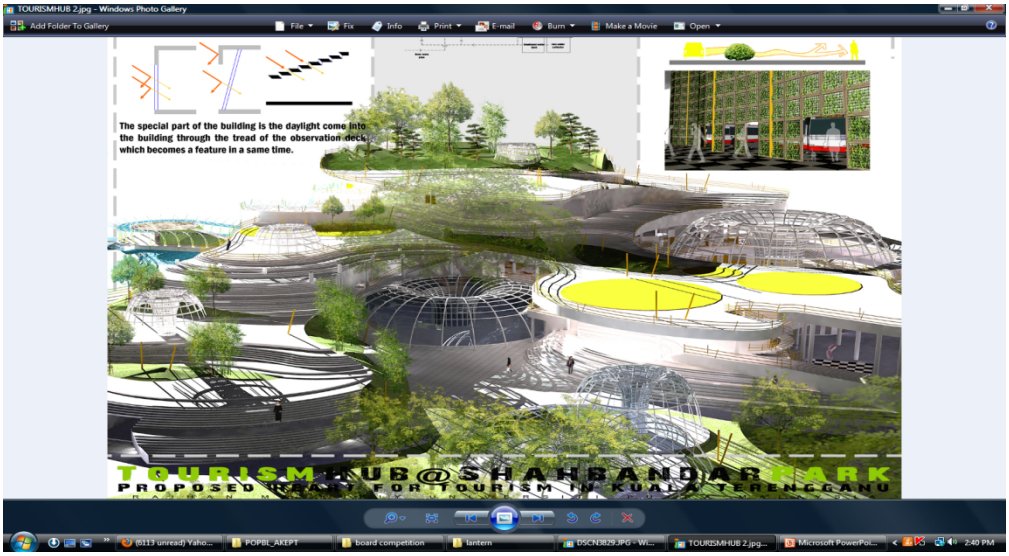
In POPBL, students are given the responsibilities to manage the process of developing the ideas, starting with the arrangement of the site visit, task distribution, planning and scheduling as well as budget and cost. The lecturers' roles are focussed on the monitoring of the students' progress and facilitating the development of the project by conducting weekly discussion and crit sessions. It is the lecturer's responsibility too to provide as many input as possible for the students by inviting outside panels (professional architects, engineers, and etc) to comment and give feedback on their process and development of projects.

Findings

The deeper approach to learning that takes place in the implementation of the module improves student performance profoundly. The student attitude and positive feedback can also be seen as a result. Another distinctive positive values evidenced are better interpersonal skills and attitudes towards peers and others. It has also been observed that the achievement of the students in their critical thinking as well as their soft skills have improved tremendously through the application of POPBL in the studio teaching. It stimulates the students to generate new ideas based on the investigation that they have conducted earlier during the process. With their cooperation, collaboration and participation with the society, authorities and experts, their awareness towards culture and society has increased and their confident level has also increased tremendously which can be witnessed through their verbal and visual presentation.

Example of Individual work (visual presentation)





Conclusion

It is found that the teaching of the architectural design studio is mirroring the POPBL methodology effectively. Based on the cooperation and collaboration that can be witnessed amongst the students and the interview with the lecturers involved, it can be deduced that the design module is successful in producing better result in the learning outcome and its project objective. The students' soft skills are enhanced tremendously since they were immersed in active and deep learning during their process of learning. All in all, the POPBL method of studio teaching has successfully cater the needs of the three goals of learning process as well as the soft skills required by a student.

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INTERDISCIPLINARY COLLABORATION & GLOBAL OUTREACH

RIDING THE RESEARCH UNIVERSITY'S AGENDA: TRANSFORMING ARCHITECTURAL EDUCATION FOR GLOBAL WEALTH GENERATION

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Abstract

The natural reflex to any threat is retreating into a defensible mode. In anticipation of the WTO Liberalisation 2012, the Faculty of Design and Architecture, Universiti Putra Malaysia (UPM) has, instead, taken on establishing its sustainable design informatics niche in the education, research and innovation of design-based disciplines for supporting sustainable products development. The goal is to produce competent design-based graduates for global deployment while engaging local practitioners in indirect dissemination discourses about emerging trans-disciplinary theories and available collaborative technologies for enhancing current interdisciplinary collaborations—the very core for professional practitioners operating at global platforms. This paper is proposing a two-tier professional competency approach to architectural education: 1) bachelor degree for technical competency and 2) masters degree for professional competency. However, their successes require the architectural education to resolve several critical issues. Among them include career development of professional architects in a research-oriented education system; and equivalency and acceptance of scientific design research outputs for annual performance evaluation. After outlining how UPM's Strategic Transformation Plan 2011-2013 was translated into the faculty's Transformation Vision Strategy 2011-2014, the paper describes the challenges faced by design-based programs and highlights critical initiatives proposed at university level by the faculty. Recommendations include establishing the arts and design cluster, development of masters program for professional competency, and the necessary ecosystem to support such programs. This paper supports an international quality architectural education which could be extended to various disciplines in the creative and innovative human capacity development since Malaysia is moving towards knowledge-based economic transformation development.

Keywords: Architectural Education, Design Education Policy, Research University, Economic Transformation Program

Introduction

The natural reflex to any threat is retreating into a defensible mode. In anticipation of the WTO Liberalisation 2012, the country saw many professional organisations taking defensible actions to curb, if not, delay the opening up of the professional services to potential foreign competitors. Such a contrary move when the Malaysian Government had purposely launched the Economic Transformation Programme for the country on September 21, 2010 (available on http://etp.pemandu.gov.my). The programme aims to turn Malaysia into a high income economy by the year 2020. It will lift Malaysia's gross national income (GNI) per capita from USD6,700 or RM23,700 in 2009 to more than USD15,000 or RM48,000 in 2020 thus allowing the country to propel to the level of other high income nations. The government expects that a GNI growth of six per cent per annum will allow the country to achieve the targets set under Vision 2020. Hence, the successful implementation of the ETP will need to see Malaysia's economy undergoing significant changes to resemble other developed nations.

The country foresees a continuous shift towards a service-based economy, with the services sector contribution growing from 58 percent to 65 percent until year 2020. The programme estimated more than 3.3 million new jobs to be created by 2020 and spreading across the country in urban and rural areas. Twelve national key economic areas (NKEA) were underlined which include the Greater Kuala Lumpur/ Klang Valley to be transformed into a world-class city. Other eleven NKEAs are Oil, Gas and Energy; Palm Oil & Rubber; Financial Services; Tourism; Business Services; Electronics and Electrical; Wholesale and Retail; Education; Healthcare; Communications Content and Infrastructure; and Agriculture. Accordingly, the government had the growth set to be achieved in a sustainable manner, without cost to future generations, through initiatives such as

building alternative energy generation capacity and conserving the environment to promote eco-tourism.

In response to such national initiative, Universiti Putra Malaysia's (UPM) Strategic Transformation Plan 2011-2013 had outlined six missions and their respective objectives for an overall university's transformation while upholding its status as a Research University. The first mission is attracting excellent students and producing graduates who are knowledgeable and competitive. The second mission is improving the level of research outputs and innovations to international level. The third mission is empowering community involvement for generation and sharing of knowledge. The fourth mission is empowering UPM as the excellent centre for education, research and services for agriculture and tropical bio-resources. The fifth mission is streamlining administration and management of resources based on best practices while the final mission is empowering the School of Business Management as a Top Business School.

Against the above background, the Faculty of Design and Architecture planned its Strategic Planning Workshop in July 2011 in order to review and realign its vision and mission to support the university's missions. This paper presents the challenges faced by design-based programmes and highlights critical initiatives proposed to UPM at university level by the faculty. The paper concludes with recommendations to support the faculty's vision and mission thus ensuring the sustainability of the design programmes it has established.

Against Traditional Research University

The challenges for any design school are typical across the globe. Since Universiti Putra Malaysia was declared one of the founding four Research Universities, academic staff at UPM has been benchmarked to meet high level of research-related outputs for sustaining the Research University status. On top of the list are top quality journal publications and awards for research grants and innovations from research activities. Almost every academic staff from the Faculty of Design and Architecture struggled to satisfactorily meet their research outputs to match with the university's key performances as research academicians. Ibrahim and Osman (2009) found the emphasis on sciences and technologies by the university's management had imposed similar science and engineering performances across the Serdang campus onto design academicians. The design-based faculty struggled hard to keep up meeting the targeted achievements but to no avail. After three years undergoing the research university's performance reviews, the scholars highlighted the need for the faculty to change and redirect their existential efforts towards meeting those research outputs but at much as possible at minimal cost to the academic staff. Hence, the establishment of the Sustainable Tropical Environmental Design Exhibition—*STEdex*—where instead of publishing in indexed journals, the outputs from all the faculty's design studios could be published in an indexed exhibition and be counted similar to other citation-indexed journal articles. Two thirds of the inaugural exhibited artefacts in 2009 were contributed by the architectural design studios.

Transforming Design Education for Enculturing Innovation

The triumph of STEdex's achievements in year 2009 has now become the pillar of encouragement for the Faculty of Design and Architecture for its efforts to be counted differently among the university's scholarly brotherhood of scientists and engineering researchers. A jump from a 0.25 citation article per staff the year before to 2.65 articles per staff in 2009, design academics celebrated the co-existence of professional academics and design researchers specifically in the professional programmes such as architecture and landscape architecture. Although the benchmark kept rising each year afterwards, the faculty only saw little incremental changes to its productivity in the first three years after STEdex 2009. It was time to redefine and refine our efforts to reposition our concerted efforts as an integral player albeit in selected missions of the university's Strategic Transformation Plan.

Change became urgent in 2011 when the university started allocating operational budget based on a formula that saw inclusion of performances by students and research contributions by staff. Therefore, as much as the need for change in outperforming our previous achievements, the faculty now faces the reality to have the capability for creating and generating its own wealth for operational purposes. After much deliberation, the Transformation Vision Strategy (Ibrahim 2011 & 2012) for the Faculty of Design and Architecture in the coming years will see the Faculty striving towards innovating new or enhanced processes, together with new or enhanced applications that, utilise newfound or newly developed sustainable resources. The synergy between the three components is expected to invigorate exciting novel sustainable products thus is expected to create a new playing field. The faculty described this niche field as *Sustainable Design Informatics*.

The new playing field in the built environment covers the three main components of sustainability—social, economic and environment. The field strives on manipulating knowledge gained from understanding all three components through trans-disciplinary design thinking and design research processes that would in turned further create new knowledge and new applications for the betterment of the global population. Additionally, intelligent integration and collaboration with industries and communities must be infused naturally into our teaching and learning in order to facilitate wealth creation. This healthy relationship can gradually encourage industry partners into academia where we can expose to them on-going R&D projects or determine future ones together. The goal is facilitating future commercialisation efforts of designed and researched products. The following section explains the foundation for the new niche field.

Foundation for Sustainable Design Informatics Niche

Sustainable Design Informatics is defined as a design discipline combining design concepts and practices with information technology (IT)—or informatics—for achieving sustainable living. It focuses on the arts and sciences of design relating to collection, creation, storage, retrieval, processing, display and dissemination of knowledge throughout the designed product development lifecycle impacted by information technology. It is a trans-disciplinary field in design focusing on the development lifecycle of innovative solutions using indigenous resources while addressing socio-cultural needs that meet economical aims. Among its research targets would include content, methods, technologies and systems besides development of tools, techniques and applications specific and practical for cradle-to-cradle product innovation in certain context.

Translation of this sustainable design informatics niche into the education, research and innovation of design-based disciplines at the faculty is expected to support sustainable products development in the faculty's Transformation Vision Strategy. We aim to produce competent design-based graduates for global deployment while concurrently engaging local practitioners in indirect disseminations and discourses. As much as possible, opportunities to include emerging trans-disciplinary theories and available collaborative technologies became pertinent in order for faculty to enhance interdisciplinary collaborations—the very core for professional practitioners operating at global platforms. Concurrently, enabling factors against successful deployment of organisation and product development lifecycle (as per identified by Ibrahim & Nissen, 2007; Ibrahim & Paulson, 2008; and Shumate et. al, 2010) would now become highly conscious awareness efforts towards mitigating potential product delivery failures. Although Ibrahim and Paulson (2008) established these operating environment characteristics for the building development projects, we found similarities in other product development lifecycles. They are having complex workflows, having multiple interdependent tasks; having different stakeholders' involvement at different lifecycle stages; and displaying regressive tacit-dominant knowledge base exchanges as the product development lifecycle progresses.

Challenges for Transformational Changes

The extension of a professional education in the architectural field at graduate level brings up several challenges for implementation. This is mainly stemmed from the need to retain professional architects as educators since the career advancement for qualified professionals without doctoral qualifications is not similar compared to one towards academic staff who have doctoral qualifications. In most top research universities in the world, professional programmes such as architecture and engineering would give preference to hire professionals with doctoral qualifications to overcome this problem. This option is far from feasible in Malaysia as there is a limited supply of potential applicants who have both qualifications and want to be employed fulltime in universities.

The paper presents alternative options that the Ministry of Higher Education (MOHE) and the Public Services Department (JPA) could consider for enriching and sustaining the architectural professional programmes at public universities in Malaysia. Our aims are 1) improving academic career development for both professional and academic architects specifically in research-oriented education system and 2) development of mechanism and measures equivalent to scientific research outputs for their individual annual performance evaluation.

Transformational Initiatives for Design Schools

The success of organising STEdex 2009 and the subsequent achievements for the Faculty of Design and Architecture in meeting and supporting the publication goals for a research university have

motivated the faculty to review and improve current career advancement path for academic staff in its professional programmes such as architecture. Among the initiatives conducted by the faculty entails establishing the arts and design cluster, development of masters programme for professional competency, and providing the necessary ecosystem to support such programmes. We rationalise the initiatives as follow:

1. Establishing the Arts and Design Cluster

The Faculty of Design and Architecture claims that design research tend to involve more complex research approach that transcends both the qualitative (constructivist) and quantitative (positivist) realms. Design researches, which tend to be founded by human-based problems, require affirmation of the subjective understanding about aspects related to the human beings before any technical or procedural design solutions could be put forth. We have justified our different stand when the annual performance review for 2011 saw UPM documented the highest achievements for innovation by the faculty against the established faculties in sciences and engineering. This is against the fact that it had the least number of doctoral staffing (57% PhD staff compared to 90% campus average) and was among the lowest three for research grants awards. It is not surprising that the faculty failed miserably in publishing articles in impact factored journals. However, it was an irony to know that the faculty was successful in producing all its industrial design intellectual property rights (IPR) without any research grants. They had all come from our design studios. Hence, through the establishment of an alternative publication outlet, artefacts from our design studios have successfully been considered as citation-indexed articles. In lieu of these different but significant achievements, we are pleased to inform that the Faculty of Design and Architecture has been instructed by the University's Management to establish another branch of academic cluster called the Arts and Design.

The proposed cluster allows different consideration for each qualification criteria specifically publication, supervision, research grants and research leadership for professorial promotion purposes. The faculty introduces alternative publication outputs in lieu of the typical citation indexed journal publication, professional mentoring supervision in lieu of doctoral supervision and consultancy projects in lieu of research grants. A unique aspect to qualify individual professional contribution is the peer acknowledgement by having his or her works exhibited in an indexed exhibition at international level (i.e. similar to being cited by other scholars). Furthermore, the professional academic staff must demonstrate his or her competency to curate other professional works which equates the work of a chief editor of a journal. The level of curatorship can be categorised for national or international professional exhibitions organised at gallery or museums which is similar when one is the chief editor for a peer-reviewed or citation-indexed journal. For example, having individual's work exhibited at the Louvre Museum in Paris where Mona Lisa painting is exhibited is like having an article published in an impact factor journal of 100. Coincidently, the quality of work by design-based professionals would speak for itself if that work is exhibited at Louvre Museum versus Balai Seni Lukis Malaysia.

2. Development of Professional Masters of Architecture Program

While other sciences and social sciences programmes have clearly charted an educational pathway ending with a Masters degree should the student chose to undergo a direct 5-year educational experience, the architectural programme at UPM saw a total minimum of 120 credits for the first bachelor degree and an additional 60 credits for the second professional bachelor degree. The faculty supports the establishment of the Masters of Architecture degree to replace the Bachelor of Architecture degree at the termination of the second professional education programme. The initial bachelor degree will focus on the technical competency in the architectural profession including architectural design studios, graphic communications, building services, structures and construction materials, history and theory, environmental sciences and basic professional practice. At the professional Masters' degree programme, students will be trained towards professional competency. The Masters of Architecture degree is proposed to focus on advanced architectural design studios, sustainable building technologies, architectural research and professional practice. Graduates from UPM's programme are expected to possess architectural design skills, competency in building performance simulations and in-depth knowledge in project delivery in Malaysia.

3. Development of Architectural Academic Ecosystem

3a. Institutionalising professional academic career path in the design fields

We acknowledge a dilemma in attracting professional architects into academia while at the same time providing a conducive environment to advance towards professorship during their tenure for those in the academic system. It is a challenge to meet the industry's financial

compensation scheme for academicians who are have professional qualifications. On the other hand, the challenge to produce research publications and obtain research grants similar to scientists and engineers means the chance for them to advance towards professorship seems too far to reach. The Faculty of Design and Architecture is known to consistently argue for different performance criteria for its professional and design academics. The instruction to create a new Arts and Design Cluster at Universiti Putra Malaysia for 2012/2013 implementation will further institutionalised the differences between major STE and SSH clusters which was recently announced by MOHE.

3b. Institutionalising *Galeri Serdang* Programme

In the 2010 status review process for research universities, MOHE had accepted the publication of artefacts from design studios which are exhibited in STEdex as equivalent to any citation indexed article published in a peer reviewed journal. It was an endorsement of our collective efforts and the faculty credits all staff and students accordingly. The indexed exhibition is now formally known as the *Galeri Serdang* Programme and is a university-supported programme. The whole of UPM is a registered member of the International Council of Museums based in UNESCO, Paris under the Research Institution category. It is the precursor to organising any indexed exhibition. The secretary for ICOM membership for UPM is the Faculty of Design and Architecture. We are now extending the indexed exhibition service to other faculties and research institutes which we hope we can later offer the same to other design schools locally and internationally.

3c. Institutionalising industry and community linkages in design studios

In lieu of improving the commercialisation of innovations from the design studios, faculty improves these opportunities by inviting industry partners to actively participate in formulating and enhancing designed solutions based on their actual industry problems or issues. The faculty won a bid for additional funding from the university that would encourage these industry and community activities to take place through student-centred learning processes specifically using project-oriented problem-based learning in all design studios. The extra funding has helped defrayed the costs of studying architecture and other design fields at the faculty since it subsidizes students' materials and travelling costs. In return, we received more industry partners who are much comfortable experimenting new ideas in the safety of the design studios. Should the solutions become feasible for potential commercialisation, the participating industry partner has the first right of refusal thus expediting further innovation and commercialisation process between university and that industry partner. The faculty is pleased to inform that we are seeking local and international education, governmental agencies and industry partners who have similar interests toward our visionary endeavours. We are pleased to report that in 2012, UPM has signed Memorandums of Understanding with *Perbadanan Putrajaya* and AECOM, a multi-national consultant, for academic and R&D activities and exchanges in the area of sustainable development and several more are in the formalisation process.

3d. Institutionalising design and design research

This on-going initiative is integral to position architecture and other design fields as a significant contributor to the nation's economy. At a British Columbia Forum on forest economics and policy, researchers acknowledge that "knowledge and technology are fast becoming commodities, and the creative use of knowledge and technology available through the use of design, offers the remaining competitive advantage" (Bell, 2006). Bell noted how those countries or regions which had invested heavily into the promotion of design were now reaping the economic rewards through competitive advantage. Included under the "design" fields, but not limited to, are graphic design, interior design, architecture and industrial design. These countries have instilled national policies where industry, educators and researchers play a crucial role in planning and implementation (ibid.). In the education system, there is a need to showcase the added value when design thinking is integrated in the problem solving decisions. The Faculty of Design and Architecture has become the custodian of the RSB 4630 Innovation Methodology course for undergraduate and postgraduate students on behalf of the university for MOHE. Additionally, it has started offering RSB 5610 Integrated Product Design Studio which allows multi-disciplinary students to come together in a design studio format. Furthermore, the faculty has established Putra Design Nucleus, a design research and services centre, where professional and design academics could offer complementary niche services to university and industry practices.

Conclusions

In summary, the Faculty of Design and Architecture is driving towards an international quality architectural education which could be extended to various disciplines in the creative and innovative human capacity development. The small, but significant, transformation strategy at the faculty will facilitate Malaysia in moving towards knowledge-based economic transformation development. The Faculty of Design and Architecture is proud to introduce the Sustainable Design Informatics programme which it expects could be expanded into more emerging niche design areas when individual design researchers successfully developed their areas of sustainable product development. The paper describes on-going initiatives that would formalise the faculty's efforts to be counted differently by non-design research clusters. They are establishing the Arts and Design Cluster, development of a Masters of Architecture program and establishing the necessary ecosystem within the university's environment.

For the ecosystem to be sustainable, the faculty has made huge efforts in institutionalising the professional academic career path in the design fields, institutionalising the *Galeri Serdang* Programme, and institutionalising industry and community linkages in all its design studios. In the process of institutionalising the above-mentioned initiatives, the faculty indirectly starts to institutionalise design and design research into the everyday of the common people's lives. In conclusion, the faculty believes that it needs to make a concerted effort focused on translating the sustainable design informatics in the education, research and innovation of design-based disciplines for supporting sustainable products development. The initiatives are expected to produce competent design-based graduates for global deployment while engaging local practitioners in indirect dissemination discourses about emerging trans-disciplinary theories and available collaborative technologies. In due time, we foresee instilling the capability and capacity for our graduates to work in interdisciplinary collaborations—the very core for professional practitioners operating at global platforms. In due time too, we can expect to gain more in-depth rooting for design and design research into the nation's innovation agenda as more and more design researchers take root in establishing their own emerging design interest.

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INTERNATIONAL URBAN DESIGN WORKSHOP AS A BASE FOR REFLEXIVE DEVELOPMENT

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Abstract
The intention of this paper is to share the experiences from the recent Urban Design Research Laboratory (UDRL), Centre of Studies for Architecture brief studios at four international venues in the last two years. These programmes were made possible from the Students Mobility Fund given by the Ministry of Higher Education Malaysia to all IPTAs to promote and expose students to international academic opportunities; thus developing knowledge and skills needed to become productive members of the global community. The theme of the collaborative urban design workshop was based on 'The Potentialities of Places' which focused on the potential and dilemma of global cities. The study aims to fill in the gap in the literature by investigating the programme that promotes students' creative imagination in generating new ideas on contemporary urban living and working conditions. Through identifying and analyzing these foundations that the UDRL posits itself as a hub to promote extensive international design research network, based on a reflexive structure of cultural exchange and knowledge transfer. This paper delineates some of the projects conducted at four different venues in Poznan, Sydney, Oxford and Berlin. Furthermore, the results of the study provided support to how this practice-oriented laboratory can foster a creative atmosphere which oscillates between thinking and making in order to generate solutions to real world problems.

Keywords: *architectural education, collaborative urban design workshop, international design research network, reflexive.*

INTRODUCTION

UiTM administers the expectation from the Ministry of Higher Education for universities to take initiative to engage with industry and community (Harun, 2009). Faculty of Architecture, Planning & Surveying, Universiti Teknologi MARA (UiTM), Shah Alam is highly attentive to form strategic partnerships with industry and community to gain mutual benefits for all parties. In response to global needs and challenge, FSPU has taken the initiative to apply for the Students Mobility Fund given by the Ministry of Higher Education Malaysia to all IPTAs to promote and exposed students to international academic. 'UiTM Study Abroad Opportunities' has established a platform for Architecture students to be involved in high quality international academic collaboration that allow them to develop knowledge and skills needed to become productive and successful members of the global community. Through partnership with foreign institutions abroad, the Centre of Studies for Architecture, FSPU seeks to increase awareness of education opportunities and to promote intercultural learning for creativity in diversity.

In providing a unique real-life experience, the Urban Design Research Laboratory (UDRL) was initiated to promote extensive international design research network. Established as a hub for cultural exchange and knowledge transfer, the UDRL has organized seminars, design workshops, conference and published students' work related to urban design for more than ten years. Over the last two years, UDRL has conducted urban design workshops in different countries around the world in promoting the creative imagination of students to generate new ideas on contemporary urban living and working conditions. The recent workshops based on the theme 'The Potentialities of Places' was first conducted at the University of Fine Arts, Poznan, Poland in July 2010. University of Technology Sydney (UTS) was the second university to collaborate with UDRL in November 2010, followed by the third and fourth workshops, which were conducted concurrently at the Aedes Campus Network Berlin and Oxford Brookes University in July 2011.

REFLEXIVE DEVELOPMENT IN ARCHITECTURAL EDUCATION

The objectives of these workshops are not only to *generate* design *proposals* that exhibit best practices in *urban design* but more importantly, they have to look forward in empowering architecture as categories of perceived, conceived and lived space envisioned in the art of place-making. As this paper seeks to demonstrate the students' response to reflexive development during these workshops, the nature of the projects were conceived on the idea that architecture of the city is a reflexive practice which involved a wide array of processes and need to be confronted within their creative parameters.

Beck (1992) examined the theory of reflexive modernity, the condition in which the moderns are increasingly concerned with managing the problems created by modernity. New social movements are said to be reflexive in the sense of information oriented, present oriented and concerned with feed-back. Beck refers to the `new modernity' as risk society, emerging in conditions in which scarcity no longer dominates as a consequence to the growth of productive forces. Reflexive development takes on a programmatic meaning: development may become reflexive in a social situation and in its political sense as participatory. Reflexive modernization is the way one kind of modernization undercuts and changes another, has wide-ranging implications for contemporary social and cultural theory (Beck et al., 1994). Encompassing social theoretical themes of 'reflexive modernization', 'detraditionalization', 'globalization' and 'individualization' this theory is equally impressive in scope and indeed the two authors have engaged in productive debate. Beck's vision of the "risk society" has already become extraordinarily influential. He offered a new elaboration of his basic ideas, connecting reflexive modernization with new issues relating with the state and political organization.

Cowherd (2012) highlighted the effects of the Creative City throughout the world and identifies specific mechanisms required for creative connectivity. He discovered the increase in the number of cities with insufficient resources and identified the investments in creative economy that can establish self-renewing power of creative connectivity cycles. Cowherd posited two models to account for stigmatizing reactions. The first model was an urban intervention in the form of the Guggenheim Museum in Spain better known as the "Bilbao Effect" that has influenced urban development and city branding throughout the world. The second model is the social transformation of Medellín, the "murder capital of the world" in Columbia, to become a centre for tourism. Drawing on examples from Bilbao, Medellín, and elsewhere, it is useful to analyze the "reflexive" forces operating through architectural and urban space as key drivers of self-renewing creative connectivity. Cowherd indicated that the literature of "reflexive modernisation" by Beck offered a powerful analytical framework to examine the urban spatial operation of social, cultural, economic and political feedback loops driving the creative connectivity cycle.

Frampton (1983) clearly described the relationship between built form and its environment. His idea on critical regionalism can recapture the lost sense of 'place', which has become globalized. Frampton's framework of ideas was incorporated in the methodology of the workshops. Lynch (1960) wrote, "Any place is its sense of connection to human life and the whole connection of living things." Reflexive responses were already evident when Lynch wanted to determine place legibility in his Image of the City studies. Neveu (2007) stated that architecture is a "reflective practice" justified when a professional is able to solve well-formed problems. Reflexive practice reveals itself during the process of finding a solution for the problems. The reflexive approach is connected with the urban-conceptual research. The traditional structures of learning founded on concepts of 'basic skills' and the trivial nature of urban design 'theory' are challenged in favour of a more contextual and reflexive conduit for urban design programmes based on urban social construct.

Students are able to develop their ability to engage critically with the subject matter, analyse and evaluate urban issues hence develop their reflexive skills as perceived, conceived and experienced by the students. Cuthbert (2001) discussed on globalization and urban design, stated that the experiences of learning in foreign environment will give social exposure as well as cultural differences. The reflexive practice in these workshops involved planning, acting, observing and further reflection in the process of improvement. As reflexivity is about putting what has been learned into practice during the process of producing and developing of ideas, students' creativity play an important role in fostering cultural diversity.

METHODOLOGY

The intention was to share and analyze the experiences gained in the four collaborative urban design workshops focusing on the potential and dilemma of global cities. Referring to the ideas derived from Beck's and Cowherd's concepts of 'reflexivity', the given experiences maybe more complex and reflective in the learning process. . Bernard (2002) highlighted the significance of data gathering as crucial in research as it meant to contribute to a better understanding of a theoretical framework. Purposive sampling is used in this study as an information selection tool to give the real-world context in which most qualitative research is carried out in addition to identify what can be gained by multi-disciplinary collaboration. The purposive sampling is to access particular information of the experiences and to have some ideas of the variation in the data from the recent UDRL's collaborative urban design workshops in Poznan, Sydney, Oxford and Berlin. *Purposive sampling* strategies are furthermore intended to increase understandings of students'

experiences and for developing theories and concept (Frankel & Devers, 2000). Obtaining data will highlight how this practice-oriented laboratory can foster a creative atmosphere that oscillates between thinking and making in order to generate solutions to real world problems.

Through data analyses, the sample results from students' urban design projects; responds from numerous participants were reviewed. In addition to the understanding of relationship between urban design and reflexive development, examples of student works have been analyzed to discover the details, especially in the issues and potentials that generate hypothesis. Documents and data generated by the students were closely analysed to see how the data attributes influenced the decisions made in the process. The first part of the data described the reflexive development involved in the creative thinking of particular activities of the programme and some insight into student feedback and the facilitating lectures' thoughts on the most important element of a successful programme. In the second part the outcome results of students' proposed urban design and the objectives of the recent urban design research laboratory (UDRL) were revealed.

INTERDISCIPLINARY COLLABORATION AND GLOBAL OUTREACH

UDRL's global network promotes program that encourages the exchange of ideas and exploring issues confronting urban life are documented in these case studies below:

Case-study 1: Collaboration workshop with University of Arts in Poznań

The first workshop based on the theme 'The Potentialities of Places' involved collaboration between UiTM and the Academy of Fine Arts in Poznań, which is now the University of Arts in Poznań. Twenty architecture students (fifth and sixth year) facilitated by two UiTM lecturers worked together to generate urban design concepts and ideas with Polish students and other international students from Shanghai Normal University and Maranatha Christian University, Indonesia. The collaboration has given the chance for participants to learn from each other while the city of Poznań provided the historic base for exploration. As pointed out by Cuthbert (2001) on the experiences of learning in foreign environment, the country's complicated history and the influences of Eastern and Western cultures simultaneously accommodated students in adapting various cultural patterns. The differences were observed; and students are capable to perceive the city from multiple viewpoints and focusing on the positive aspects of the new environment while enjoying working with interdisciplinary teams. An imaginative projection of new ideas emerged through emotionally experience and appreciation of the reality of the place.

Figure 1: Reconstructing the Invisible, Poznan.

Dilemmas and Potential:

In one of the proposal entitled 'Reconstructing the Invisible' has been derived from a historical perspective. Since Poznan was established as a fortress city that has compounded all activities in a specific perimeter space termed as a 'courtyard approach' planning, it was considered to be appropriate as it could generate a self-sufficient community/society. In contemporary times, when the social and cultural aspects of cities have been reformulated through universalized system of modernism, the traditional approach of courtyard ceased to function as it was.

Hypothesis:

"Re-thinking of the Invisible' is an approach to reconstruct back the historical wall of the fortress in a new way that can sustains the density of Poznan. Therefore, the new typology of fortress walls and their function can bring back the magnificent history of Poznan. It may seems like a radical

approach for this urban intervention and it may take 50 to 100 years to realize the completion of the mega courtyard in the air with new transportation to be added in phases. This new growth pole is an on-going long-term development so as to propel the adjacent sites for future expansion and improvement. As a concept, the city wall is used as a metaphor to glorify the magnificent history of Poznan. More or less, the approach is about reconstruction of the wall in abstraction. Courtyard in the air is a re-interpretation of the city wall where the invisible line is visualized as a built form in the air and connected with horizontal and vertical spines. The main spine that goes around the city will create a mega architecture where the traditional courtyard of Poznan's urban blocks will have new typologies of built forms mimicking 'Courtyards in the Air'.

Case-study 2: Collaboration workshop with University of Technology Sydney
The second Urban Installation Workshop titled "City's Fragmentation / By-product: Sydney" hosted by University of Technology Sydney (UTS) has been set along with the same intention with the UTS School of Architecture which aimed to support a new generation of experimental architecture. Towards the principles of 'Critical Regionalism' as described by Frampton (1983), students have extensively work closely in the design *team* to generate most ambitious urban design schemes ever produced to guide Sydney's growth and fostering new discussions on architecture in the public realm. During the beginning of the workshop, UiTM students participated in 'INDEX Forum' which was UTS Architecture students' end of the year exhibition that discussed current architectural issues in Australia. The key panellists were leading government officials, practitioners and academic spokespersons around Sydney who facilitated UiTM students in producing urban design proposals that solved the most pressing imminent environmental and social issues around Sydney. The workshop acted as a platform for a new debate on the limits of formal thinking in architecture realm as the city reached the cross roads where it is either becoming increasingly dysfunctional or one of the century's most attractive and sustainable cities (Department of Planning, 2005). Students' strategies in urban design proposals to be developed over the next 25 years Sydney could elevate her as one of the world's most sustainable and attractive cities.

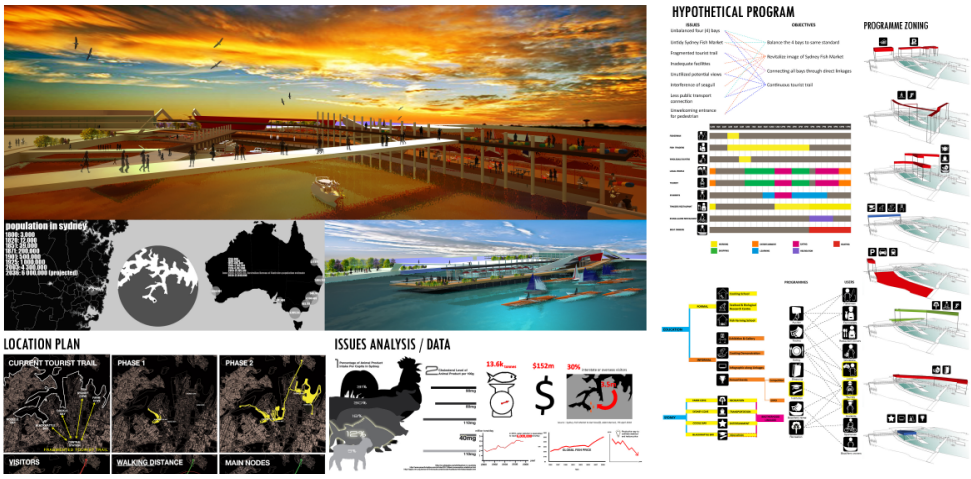

Figure 2: Brotherhood Linkages, Blackwattle, Sydney.

Project Setting
Blackwattle Bay is located in the south of Bays Precinct and covers an area of approximately 7 hectares. The site includes a number of working harbours along Bank Street, Sydney Fish Market and on the southern edge bordering Pyrmont Bridge Road. It is 2 kilometres west of Sydney's central business district. NSW Maritime owns the majority of land within Blackwattle Bay. The Sydney Fish Market is perhaps one of the most significant sites situated along the harbour foreshore as it covers an area of about 43,000 square metres. It is closely located to the inner city suburbs of Glebe and Pyrmont and is close to public transportation networks. The existing site offers retail and dining facilities, wholesale seafood, a marina and offices. Over 13,000 tonnes of seafood is auctioned in the auction hall annually, which serves as a major tourist attraction.

Issues & Potential
Sydney is characterized by its four main harbours, each with its own individual identity. Blackwattle Bay, once an iconic and popular destination, still maintains the mundane character whereas others have been developed with more interesting programs and activities. New insertions of varied programmes need to be implemented to make it shine once again. At the same time, connecting all the four harbours through a direct linkage is crucial as the revitalizing of the Sydney fish market

will not be complete without an artery connecting the others together. This two-phase development will enhance tourism and the quality of urban spaces along Sydney's waterfront.

Hypothesis
Revitalizing Sydney's fish market with a new introduction of a marine research centre could induce and elevate the brand image of the city whilst making the locality more dynamic with activities. Since this place is already connected to all other harbours by freeways in Sydney, the spill over effect will also benefit those places. This brotherhood-linkage will not only strengthen the individual identity of the harbours, but can also act as an interactive medium between people and architecture, which in turn will enhance the quality of urban spaces in Sydney.

Case-study 3: Collaboration with Joint Centre for Urban Design (JCUD)
The JCUD is an interdisciplinary centre promoting better design of public spaces and reaching out to the wider community to address the issues and promote better design of the urban public realm. The collaboration with JCUD offers a team of experts in urban design from Oxford Brookes University who have set to help students to unveil the opportunities of contemporary architectural and urban knowledge of the places which are essential for the workshop programme. It is crucial to address the setting for urban design in Oxford City to remains on the strength of its heritage and the aesthetic integrity of the built environment. In reference to this concern, JCUD has supplement students with the theoretical concepts to strengthen their urban design thinking expanded from the original Responsive Environments ideas which similar to Lynch (1960) sense of connection between psychology and environment. Issues on the sustainability, identity by design, urban transformations and place-identity agenda was delivered by Emeritus Professor Ian Bentley and Professor Georgia Butina Watson as a framework for students to understand the form-production process and the built-form typologies. These theories fed directly into the proposed urban design workshop allowed the students to integrate different types of knowledge and skills. The need for adopting an integrated approach by the Joint Centre during this UDRL workshop has equipped students to intervene effectively in the production of an improved public realm. The concept of the 'reflective practitioner' is a central to the Joint Centre's philosophy that must be reflective practice and integrated with critical theory, which is critical of many current ways of doing things.

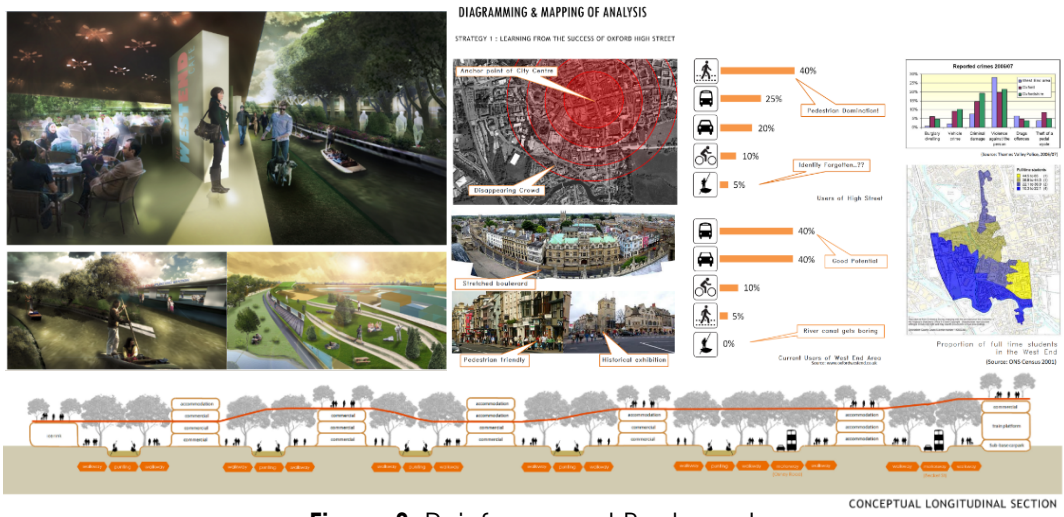

Figure 3: Reinforcement Boulevard

Project Setting
The Oxford's West End has turned out to be an area that seemed to be neglected and disconnected from the city development. The identification of what is lacking and the causes of the under-development of the Oxford West End is analysed. The movement of people is from the nearest anchoring point which is the Oxford City centre. Based on the study of the success of the High Street of Oxford (the anchoring point), a proposal of creating a sort of district development is being introduced to the Oxford West End. The proposed scheme is derived from the intention of solving the key issue of the site which is to increase the number of 'eyes on the street' that will in time, reduce the rate of crimes and make the Oxford West End much livelier especially at night with the injections of commercial and housing programmes.

Issues & Potential
The idea of putting forward an agenda to reinforce the identity of Oxford is not only aimed at fixing the Oxford West End area but also to promote the redefinition of the first impression on Oxford.

Besides that, the high number of foreign students in Oxford is already a threat to the Oxford identity. Therefore, by going back to its origin, the image of the West End shall be the definition of the true Oxford through the showcase of punting activity, commercial and trades, a context-friendly form and greenery injections.

Hypothesis
The proposed West End Boulevard will increase the number of 'eyes on the street' and become a commercial district that will boost up the local economy and at the same time makes the area livelier at night through the injections of students housing. The new West End will also become a parameter for further developments from the introduction of new waterway networks that provides natural grid, obeying the pattern of Oxford city grid and also from the redefined transportation interrelations with urban blocks and pedestrians. T*he 'hidden attractions' of the* West End area *such as the Castle Mill, Stream, will be revealed.*

Case-study 4: Collaboration with Aedes Network Campus Berlin (ANCB)
ANCB is a unique "Metropolitan Laboratory" focussing on the future of the cities. Fostering an international network of trans-disciplinary research, ANCB is the hub of an extensive research network, connecting partners from all continents with experts in the fields of urban culture and metropolitan technology. Berlin is a city of great importance for historical and new architecture. Such a unique city concerning urban and social developments creates an exciting and unique context for the workshop. The workshop programme emphasized on 'Knowledge Circuit Berlin' which imagined a circular band of civic domains around the inner city of Berlin. A circular campus consists of academic institutions, housing, private companies, and parks. As such its impact on a social world involved shaping urban environment have found crucial importance (Beck, et al., 1994), the city offers a large field of observation and theoretical reflection to become the foundations for professional strategies. The characteristic forms of the city's determining elements which include the way the population performs and the form of its urban territories such as settlements, traffic systems, forests, agricultural lands, fallow lands and water. The morphological principles, their rules of appearance and change are subjects of investigation for the students to create strategic design proposals for the future city. The control of metropolitan infrastructure, its principles and concrete manifestations through urban projects challenge the theory and the practice of the architect. The investigation of the Berlin S-Bahn-Ring meant being concerned with the urban space of both, the one of the city centre and the one of the city edge. In both cases innovative forms of living and working, which respond to the new socioeconomic conditions such as distributive knowledge work, globalisation, and demographic changes, can be taken to create a vision for the whole city.

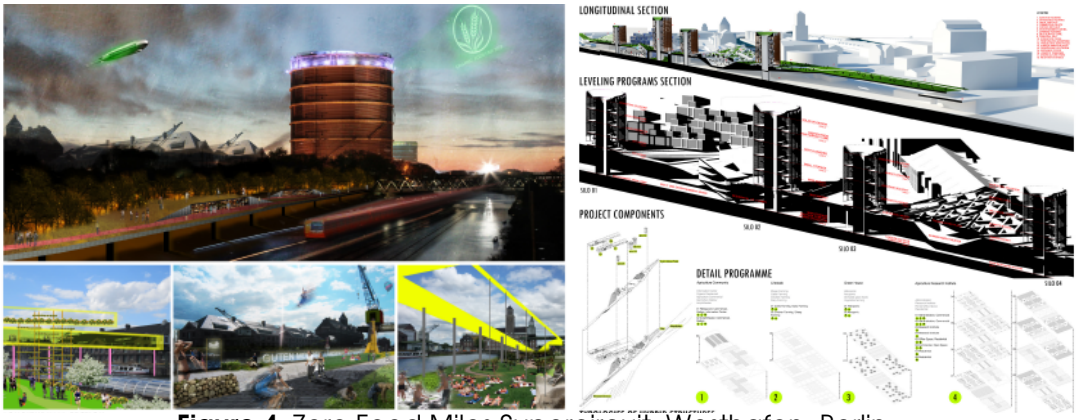

Figure 4: Zero Food Miles Supercircuit, Westhafen, Berlin.

Site Settings
The project is strategically set in between two S-Bahn Stations, Westhafen and Beusselstrasse. Currently, the site is occupied by BEHALA, Berlin's logistic port. The site has an abundant amount of unused vacant space. Its strategic location along the river, Tegel Airport and the Ringbahn, further enhances its potential as an important future landmark in Berlin.

Dilemmas and Potential
"Food miles" or food kilometres is the distance that food is transported as it travels from producer to the store where you buy it, and these miles are costly to the environment. Demand for sustainable food is on a rapid rise in Germany, making it the country with the highest purchase for organic food in Europe. The site has an abundant amount of vacant space, giving it a huge potential to inject a

new program to produce fresh organic food for the people of Berlin without contributing to the food miles.

Hypothesis
Organic food producers cannot keep up with the increasing demand of food supply. Westhafen encompasses the ability to be a starting point for organically grown food as space is abundant. Its strategic location on the Ringbahn, reclaims land for the public and eases distribution contributing to zero food miles. The possibility of future expansion creates a "Greencircuit" on the Ringbahn, making it the largest public park in the world.

DISCUSSIONS
In connection with promoting and exposing students to international academic, UDRL workshops have established an inimitable 'dialogue platform' focusing on the potential and dilemma of global cities. Partnering with some of the most highly acclaimed institutions and universities worldwide, UDRL provides a trans-disciplinary laboratory environment in which the likes of architects, planners, economists, philosophers, scientists, artists, engineers and ecologists come together to tackle the key issues facing our globalised urban environments. Reflexivity has emerged as both an issue and a solution in urban design approaches, for example in 'The Potentialities of Places' workshops aim to fully explore the hidden potentialities of urban conurbation to amalgamate ideas and generate alternative program for urban regeneration and city rebranding. A total of 90 UiTM architectural students comprising fourth, fifth and final year students and four facilitating lecturers have collaborated with their intercontinental counterparts in generating urban design proposals.

Based on the assertion that certain urban principles of 'dilemmas' and 'potentials' can be used to construct the city, it is posited that the benefits of these principles can transform the urban physical and spatial components into strategic catalytic generators. This innovative architectural intervention will re-formulate the public realms and private domains of the city by creating new programs which manifest themselves physically. Synchronizing these urban principles has created juxtaposition of programmes that manifested themselves physically through the urban design proposals. These cities offered a large field of observation and theoretical reflection to become the foundations for future strategies. The students have worked with guest workshop panels from different multi-disciplinary background to unveil the opportunities of contemporary architectural and urban knowledge of the places. The control of metropolitan infrastructure, its principles and concrete manifestations through urban projects challenged the theory and the practice of contemporary urbanism. In most of the cases, innovative forms of living and working, which respond to the new socioeconomic conditions such as distribution of new workspace, globalization and demographic changes can contribute in creating a new vision for the urban populace.

The agenda of 'The Potentialities of Places' workshops seek to assimilate discourses in urban and architecture milieu, thus expanding the flux of networks in attaining the followings: -

(i) Nurturing an international network of trans-disciplinary research

The Urban Design Research Laboratory is the hub of an extensive network, connecting partners from all continents with experts in the fields of urban culture and metropolitan technology. Fostering a culture of international exchange, the UDRL programme encompasses the fields of arts, humanities, sciences and design to develop trans-disciplinary solutions to complex urban and architectural conditions.

(ii) Effectively communicating issues of urbanism to a broad audience

Through its ongoing programmes of seminars, exhibitions and publications, UDRL aims to communicate issues of urban development to a broad audience in order to further advance awareness and debate on the future of our urban environments.

CONCLUSION
UDRL urban design workshop is an avenue for *students* to gain knowledge and experience through an intensive program of collaborative workshops. St*udents* are *exposed* to issues of urban design, focusing on the potential and dilemma of global cities in promoting independent learning that aims to develop student understandings and critical thinking skills. Reflexive development is the main aspect of learning during the intensive workshops. It is important for students to get a broad *exposure* to professional issues and knowledge. Architecture graduates should not only be technically competent but they should also be skilled in communication and teamwork. Hence, these programmes promote social and global awareness, to be self-directed and have an expectation of life-long learning. UDRL emphasised these "soft skills" which developed students' sensitivity in their processes of learning while aiming at improving the quality of the urban design proposals.

In conclusion, the project-based learning is a fundamental to urban design studies and a globally integrated content linked to a reflexive process that required to assist and train them to become responsible and self motivated learners in order for them meet the academic challenges that lie ahead. UDRL aims to connect the needs of industry, commerce and urban planning with the research capabilities of the university partners. This praxis-oriented laboratory for urban design strategies fosters an intense atmosphere of production. The workshop programme explored an innovative approach where students experienced learning that incorporated theory and practice from urban design and specific site issues which need further investigation from local sources. The approach involved interdisciplinary areas of studies and activities requiring engagement of the physical. UDRL urban design workshops have given learning opportunities to many architecture students providing intercultural and experiential learning experiences. Students receive the chance to connect design knowledge with real life, while working alongside people in developed countries to help meet identified community needs. Its objective is to share and learn from international and local experiences regarding current issues, best practices and policy implications of creative connectivity on place-making.

The Students' mobility programme provided experiences and lifelong learning processes involving 'reflexivity' which reflect range of experiences, approaches and practices of thinking. Reflexivity is suggested as a methodological principle through students' participation in holistic learning did not end after the workshop programme completed. They have the initiative to share their experience and knowledge with different actors in society such as community, business, government and academia. Various student projects conducted under UDRL programme have been presented by UiTM students during Arte-Polis 4 2012, an international conferences and design workshops at Institut Teknologi Bandung (ITB) with the theme 'Creative Connectivity and the Making of Place: Living Smart by Design'. This biennial event is one of the platforms for UDRL to showcase and share their respective researches in architecture and urban design which they have done internationally. Through this event, students are able to create an effective network among other participants from various fields of expertise and network society. Students gained the understanding of architecture and built environment by experiencing themselves to get better appreciation which is unattainable within the confines of a classroom. The values of experiential learning have provided students to foster the development of leadership, teamwork and other personal and inter-personal qualities. These programmes have equipped students with appropriate skills to enable them to compete in an ever-changing market. While fostering greater international unity through inter-cultural understanding and diversity, the implementation of reflexive during these activities have build and stimulate students creativity, innovation and leadership.

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INTEGRATION OF TEACHING & RESEARCH

INTRODUCING EVIDENCE-BASED DESIGN TO ARCHITECTURAL EDUCATION: BRIDGING THE GAP BETWEEN RESEARCH AND PRACTICE

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Abstract:
Evidence-Based Design (EBD) is an experience-based design by judiciously gathering, validating, selecting and using knowledge; traditionally, the link between research and architecture practice lies in some pre-design activities known by briefing or programming. The term, recently, is used as a new approach of architectural design, especially in hospitals' design. This paper explores, theoretically, the integration of EBD, being problem-based learning educational approach, to enhance the architectural pedagogy and link it with the constantly varying practice needs. An introductory exploration of EBD is crucial to understand what this method could offer to improve the architectural pedagogy. The paper would display students' trials of EBD applications in order to achieve better understanding of the nature of their project, and to link the typological functionality of their briefs with the cultural context. EBD has been recognised as spontaneous response to solve design dilemmas. The motivating processes through which this design tool is used in scheming and in creating suitable design outcomes would be discussed. Finally, this paper provide basis to introduce EBD as a methodological educational approach that has potentials for enhancing the architectural design pedagogy process by offering more credibility through linking design to both users and context.

Keywords: *Evidence-Based Design, Architecture, Pedagogy, Architectural Design studio.*

Introduction:

Design studio pedagogy is entitled to transfer and protect the value of the design profession. Architecture pedagogy, within the design studio, is considered to be demonstration of students' abilities to conceptualise, coordinate and execute gathered ideas and data through the design process. Although the architecture design is considered to be a broad activity starting from recognising and classifying problems, identifying relevant solutions to generating responsive design outcome, the quintessence of design pedagogy is usually unsatisfied (Salama and Wilkinson 2007).
Nowadays, the rapid transformation experienced by our societies requires competent architectural learning systems, capable to respond to unlimited changes associated with such transformations. Integrating rigorous research, in a simple and efficient way, into the design process becomes crucial to answer boundless arising problems pertaining to each unique context. Engaging evidence-based design (EBD) within the design process allows designers to move beyond traditional literature reviews or standards, in order to accumulate evidences, using various techniques required for systematic reviews. Unlike the design traditional review, the methodical review offers more grounded and solid solutions since it is more related to context and to users.

Literature Review:

Herbert Simon, in his book the Science of the Artificial (1996), introduced synthesis versus analysis; as the first is used in a broader sense for 'design' or 'compose', while the second is reflecting 'science' or 'research'. He claimed that prospects synthetic or artificial object are the central objective of any designer: *"…the designer, is concerned with how things ought to be- how they ought to be in order to attain goals"* (Simon 1996, p.4) . However, there is an academic convention that design employs systematic and logical approaches combining both analysis and synthesis, used by designers to solve design problems. Research provides tools, elements, features, guidance…, by which designers are able to synthesis their final products. The research value comes from its authenticity as a pointer to discover new knowledge and to expands the body of knowledge in each specific field (Dickinson, Anthony et al. 2009).

Allen Cunningham highlighted three distinct characteristics of architectural research; science-based bias which favours separation of research from practice, research-based design appears problematic since it is spontaneously enclosed into practice, measurable research is built significantly (Cunningham 2005).

Despite the cumulative academic knowledge pertaining to the architectural studies, a wide gap still exists between academia and practice due to the following:

- Much of research outcomes have no direct and prompt link with practice; they are not transferred to practitioners in accessible channels: *"A creative, internal discourse between practitioners, teachers and researchers is almost non-existent except indirectly, through the random creation of experimental 'paper' projects exploring the potential for architecture to change the world"* (Roth 1999, p.19)
- Architectural research is mainly theoretical, many of its built knowledge rely on qualitative methods, it does not tackle arising unique problems pertaining to specific design circumstances. While in practice, ascending problems arouse relentlessly due to the uniqueness of each project context; "*Our argument for the essential importance of research is that an ever-increasing proportion of architectural practice involves unfamiliar circumstances beyond the expertise of individual practitioners, and beyond the unconventional wisdom of the profession as a whole."* (Groat and Wang 2002, p.8)
- Architectural design is a rather debatable and subjective, since a communal view that helps in a specific need for design, is not usually shared by all the actors dealing with the architectural domain. This may be, partially, connected to the general perception about research in architecture itself as well.

As a consequence, practitioners were detached from research paradigms and academic knowledge; *"In the practical world of business reality architects are losing credibility, not because they lack knowledge but because they are perceived to lack the rigorous foundation of specific knowledge the client expects."* (Hamilton and Watkins 2009, p.6).
Richard Buchanan introduced the expression of the "Design research" as a new approach to bridge the existing gap between design practice and research, with the intention of producing designs more based on rigorous studies, reflecting the characteristics of each distinct context. Yet, he discussed the dilemma of the varied range of possibilities: "*No one seems to be sure what design research means. Should design research follow the model of traditional academic disciplines, or should it seek a new model, based on the intimate connection among theory, practice, and production that is the hallmark of design?"* (Buchanan 1996, p.74-75)

Introducing Evidence-based design to practice:

Evidence-Based Design (EBD) offer suitable answers for Buchanan enquiries, being a design process, based on research, followed to answer design dilemmas through the use of reliable evidences and validated local facts. The most commonly used definition of the EBD is: *"a process for the conscientious, explicit, and judicious use of current best evidence from research and practice in making critical decisions, together with an informed client, about the design of each individual and unique project"* (Hamilton and Watkins 2009, p.9). This emerging design approach becomes popular in Healthcare Architecture to improve patient/staff well-being, stress reduction, healing process and safety issues. Recently, the term is used as a new approach for the architectural design in general.

EBD is an experience-based design, associated with research that use credible data to inform the design process (Dickinson, Anthony et al. 2009). It employs research methods based on quantitative and qualitative inquiries to support design decisions; "*evidence-based design is conducted not only through research summaries and journal articles, but also through examination and analysis of precedents*" (Nussbaumer 2009, p.56). The choice of the methods used through the design process depends, to a great extent, on raised-problems' nature, and the designer's, together with the client, vision for the appropriate route towards the solution: "*The method is a process by which a designer and his or her client can find their own answers*" (Hamilton and Watkins 2009, p.10). Critical thinking is essential to develop an appropriate solution to design dilemmas; that gathered information from previous experiences does not offer an adequate design solution matching with client's unique situation. Thus, research that is detailed to the project's distinctive objectives is crucially required.

Hamilton & Watkins (2009) identify three central objectives to enhance the EBD process:

1- *Exploring new fields as sources of data*:
Architects using EBD in practice are supposed to explore new horizon of knowledge beyond the traditional sources of information, to tackle the massive possibilities of information that might be acquired from other unaccustomed fields. They suggest that architects must explore new disciplines pertaining to the project typology and context.

2- *Client and users inclusion in the design process and decisions:*

Kisho Kurokawa explains: "*Architecture (is) a theatre stage setting, where the leading actors are the people, and to dramatically direct the dialogue between these people and space is the technique of designing*" (Lake 2009). Client/users inclusion in the design process is an important factor to enhance design outcomes. A designer, together with an informed client, makes decisions based on the best information available from: research, previous similar projects' evaluations, evidences gathered from the client experience and vision.

3- *Relying on rigorous data from solid research methods:*
Analysing the best credible information through research is what EBD is based on. Adding rigour research methods to what is already conventional in the design process, can produce competitive designs and increase client confidence (Hamilton 2004). "*Research has become an important component throughout the design process*" (Nussbaumer 2009, P.xix). Founding design decisions on reliable evidences leads to more efficient solutions/outcomes; design with measurable outcomes presents significant benefits for designers, clients and users.

Finally, EBD is deliberated as a process allowing designers to answers different design questions. The main important argument is that there is no ready-made answers from a standard manual; different data may lead to different set of answers for a similar project (Hamilton and Watkins 2009)

The application of evidence-based design as an educational approach:

Architectural design education is the manifestation of the ability to conceptualise, coordinate and execute gathered ideas and data through the design process.

Design-studio has dominating role in the architectural pedagogical experience, being the main medium for knowledge acquisitions and assimilations.(Salama and Wilkinson 2007). However, it is argued that project-based education seems to experience lack of the intellectual rigour of the methodical procedures associated with research. Academic convention has constrained the potentials of connections between architecture education and research activities, in the favour to establish project-based education as a pedagogical alternative. (Cunningham 2005)

Recently, bringing up research into design is gaining momentum, however, still the number of graduate programs with focus on structured methods and comprehensive thesis, rather than design production, remains relatively small: "*While other professional disciplines have a tradition of advanced research in academia, design research is a more recent phenomenon. It has yet to establish universal standards related to process, presentation, and evaluation.*".(Roth 1999, p.18)

Through the examination of existing literature, a lack of significant researches discussing teaching EBD to design students has been found. Introducing EBD to architectural pedagogy allow educators to establish a design- integrated system, based on solid research, supports the design process and adds more credibility to the design-projects being an important outcome of the architecture pedagogy. Teaching EBD to design students prepares entry-level designers for the workplace (Nussbaumer 2009).

Kirk Hamilton presented four levels to differentiate the EBD types in practices (Hamilton 2004). The first model could be an ideal guiding framework for the architectural pedagogy. The model entails the making of careful effort to design, based on available evidences; by staying current with literature in the field, by attempting to develop contextual research related to social and physical settings. Students are supposed to interpret the meaning of 'evidence' as it relates to their projects and make judgments about the choice of the best evidences for designing in specific circumstances.

Yet, some educators support the introduction of EBD to beginning design students through the presentation of the methods along with the design process; they believe that EBD forms a basis for good design and it is an important research/design methodology. According to (Kroelinger 2007, p.16): "*advocating a sound research basis for design is essential. Our students need it and their future clients expect it (for accountability and assessment of design results)….These issues are equally important to undergraduate students at an entry level in their academic program*"
Educators against introducing evidence-based design to beginning design students believe the method requires too much information to cover at beginning level and might affect creativity.

Evidence-Based Design Steps:

From the reviewed literature, it can be assumed that the EBD processes, throughout the different disciplines, have broad area of similarity. That EBD process, within any field (hospital design, architecture design, management system design, policies and decision making systems...etc.), is a methodological technique that has logical phases lead to more efficient design solutions, regardless the nature of the scientific field encountering this process. EBD is positioned in the context of design science paradigm; it demonstrates how to extend an experience-based knowledge by judiciously gathering, validating, selecting and using relevant data.

In his book "Evidence-based Policy: A Realistic Perspective", Ray Pawson (2006) suggests a meta-analysis template for EBD. Although the book was mainly concerned with using evidences to support policies' decisions, there is a big similarity between this analysis, the EBD process analysis published by Centre for Health Design[1] and the EBD steps defined by D.K. Hamilton and D.H. Watkins in their book the Evidence-Based Design for Multiple Building Types (2009) (p. 210).

Through comparing the steps defined through the three mentioned above sources, many similarities has been found:

The meta-analysis template for Evidence-Based Policy and decision-making tool produced by Ray Pawson (2006)	The key EBD steps that can be incorporated into the design process identified by the Centre for Health Design	Steps of evidence-based design process as detailed by Hamilton and Watkins (2009)
1- Formulating the review question: what was good/wrong with the previous experiences?	1- Define evidence-based goals and objectives	1- Identify the client's goals; 2- Identify the firm's goals; 3- Identify the top 3-5 key design issues; 4- Convert design issues to research questions;
2- Identifying and collecting evidence: using different methods	2- Find sources for relevant evidence	5- Gather information (benchmark examples, literature sources, internal studies);
3- Appraising the quality of the evidence	3- Critically interpret relevant evidence	6- Critical interpretation of the evidence;
4- Extracting and processing the data	4-Create and innovate evidence-based design concepts	7- Create evidence-based design concepts;
5-Systematizing the data	**5- Develop a hypothesis**	**8- Develop hypothesis**
6- Disseminating or publishing the findings	6-Collect baseline performance measures 7-Monitor implementation of design and construction 8-Measure post-occupancy performance results	9- Select measures

Table (1): Comparison between three EBD procedures, from different sources.

The last zone in (table 1) questions the post-design stage, while the first five steps are the relevant process to be integrated in design studio pedagogy.
Following evidence-based design process, it is essential to research into the physiological (Anthropometrics[2], Proxemics[3] and Ergonomics), psychological (feelings), and sociological (interactions with other users) needs of users (Nussbaumer 2009).

[1] http://www.healthdesign.org
[2] Anthropometrics: refers to the measurement of the human. It has been used for the purposes of understanding human physical variation, in various attempts to correlate physical with racial and psychological traits. It plays an important role in industrial

Methodology:

This paper present and analyse case-studies employed EBD approach through the design project assigned to the Architecture Qualifying Year students, University of Nottingham Ningbo China. The project brief required designing a multi-faith veneration building, allocated within an identified site in Ningbo city, China. The project was classified as small public building (total area 250 m^2). Students were required to develop a detailed programme that reflect the project's specific requirements and based on the general guidelines of the brief. Some of them applied EBD methods, as a tool to support the design decision-making process.

Case-Studies:

This section displays the case-studies in accordance with EBD steps demonstrated through literature. Steps identified in *table 1*, above, tackle EBD procedure in its broad sense. While familiarising EBD technique to the architecture pedagogy it is important to consider the educational process itself and the normal role of tutors in writing the brief, introducing the project to the student, delivering guidance lectures and finally assessing and evaluating the final projects. Thus within architecture schooling, it is argued that EBD procedure steps are distributed between tutors and students, in the following manner:

1- The identification of design objectives and goals occurred primarily through the given brief to students (Educators' role)
   - The users' goal, as mentioned in the given project brief, was to find *"a place for contemplation and reflection. This will be a multi-faith centre in which all of religions (Judaism, Christianity, Islam, Hinduism, Buddhism, etc) can worship; therefore it needs to be designed to accommodate all of the world religion. The design challenge is to create a uniquely versatile venue in which students and leaders of all faiths would feel equally welcome and equally valued"*
   - The context requirements were envisaged by defining a specific context: nominated site within the educational district, Ningbo city, China.
   - The review question as clarified in the brief was: *"this project is not about replicating an existing church, mosque etc by using religious icons or symbols associated with a specific religion but more about creating the connection to the religion / spiritual practice through the appropriate design of the overall space."*
   - Key design issues were briefed to the students as following: *"The design needs to be very contemporary with the main focus on how the building will create the feeling of connection to these spiritual practices... The project needs to provide a main room for a large group, smaller spaces for smaller groups to sit and talk, and spaces for individual contemplation and reflection- with all appropriate and necessary services (toilets, washrooms, reading resource room, storage for movable furniture, small kitchenette, etc.)."* In addition, other key design issues were introduced to the students through guidance lectures such as: the use of daylight, social habits, Proxemics.

2- Starting from the previous point, the students were capable to formulate their own design questions: How can they design the main functional zones in their projects? How can these functional spaces answer the users' needs in this context? What is the user need in this Chinese region? The design will counter which religious buildings' design criteria the most? Answers to these questions were not found in precedents due to lack of available sources pertaining to the specific project typology, whereas found precedents were pertaining to different contexts. Meanwhile, standards books cannot afford answers for the programming and the functional ergonomics studies for this building type. Consequently, students reframed the statements of the design dilemmas into many researches questions related to users and context.

3- To answer such research questions it was essential to identify research methods to collect relevant evidences, such as:
   a- <u>*Field observation*</u> to study the kind and amount of vegetation, contextual architecture features and styles, shading and natural light, scenery views, air pollution, openness and

design, clothing-design, ergonomics and architecture where statistical data about the distribution of body dimensions in the population are used to optimize products.

[3] Proxemics: is the study of the relationship between humans in a particular culture and their use and perceptions of space (Hall, 1966; Nussbaumer, 2009, p. 130).

visual connectivity in different points within the given site. They took different measurements to study the sound level, traffic flow by counting the amount of traffic/hours for a whole day), amount of the people flow within the site surrounding area.

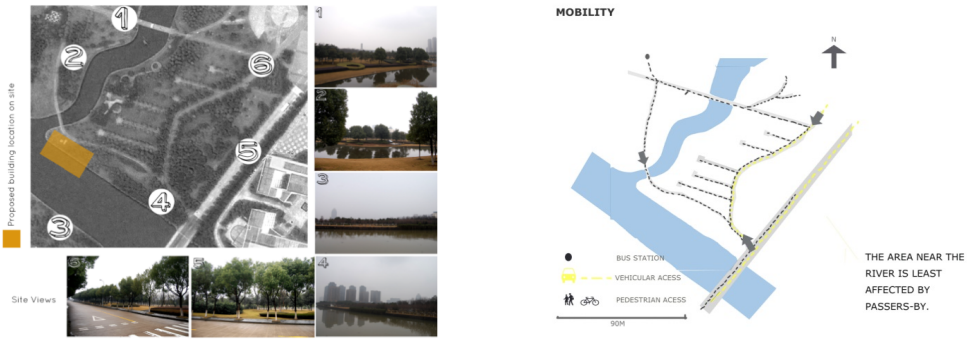

Figure 1. Examples from students' field observation and gathered data

b- *Questionnaires:* Students developed questionnaire, to enquire from people living in this context about their religion believes and their understanding of veneration buildings. The questionnaire enclosed questions related to the users' backgrounds and believes and tackled the spatial requirements and conditions from their point of view; such as preferable day-light, sound levels, and views (rivers, trees, sky, none...). Also, some questions investigated the functional ergonomics; praying /thinking positions, related washing spaces, expected number of people engaged into the activities...etc.

Age	Religion	Sex	Occupation	Education level	Nationality	Praying or thinking position	Light condition	Amount of people around
22	Christian	F	student	Y3	Taiwan	Sit	Dim	few
21	Christian	F	student	Y2	Taiwan	Sit	Bright	More
21	Christian	F	student	Y4	Taiwan	Sit	Dark	None
23	None	F	Student	Y4	China	Sit	Dark	None

Praying or thinking position	Light condition	Amount of people around	Time	View	Sound condition	Having food or drink after	Shower after settled the heart	Special require ment	Taboo
Sit	Dim	few	Night	Natural view: River	Music	Yes	Yes	No	Noisiness
Sit	Bright	More	Night	Natural View: forest	Natural sound: bird singing	No	Yes	No	No smoking
Sit	Dark	None	Night	Enclosur e space	Natural sound: Rain sound	Yes	Yes	No	No Smoking
Sit	Dark	None	Night	Sky	None	No	Yes	Steady, comfo	Small, secure

Figure 2. The questionnaire include the gathered data

c- *Interviews:* Additionally, they took notes from verbal open ended interviews with users; discussing their ideas, thoughts and expectations from this genre of buildings, being newly introduced to this context.

d- *Mock-up simulation:* to define ergonomics relevant to the functional need of the project

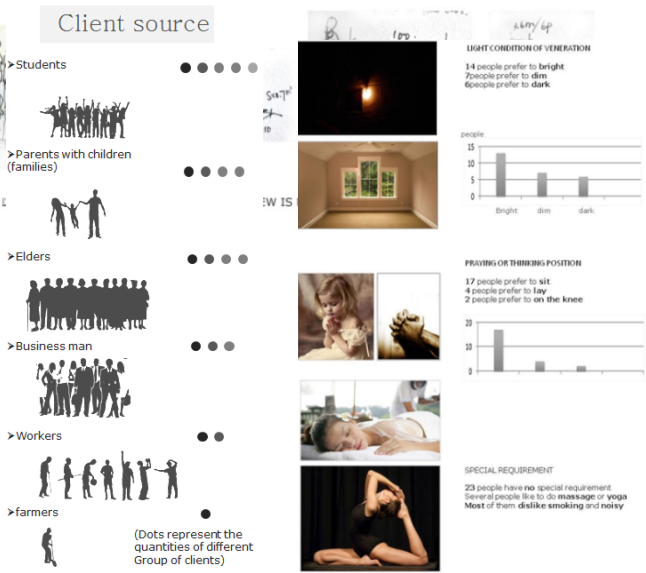

Figure 3. Physical and functional ergonomics studies based on mock-up simulation

4- Critical analysis and interpretation of the gathered information resulted by thorough contextual social study and site analysis study, that support the design decision made in later stages. Students used critical thinking to evaluate evidences and used design thinking to determine the best approach to improved design results.

Figure 4. Examples from students' critical analysis of gathered data (Data operationalization)

5- Different design-concepts emerged from the results of the analysis done such: Unity, equality, puzzles as sign of integrity and solidity.

The design process phase was documented while developed till the final outcome that considered being an innovative product.

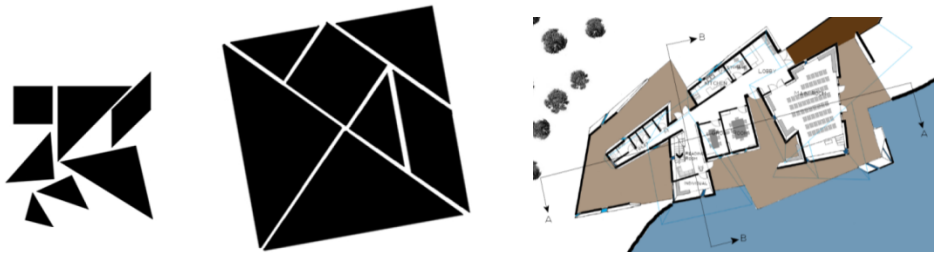

Figure 5. Based on EB research, a student chose the Tangram (the oldest Chinese geometric puzzle) to represent the different believes and habits, which might appear conflicting but actually they all are pieces that complete a full regular form. The final design cleverly engages indoors and outdoors spaces to work in unity rather than their irregular geometries.

This project case represented an innovative and unusual approach to design veneration building. The student built his concept on evidences from the social research done. Equally the choice of the deconstruction as style for his building was arguable; however such decision was strengthen by the interview analysis and users' vision (most of the sample were universities' students) towards such building typology.

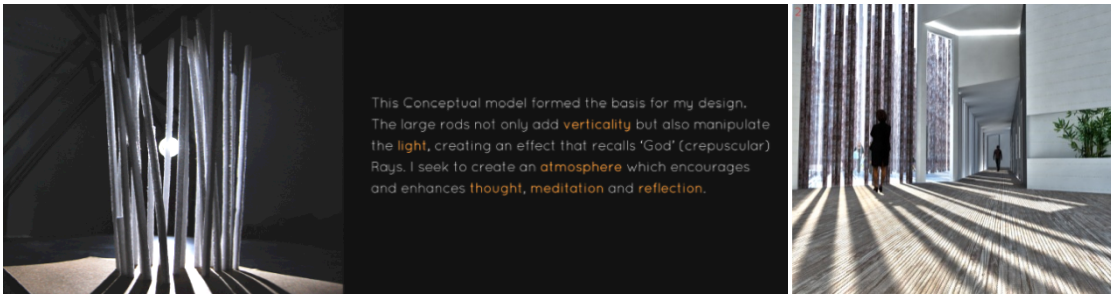

Figure 6. light as a medium for manipulating a meditating atmosphere. The project employs simple forms, and cleverly controls daylight inside the building via the use of different materials/scales of vertical beams that deflect and reflect sun rays; particularly by sunset.

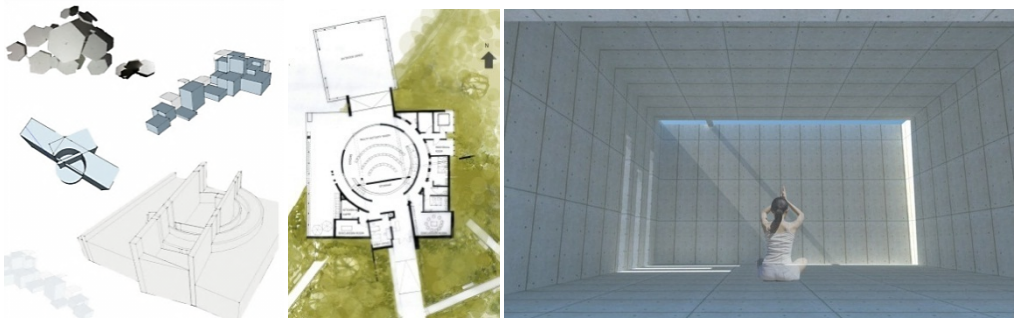

Figure 7. Focusing more on the commons between varying meditation practices, a student chose unity of form and purity of geometry as a design concept. The design employs pure geometries, and uses orientation to guide and identify different spaces. Also, uses vertical scales to influence spiritual engagement within the different spaces.

The two previous cases demonstrate that students' final designs came to reflect the users' ideas about religions, meditation, religious group discussions...etc., as most of the interviewees were seculars. Their projects outcomes were reflecting the users' preferable way of the users to see and exploit this new building typology.

Results and Discussion:

From the analysed cases, *three* valuable observations are revealed:

1- as a first step, students employed research[4], by identifying problems with no clear traditional answers, that cannot be solved without the aid of research.

2- the students, spontaneously, recognised and appreciated the importance of users' engagement in the decision- making process.

3- ***The high potentials of design creativity*:** The gathered evidences and data through rigours qualitative and quantitative methods, the exploration of new domains by gathering data and information pertaining to new field (in this case: religions and believes) remote from conventional architectural knowledge, helped students to think out of the box. Relying on solid analysed data, the students were able to create innovative designs far from the common-sense designs of this typology. Designs included successful spaces and circulation areas mixing between indoor and outdoor, in a more confident approach. Challenges rose from new emerging design problems are requiring imaginative and ever-changing interpretations of the design insinuations. This observation is supported by the literature claiming that; EBD does not mean rigid rules and lack of creativity; on the contrary, it may produce a "*demand for higher levels of creativity as the designer responds to the challenges raised in response to new and ever-changing information"* (Hamilton and Watkins 2009, p.14-15).

Hamilton & Watkins (2009) in their book 'Evidence-Based Design for Multiple Building Types' asked a question: "*Did Architects design with evidence before the term become popular*?" He answered his question by; "*Absolutely, architects have always relied on engineering sciences, statistics and strength of material, geometry, physics, soil mechanics…"* we would argue that architects not only use EBD through these fields, but we claim that EBD methods were already included within the traditional educational design process. However, this paper presents an educational systematic process following seven essential steps to integrate EBD in the architecture pedagogy:

1- Identification of the Project's Objectives and Goals:
   - Client/Users' goals
   - Context requirements
   - Formulating the review question: what was good/bad, achievable or not in the previous experiences of the tutor.
   - Identify 3to 5 key design issues, or key topics will influence the design.

[4] It worth mentioning, that the results accuracy, sample size, prompt methodological features, are not discussed; as the use of such academic methods was not judged, being not among the project's aim.

In architecture pedagogy, step (1) is normally done by educators; while for students this step represents the main guidance topics that will lead them in the following steps; meant to be advisory design-process for the students.

2- Conversion of main project's goals and design issues to research questions: reframe statements of design issues to become research topic.
3- Finding sources of relevant evidences; identify and collecting evidences through:
   - Employing different research methods
   - Collecting relevant, literature, precedents, magazine articles, standards, benchmarks...etc.
   - Be exposing to different knowledge from different disciplines relevant to the project nature, latest state of art, technologies...etc.
4- Critical interpretation and analysis of all gathered information (data operationalization).
5- Creation of an innovative evidence-based concept.
6- Development of hypothesis which is the final design product.
7- Develop base-line project performance measures to successfully evaluate students work.

(In architecture pedagogy, step (7) is done by the module's tutors.)

Finally, while discussing brining EBD into architectural education, we must acknowledge the new roles contemporary architects need to accept, in order to bring their envisioned art and design into perfection. This would entail the inclusion of the tools that prepare our students to such new role within the educational system of architecture. Yet, some questions still need answers: What counts as reasonable and useful evidences for a design process? What are the boundaries of a naturalistic context? And, how can we control students' bias in selecting evidence, in reporting observations, and in developing trustworthy claims?

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RESTRUCTURING ARCHITECTURAL EDUCATION: RESEARCH BASED CURRICULUM FOR RESEARCH UNIVERSITIES

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Abstract
In response to climate change and other environmental challenges, there is an urgent need for a re-evaluation of the architecture education in the country to promote sustainability as part of the pedagogy objectives. It is vital to produce architects of the future who are more competent in designing sustainable buildings as they are major contributors to global warming. Currently, architecture educations still lag behind their counterparts in developed countries that offer a holistic sustainable education curriculum. Efforts are piecemeal just adding relevant papers on sustainable awareness but not well integrated into the existing curriculum. This paper describes the new directions to draw and navigate the architecture education as dynamic and relevant for the future. The paper reviews and explores the need for the tertiary architectural education advocating for renewed curriculum that emanates from research findings to make it more indigenous rather than importing information irrelevant to the local climatic condition. With the designation given to selected Institutes of Higher Learning as Research Universities there must now be a dissemination of new knowledge discovered incorporated into the teaching curriculum. The paper outlines the integration of research and teaching for architecture education based on case study at the Architectural Program of the School of Housing, Building and Planning, Universiti Sains Malaysia. Challenges encountered need pragmatic solutions and needs future research to test the effectiveness of proposed integration.

***Keywords**: Architecture education, Integration, Research, Teaching, Sustainability*

1.0. Introduction

The Brundtland Report had been a turning point which triggered global concern for sustainable developments to meets current needs without compromising on the needs of future generations (WCED,1987). Education has a vital role to play in the development of renewable energy and sustainable development (Taleghani et al, 2011). It is a powerful agent of social change, which foster awareness of new discoveries, provides training for the professionals and researchers who will develop the next generation of systems and devices (Jennings, 2009). Promoting education in sustainable issues and development already became the global agenda since 1992 after the Earth Summit at Rio de Janeiro, Brazil, and this topic is reaffirmed at the Johannesburg Summit in 2002 (UN/DESA, 1992). This awareness on the need to integrate sustainability at all levels has recently gained momentum in education to meet pedagogical university policy, government and employers' expectations (Hamza and Horne, 2007). Tertiary education is a crucial component in promoting education for sustainable development as advocated by the United Nations under Agenda 21 (UN/DESA, 1992). Consequently, the challenge for universities is to critically assess themselves and re-orientate their approach in order to fully engage with the sustainable agenda (Jones et al, 2008, Abdul Rahman, 2011). In Malaysia, the percentage of 17 to 23 years old cohorts who attain or gain access to higher tertiary education had increase from 12% in 1980's to 29.9 % in 2006 and expected to reach 40% in 2010 (Md. Salleh, 2007).This represent a large percentage of the population as potential sustainable literate citizens who will make a huge impact in future if the right seeds are sowed in their education towards protection of the environment, economic viability and social issues.

Four years ago the Ministry of Higher Education embarked on the conferment of Research University status to four public universities starting with the Universiti Sains Malaysia (USM) as well as designated as an APEX university (Accelerated Programs of EXcellence). Eventually three other public universities have been elevated to Research University status namely, Universiti Malaya (UM), Universiti Putra Malaysia (UPM) and Universiti Kebangsaan Malaysia (UKM).And later two more universities, namely, Universiti MARA Malaysia (UiTM) and Universiti Teknologi Malaysia (UTM). Universiti Islam Antarabangsa Malaysia (UIAM) was the latest in line to be assessed. Being designated as research universities, they should revamp their previous ways of imparting knowledge to the students. Research should not only be carried out for the sake of research but the new knowledge should trickle down to the students. Currently research findings are geared to commercialization and the emphasis is put towards indigenous products that can be manufactured for local use and for export. After about five years of providing research funds into the universities' coffers, the link to industry is still found wanting. Though money can come in

immediately, the research culture among the lecturers has to be inculcated. This process is ongoing. This paper reviews and explores the need of integration between academic research in universities with the curriculum of undergraduate and post-graduate courses whereby, the research findings should be directly incorporated into the subject modules to achieve education for sustainability focusing on architecture education and USM as a case study.

2.0. Education for Sustainability in Architecture

Buildings are considered as a major threat to the environment as they consume a large amount of energy from about 40 to 45% in developed countries (Omer, 2006). As the threat from global warming grew stronger in the turn of the century, green building and sustainable architecture are rapidly moving from the periphery to the mainstream architecture and construction industries (Williamson et al 2004, Kibert, 2005). This scenario sees the urgent need for architects to play the pivotal role in addressing pressing global issues hence, requiring rigorous specialized education and training in environmental sustainability (Abdul Samad and Abdul Rahman 2007a,b Abdul Samad, 2008, Abdul Rahman, 2005). Transforming the training of architects, and other professional is essential to include sustainability as a major learning outcome in the curricula in order to change their mind set (Abdul Samad and Abdul Rahman, 2007a and 2007b, Abdul Rahman and Abdul Samad,2011. According to Hamza and Horne (2007), in applying the principles of sustainable development, architectural education need to highlight the need for the built environment to learn from lessons of the past while using technological achievements to sustain the needs of the present without compromising the needs of the future.

According to Bennetts (2008), the challenge for educators in architecture is not to consider sustainability as either only optional or purely technical, but rather to ensure architecture graduates to have a primary role in shaping sustainable buildings as cross-disciplinary generalist with sufficient knowledge of technique in passive design principles based on local climate conditions and responsibly sourced materials. Stasinopoulos had identified a few main obstacles to sustainable architecture teaching and they are: i.environmental related issues are usually offered in elective classes, detached from design studios. ii.emphasis on quantitative rather than qualitative matters and iii. focus on aesthetics and detached from earthly realities (Thaleghani et al, 2011). A model approach to integrate sustainable knowledge application in architecture curriculum was put forth by Hamza and Horne (2007) through a model of integrating several modules of subjects (1.Professional Practice, 2. Computer Aided Visualization and 3-D and 3. Building Envelope and Services) where the methodology was aimed to provide the students with a practical approach in which they would be able to assess the impact of their own decisions on energy consumption. The outcome of the research showed that although majority of students agreed that the integrated approach was successful in the objective of ability in designing low energy building and visualisation however, the disadvantage from the student viewpoint was failing one module meant that they failed the others and that they suffered heavier workload due to simultaneous submissions. The integration methodology also required more staff time dedicated to supervise the students.

3.0. Strengthening the existing curriculum

Previously, the five or six years architectural training focused on the required range of skills and creativity in design, managerial, media, and technical expertise with core subjects or courses ranging from design, technology, history, theory, practice and environmental behaviour (Abdul Samad, 2008, Abdul Rahman, 2010). According to the National Pollution Prevention Centre for Higher Education, University of Michigan (Kim et al, 1998) the ultimate goal of environmental education in architecture to increase sustainability in the building sector with three levels of educational objectives as shown below: Level 1: Creating Environmental Awareness; Level 2: Understanding Building Ecosystems and Level 3: Ability to Design Sustainable Buildings.

A renewed curriculum that emanated from research findings to make it more indigenous rather than importing information irrelevant to the local climatic condition is badly needed. With the onset of the word 'sustainability' previous syllabus needs rethinking from a different perspective and to be implemented. The integration of research and teaching is presented in a Case Study at the Architectural Program of The School of Housing, Building & Planning, Universiti Sains Malaysia.

Identification of design strategies

By going back to basics several design factors were identified that could help to reduce energy consumption in a tropical building. The word tropical is specifically being mentioned because for

other climatic zones require different approaches. The identified design strategies for tropical climate are categorized as shown in Table 1.

Table 1: Design Strategies for Tropical Climate
Source: Excerpt from Abdul Malek Abdul Rahman et.al. (2009), Towards A Low Energy Building Design For Tropical Malaysia

A. Passive design strategies:	*1. Building site - land and sea breeze; prevailing valley winds; natural vegetation* *2. Building design –* *(a)Reduce heat gain – building materials; orientation; sun-shading; bio-facade / green roof; insulation; reflective materials; double walls; double roofs* *(b)Encouraging air movement – orientation; wind deflectors; open plan interiors; stack effect; fenestrations; courtyards* *(c) Daylight – orientation; sun pipes; fiber optics*
B. Active systems:	*1.Cooling strategy – fan; air conditioning; moisturizing* *2. Heat generating - office equipment; sensors* *3. Lighting systems – energy efficient bulbs*
C. Energy management:	*1.Energy Committee – programs; campaigns; competitions*
D. Renewable Energy:	*1. photo-voltaics; wind; hydro; biomass*
E. Others	*1. recycling waste; rainwater harvesting*

These categories were identified before the advent of the Green Building Index (GBI) mooted out by the Malaysian Institute of Architects (PAM) in collaboration with Association of Consulting Engineers Malaysia (ACEM). The government has officially launched this document as reference for benchmarking in six different criteria, viz., energy efficiency, indoor environmental quality, site planning & management, materials & resources, water efficiency and innovation. These criteria are further subdivided into several other sub-criteria and are fodders for research topics in Institutes of Higher Learning. The government came up with their own brand of benchmarking on sustainability with emphasis on carbon sequestration as a follow up by the Malaysian Prime Minister who pledged at a UNESCO meet to reduce 40% of carbon dioxide by 2020. Thus a document yet to be launched entitled Low Carbon Cities Framework - Assessment System (LCCFAS) was published. So now there are three well-documented reference documents that can provide research ideas to be explored. Figure 1 below shows the need to use some base reference for further research in new knowledge to be incorporated in the curriculum.

Figure 1: (Left) Passive design elements identified by author
(Middle) GBI document (Right) LCCFAS document

Research activities

Universiti Sains Malaysia provides in-house research grants such as the Short-Term Grant, limited up to RM40000.00, and the Research University Grant (RU Grant) of up to RM250000.00. One can also apply funds from the Ministry of Higher Education for Fundamental Research Grant (FRGS), the Exploratory Research Grant (ERGS), the Prototype Research Grant (PRGS) and the Long Term Research Grant (LRGS). Grants are given periodically normally after announcement made by Research Creativity Management Office. Forms must be scientifically, systematically and intelligently filled in order to be successful as applications among all the Malaysian Research Universities are very competitive. Sometimes due to lecturers' own contacts and public relations, they are able to secure research grants from private companies and these are known as contract research. This is highly valued as it brings in money to the universities' coffers. The identified design

strategies, the green building index documents and the low carbon cities framework mentioned above provide fodder as research topics.

Relevant application forms are downloaded from the website after official announcement, filled up and sent to respective management office of individual universities who then send them to research cluster to be vetted through by panel members (normally handpicked academicians from various universities) before sending the forms to the Ministry. The procured research grant can be used for the research to be carried out by a post-graduate student for their proposed experiments. Conditions are being set that they are to publish their findings in respectable journals before they can graduate. Sometimes, depending on the quality of their findings, their PhD thesis can be transformed into an academic book. Figure 2 refers.

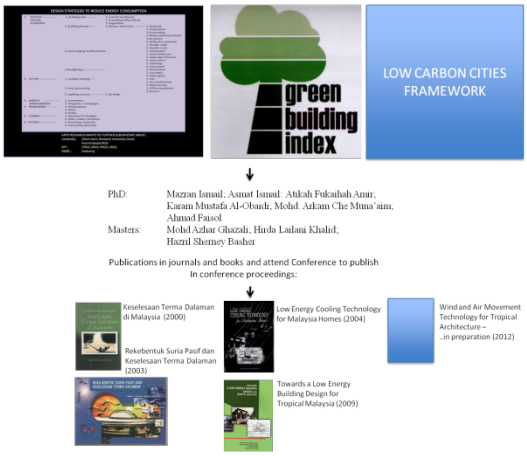

Figure 2: The flow of how the research done by postgraduates transforming knowledge into publications

Teaching

At the same time a subject on energy efficiency in building design was introduced code number RAT430 entitled as Energy Efficient Building Design Technology. This was taught in level 400 i.e. at the fourth year, it is a 60% coursework and 40% examination. The students were taught seven weeks of theory by power-point presentation as stipulated below;

Week 1 – Introduction to Global Warming; Human response to tropical climate
Week 2 - Passive Design Strategies – Reduce Radiant Heat
Week 3 – Passive Design Strategies – Encouraging Air Movement;
- Passive design Strategies - Daylight
- Innovative Mechanical & Electrical Systems
Week 4 – The Way Forwards – Renewable Energy
- Other sustainability issues
Week 5 – Introduction to Green Building Index
Week 6 – 7 Assignments 1 – Literature Review
Week 8 - BREAK
Week 9 – 11 Assignment 2 – GBI report on Studio 400 project
Week 12 -14 Assignment 3– Group work project

This subject is upgraded constantly every academic year input from;

i. the research findings
ii. by obtaining knowledge gathered from attending conferences,
iii. read relevant articles from recently published journals and
iv. the media.

Recent published journals are the best as they are the outcomes from recent research carried out and are new findings that generate more avenues of ideas for further research. Media reporting can be used for awareness but not for journal publication as the nature of reporting has no literature review and can be classified as plain conjectures, gossips and hearsays that have no academic value.

Studio programs

The studio programs or projects given as exercises to students must be seen in its entirety (i.e. from year 1 to year 5) and not independently from its overall objectives. The gradation of complexity must be conspicuous not only from design viewpoint (from kiosks to double-storey buildings and to medium-sized buildings and to finally multi-storey or mixed development) but also from the sustainability criteria input. Previously the contents of the studio projects have only three components, namely the *design philosophy,* the *visualization and technology*. The proposed strategy is to now emphasize the fourth component to value add the studio projects and that is the *environment sustainability*. The explanation is as follows using Figure 3 as a reference;

Year Studio:	1	Contents are to introduce the necessary basic design tools, presentation techniques, etc. and a simple understanding of orientation of the sun, shading etc.
Year Studio:	2	Case studies of small buildings pertaining to environmental criteria. Identify passive elements that provide thermal comfort. For example the hard landscape versus the soft landscaping
Year Studio:	3	Computer simulations on environmental aspects to be tested and understand the need for passive design. Gradually introduce simple GBI requirements.
Year Studio:	4	Students are to use simulations together with her project design and to further include other sustainability issues such as rainwater harvesting to understand how it relates to energy savings.
Year Studio:	5	This is where all the knowledge that have been taught from year 1 to 4 to be consolidated and rationalize to reality. Here literature reviews, simulations of green results are emphasized. And in Table A these proposed criteria are to be assessed. GBI essentials are introduced in the first semester and the details in second semester.

A paradigm shift from the conventional studio education, i.e. the nature of multi-disciplinary that has been taught since the beginning of the architectural course in the first year first semester, need to be restructured. The first year first semester comprises of lecturers from all the built environment disciplines, namely, building technology, planning, interior design, quantity surveying and coordinated by a lecturer from architecture. The reason why it has to be an architecture lecturer as a coordinator is because of the requirement by the Council of Accreditation of Architectural Education Malaysia (CAAEM). This multi-disciplinary should now be extended to the final year for the architectural program. This is the time where the final year students would have a holistic knowledge to understand the connectivity of the different professions and with one project to run for the whole year, they need proper advice from multi-disciplinary experts in order to be able to strengthen their design project. This would be the best stage of seeing the big picture and a good preparation before delving into the real world.

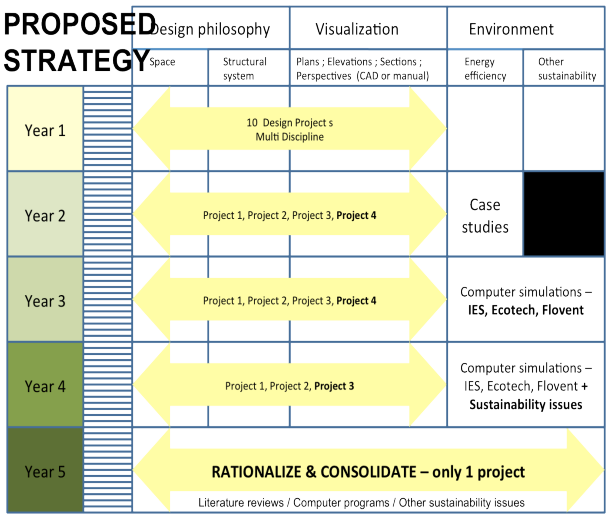

Figure 3: The proposed strategy to incorporate 'green' into studio projects

Table 2: Proposed assessment for 5th year studio

SEMESTER 1			
WEEK	REQUIREMENTS	EXAMPLE	TICK
1	TOPIC CONFIRMATION		
2	LOCATION PLAN		
	SITE PLAN		
	SITE ANALYSIS		
3	BRIEF DEVELOPMENT		
	Space of Accommodation		
4	Design concept		
5 - 13	SCHEMATIC DESIGN		
	DESIGN DEVELOPMENT		
	Floor plans		
	Elevations		
	Sections		
	Perspective		
	GBI Essentials		
14	SUBMISSION		
SEMESTER 2			
1 - 2	Period of adjustments		
3 - 4	Schematic Building Services - AirCon; Electrical Lighting; Plumbing		
5	Rainwater harvesting detail		
6	Daylight detail - skecthup/ IES / ECOTECH		
7	Green Roof detail		
8	Any other GBI detail		
9	1:20 Roof Section detail		
10	1:20 Façade Section detail		
11 - 14	FINALISE AND SUBMISSION		

4.0. Summary and discussion

Table 3 below shows a summary of the above the path to link research to teaching as well as to the studio. Studio is where the knowledge gained are tested and simulated as a cubicle of practice. This is the flowchart of one subject i.e. the Energy Efficient Building Design Technology using the top three tables as the reference point. For other subjects to follow this path may have to source their own baseline references pertinent to their individual subject.

Table 3: The link from research to teaching and practice

Identification of passive design elements	Green Building Index document	Low carbon cities framework	
Post-graduate students to do research and publish findings in respectable journals and books			RESEARCH
These books and journals to be used as references for subjects taught in the curriculum			TEACHING
What is taught in the subjects is to be implemented in studio projects			PRACTICE

At specified time period there would be a crit session assessed by invited practicing architects. This would expose the students of the 'outside world' working experience perception. But still why is it that the impact of linking research right down to studio work very low?. The factors identified by the authors are as follows;

(i) Most probably individual lecturers do not have any references to be used as benchmarking. Having benchmarking is considered as 'best practice'.
(ii) Many lecturers are not active in research or whenever he/she is active, the topics of research are not related to his/her subject. These research activities are most probably for filling up the curriculum vitae.
(iii) Being inactive in research means no new knowledge can be discovered and therefore there is no for publications.
(iv) Lecture notes are not upgraded and students are taught with probably outdated knowledge.
(v) Studio projects have no relationship with what were taught in lectures.
(vi) As for industrial crit session feedback from practicing architects show interest only in the design ideas and philosophy rather than actual detail drawings on green solutions. Majority does not have comprehensive view of the accurate meaning of green or sustainability.

In order to address these problems a quick attempt at using the Logical Framework Analysis (LFA) as shown in Table 4 is done to identify the possible solutions with its Objective Verifiable Indicators (OVI) and Sources Of Verification (SOV).

Table 4: Logical Framework Analysis

PROBLEMS	SOLUTIONS	OBEJCTIVE VERIFIABLE INDICATORS	SOURCE OF VERIFICATION
No reference for benchmarking	Look for benchmarking	Documents	Industry : eg., MGBC/SIRIM/GBI Sdn Bhd
Not active in Research	Be active in research	Research grants	TD R&I; RCMO
No publications	Publish	Number of journals and books	Publishers
Lecture notes not upgraded	Upgrade notes	Improve content of books	Books published
Studio projects not related to subjects	Relate subjects to studio projects	Invent a reference code system	The lecture notes
Lack of green knowledge by practicing architects	Intensify green courses through CPD eg. Many more GBIF courses	Number of knowledgeable consulting architects increased	PAM

To read from the above table, the problems are listed vertically downwards and to rectify the situation the steps to be taken are read horizontally. For example, the first problem shows that there has not been any reference to any benchmarking by a particular lecturer that would make him/her to see any link from research to teaching. Therefore to overcome this, the column 'SOLUTIONS' require him/her to look for one. This benchmarking can be confirmed by referring to any officially recognized documents. By stating the source of verification it gives authentication and credibility. When these are identified it would make research more meaningful and probably the lecturers would become more motivated and carry out the research with more passion. Therefore the best practice is for every studio level to have the accompanied taught subjects go through the sequence as shown in the Figure 4 below.

5.0. Conclusion

This paper proposes a paradigm shift from the conventional architectural pedagogy in imparting relevant knowledge for the sustainability in architecture era. It emphasizes on more thinking and researching new knowledge that sometimes can be the edge for future architectural direction. Majority of architectural institutes borrow, adapt and repeat existing knowledge to be imparted to students of architecture but for research universities the component of research must be in the forefront in generating new knowledge. Useful new knowledge must replace old outdated ones because the rules of game have changed with the onset of global warming phenomena. Linking research to the architectural curriculum has been presented above by a case study of one particular subject that is thought can be emulated by other subjects.

Therefore for a typical research university to be successful, research grants must be readily be available for healthy culture. A healthy research culture comes from researchers who have passion for doing research. The new findings are becomes the content of the teaching curriculum and this becomes a cycle. Thus a template for a successful research university has the ingredients of research funding, passion for doing research and teaching the research content in the curriculum. A constant desire to improve must be inborn in the psyche of the researchers.

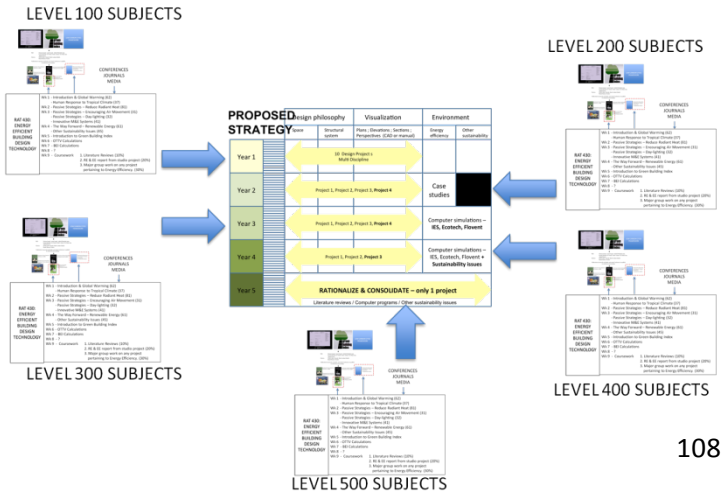

Figure 4: The 'Kaizen' approach for architecture education.

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VIRTUAL DESIGN

ISSUES AND CHALLENGES IN INTRODUCTING COMPUTATIONAL ENVIRONMENTAL SIMULATION IN ARCHITECTURAL DESIGN EDUCATION.

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Abstract
To achieve sustainable development, designers need to integrate various technical issues very early in the conceptual design stage. This is difficult to be handled in the design process for architectural students. At this stage, they are still struggling to balance between different spatial and program need. To add more practical consideration such as environmental issues has long been considered as a hindrance towards design skill development. However, with the advent of information technologies there are tools to make this intricate exercise possible even at student level. This paper look at issues and problems of introducing simulation tools in the creative design process. The examples examined are not exclusively that of architectural design students, but the method, potentials, problems and challenges would point toward a comprehensive framework of developing such paradigm in architectural education.

Key Words*: architectural design process, Environmental simulation and Integration.*

Introduction

The need to have a holistic or systemic approach in producing buildings is expounded in the era of sustainability. Designers can no longer work in silos to produce their creative concepts and hand them over to technical consultants to solve issues of energy, structure etc. A lot of inefficiency in terms of material use, operational energy and overall sustainable development requirements arise out of insufficient consideration given during the conceptual design stage. The architects, the initiator of a building project need to bring in ever increasing number of factors to be considered during their creative process. However, there is a shift in the building industry where the introduction of sustainable rating system forced the designers to use systemic approach in their design development.

This daunting task of including technical and environmental aspects in conceptual design stage has recently been made easy with the introduction of computational simulation tools which help designers to iterate environmental issues quickly in their design development. Software such as ECOTECT, IES and Design Builder is becoming widely used in the design industry.

However, this development in the industry is not well reflected in the architectural education system, where curriculum and modules used has change little over the years. There need to be a paradigm shift in architectural process and this need to be exposed to students of architecture. The study is a literature investigation of cases where simulation tools have been used in education and training scenarios. Issues and challenges identified, provide an insight of the necessary framework for the successful introduction of simulation tools in architectural education.

The use of simulation tools in architectural design process.

Morbitzer , et. Al. (2001) conducted a research to identify which design stages have the opportunity to employ simulation tools to evaluate energy and environmental performance in architectural practice. They used three main building design stages as classified by RIBA (RIBA 1995); outline design stage, schematic design stage and detailed design stage, as the focus of their study. Several parameters were selected to be evaluated at every design stage to identify potential overheating problem and then help designer to make a good design decision. Thereafter the implications of these decisions are assessed in terms of their implication in term of energy consumption and comfort condition in a building. He recommended that simulation should start at the initial stage of design process and be continued to final presentation on architectural practice.

Hobbs et.al, (2003) identified the barriers to the use of simulation in architectural design process as follows: complexity in creation of the simulation model; poor understanding of simulation by architects. Through the experience of using simulation within an architectural practice further barriers to its use have been identified through user surveys and feedback as: increased risk of liability of the architectural practice; unfamiliar working methods; lack of knowledge of energy modeling and perceived increase in workload.

Morbitzer (2001), point out that building simulation should not be used for final representation only but should integrate it into design process at early stage and within the design practice. These approaches are norm in many businesses. (Ofori and Kien, 2004). However this trend is not reflected in the current architectural design education. Student, at higher level of study are often asked to consider the traditional design factors such as spatial arrangement and programme, structure and aesthetics and some idea of cost constraint. Environmental issues, such as thermal comfort, daylighting and ventilation are often left out in favor of freedom in design flair and creativity.

Wang, Shen and Berryman (2011), stated that ECOTECT is a good software for architectural practice in order to evaluate building Life Cycle Analysis (LCA). They conducted a case study to analyze the whole building Life Cycle Analysis of a campus building via BIM model and identified its potential. They made a comparison between two lifecycle performance (CO2 emissions and energy consumption) within different design strategies of the same building. They also divided the construction into three stages while doing the life cycle analysis of the building; raw materials and manufacturing stage, construction stage and operation stage. In every stage, they made design changes of the building then identify the rate of CO2 emission and energy consumption of the new design. They also used sensitivity analysis as the last method to examine the relationship between building performance and its influence factors. They also identified the operation stage of a building contribute to the biggest energy consumption and material of building such as steel release the higher CO2 emission. Kwon et. al. (2004) stated that the integration of computational tool in creative architectural design process can help the integration of the whole development process into a holistic one.

Azhar, Brown and Farooqui (2009), conducted a case study to explore the performance of three building performance analysis software (Ecotect, Green Building Studio and Virtual Environment) for BIM (Building Information Modeling)-based sustainability analysis. They used BIM in the early design phase to identify good building orientation, do energy and daylighting analysis and evaluate various building envelope and skin design option. They integrate the three softwares to evaluate the same building model, and comparing the result to identify the best software for BIM. They conclude that IES's Virtual Environment was the best software for BIM under consideration of the 7 sustainable design features; energy, thermal, solar, lighting and daylighting, acoustic, value and cost and LEED rate.

Ibrahim and Rahimian (2010) stated that there is a gap between precise manufacturing-oriented modeling and experimentation in architecture studio project to support an integrated during conceptual design process. As a potential solution, they introduced VR- based design interface. Frost and Warren (2000) stated that collaborative design process including VR (cave-technology) helped users by providing a method with which their ideas could be better formulated, analyzed, tested and finally realized. They conducted a case study to see how new technology can be integrated into architectural design process. They introduced Virtual Reality (VR) by Cave-technology as a way to visualize the architectural design model instead of scale model that was built by model board. This model can then be visualized digitally and the user can experience the environment. Here they are free to investigate what they want and go where they like in the model. They also conducted a workshop to identify the existing problems, user needs and to produce actual proposal of the new building.

The use of simulation tools in education

Shari and Jaafar (2006) surveyed the integration of sustainable issues in several architectural schools in Malaysia and found that among the barriers of introducing sustainable design in studio courses are the perceived complexity and breadth of issues involved. However this is the area where the use of computational tool might offer a solution, where complex technical design can be iterated quite easily in architectural design process.

A more interesting area of study is when computational tool is used during creative design process. Ibrahim and Rahimian (2010) conducted a similar study of the use of 3d visualization tools in architectural design studio, during conceptual design phase. They studied the working process of several undergraduates during their studio courses. An Interesting finding is that those who rely solely on digital tool produce the least quality. They conclude that the use of computational tool hinders creativity. However they also found that the mix use of manual and digital visualization produce the most positive results in terms of design quality compared to those who use full manual sketching. Further analysis also reveals that when a design becomes too complex, those who employ digital tool would perform better.

Simulation has been found to be effective in inculcating understanding and attitude. Tanes and Cemalcilar (2010) state that the perception of Turkish adolescents toward their neighborhood and local authorities has positively changed after playing SimCity game for six weeks. On the other hand, Cascio (2004) warned the oversimplification of complex task using SimCity would lead to simplistic evaluation of urban complex issues. Nevertheless, the argument shows that there is potential for the possibility of inculcating affective knowledge in sustainable education by using simulation tools.

In Universiti Putra Malaysia, where the author teaches, several issues can be highlighted from the experience of introducing simulation tools in several courses and studio projects. Among the most pressing issues is the perceived extra time imposed by insisting students to use such tool in their studio projects. When it is taught as part of a specific course, the students expressed their interests of what the tool can do. However, they expressed difficulties in accommodating such exercise in their studio projects. Among the reason for this is that the studio programs were designed with conventional design process, seldom allows for a hiatus of design development to specifically look into specific technical issues, such as optimizing window to wall ratio to achieve good protection against external heat gain.
Cooperation from the studio master is crucial when incorporating simulation in their studio project. They need to allocate certain amount of time during studio hours, for students to iterate their design using the tool.

Discussions

The above discussions highlight several issues and challenges in introducing simulation tools in architectural design process. The barriers highlighted in this study are; incompetency of the current design professionals in implementing simulation tools in their design process, the time consuming process of creating the virtual model in the first place and perceived extra time consumed during design process. Other worries are concerned with the effect of using such technical tool on creativity and design flair.

The study also found that there are real benefits in introducing such tool. When design briefs and solutions get too complex, the use of simulation tool is indispensable. In the light of sustainable concern, the variety of factors to be considered by designers makes the design process anything but simple. Another potential benefit in the use of the tool is the development of affective knowledge in sustainable design, as shown by the Turkish study. Hence this paper would take the position that the use of simulation tool in architectural design studios is a positive step towards achieving sustainable buildings and development.

Conclusion

There are clear benefits offered by the use of computational simulation tool in the architectural design process. New generation of software make it easy for designers to consider multiple issues in producing a sustainable solution in their buildings. However, such new practice is not reflected in education. The introduction of such tools in architectural education is still new and poses challenges to educators. The study looks into the benefit, issues and challenge in introducing Simulation tools in architectural design education. The paper suggests that the way forward is to push for the implementation of computational tool in architectural education.

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GAME-LIKE VIRTUAL REALITY INTERFACES AS A NEW PARADIGM IN ARCHITECTURE/ENGINEERING/CONSTRUCTION DESIGN SIMULATION

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Abstract
In global operation, the success of Architecture, Engineering, and Construction (AEC) projects are often highly dependent upon the type, level and quality of the communication exchange between the various disciplines involved in the design and implementation phases. The communication exchanges among building professionals take place in the form of documented 2D/3D CAD formatted design. Recent innovation in Virtual Reality (VR) technologies and AEC decision- support toolkits have now matured in the developing countries which enabled tele-presence engagement to occur through collaborative environments. Several opportunities are now available, including significantly improved immersive interactivity with haptic support that can enhance users' engagement and interaction. Whilst several benefits can be cited from using this technology, it is postulated that current collaborative approaches could be significantly improved by augmenting immersive interactivity to enhance users' engagement and satisfaction in the process. This paper reviews the current situation of using VR interfaces in building design and construction management simulation and describes its related benefits and challenges. Game-Like VR interfaces are presented as a viable solution, particularly for promoting better integration of data simulation and communication through the whole construction design and management process. It is therefore argued that the use of such interfaces would have a positive impact on Architecture Engineering and Construction (AEC) projects. Moreover, this approach could proactively foster multidisciplinary teamwork synergies and provide enhanced outcomes for respective collaborative participants in detailed design and construction phases.

Keywords: *Virtual Reality, Construction Management, Game-Like Applications, Collaborative Interfaces, Data Communication, Immersive Environments*

INTRODUCTION

The Construction Industry Master Plan 2006-2015 is being implemented in Malaysia and is here to stay as part of the Government's Economic Transformation Plan (ETP); specifically in advancing manufactured or industrialised building system (IBS) components per se for the construction industry as the country moves towards a developed nation. A CIDB survey in 2005 highlighted the lack of interest in implementing IBS for building projects among architects which an earlier study had identified was due to the weakness of CAD-supported tool to support the intuitive design process that architects preferred in the early stage of the design lifecycle. This is a concern, since during the design of an IBS project, architects often handle numerous repetitive building components with almost similar embedded information in them during modelling of prefabricated building projects. In order for a full-scale advanced manufacturing and rapid delivery of industrialized projects, there is a need to support the 3D modelling process while the designers are practicing Computer Aided Design (CAD) systems. The need is more so as the Malaysian Government has called for globalisation of services whereby builders and consultants are encouraged to export their services in the recent 2012 Budget.

Architecture, Engineering, and Construction (AEC) sector is one of the largest industrial employers, representing 9.8% of the countries' Gross Domestic Product as it employs over 7.1% of the workforce (Business Watch, 2005). The fragmentation of the AEC industry is well recognised the consequences of which have led to well-documented problems relating ostensibly to failures in communication and information processing (Egan, 1998; Latham, 1994). These failures have contributed to an increased proliferation of adversarial relationships between the different parties involved in a project (Forcade, et al., 2007), which has also affected the veracity of design information (Cera, et al., 2002; Fruchter, 1998) within the project lifecycle. In essence, the nature and complexity of communication within AEC projects has changed significantly over the last ten years, especially with advances in technology, and the increased prevalence, of web-based project collaboration technologies and project extranets. Within the AEC sector, Information and Communications Technology (ICT) has revolutionised production and design (Cera, et al., 2002), which has led to dramatic changes in terms of labour and skills (Fruchter, 1998). However, it is also important to acknowledge that the capabilities of such applications (and implementation thereof) in predicting the cost and performance of optimal design proposals (Petric, et al., 2002) should enable design

engineers to compare the quality of any one tentative solution against the quality of previous solutions. This was reinforced by Goulding and Rahimian (2012), regarding the ability to experiment and experience decisions in a 'cyber-safe' environment, in order to mitigate or reduce risks prior to construction. Consequently, the success of AEC projects is highly dependent upon the type, level and quality of the innovative communication exchange between various disciplines involved in the design and implementation phases.

Notwithstanding these potential benefits, the use of such applications is not quite evident in design and construction management educational programmes. This is ostensibly because employing advanced technologies in education is still very new, with deficient consensus regarding the measurement of the impact of technology in education and design studies (Wellings and Levine, 2010). Therefore, in order to bridge this theoretical gap, this research aims to investigate the use of Virtual Reality (VR) applications for training purposes; specifically, with a remit of mitigating the high risks and costs of on-the-job-training (OJT) by simulating construction process in a risk free VR environment – the notion of which is echoed by Ponder et al, (2003). This research will also investigate the importance of tele-collaboration (Fruchter, 1998), which enables different parties to share ideas from distant locations. This is the crux of this research and what makes it different from preceding attempts in this field. Thus, in order to facilitate both immersion and tele-collaboration in a single interface, fusion is needed to integrate VR technology with web programming applications.

This research concludes by recommending Game-Like Virtual Reality interfaces as part of the proposed solution. This is in line with thinking by Thai et al (2009), who advocated that educational digital games could offer an intact opportunity to stimulate trainees' engagement and help revolutionise education. This paper highlights the importance of using Virtual Reality interfaces in construction management simulation, and describes the related benefits and challenges. It concludes by recommending the implementation of Game-Like Virtual Reality interfaces for better integration of data simulation and communication, and provides technical insight on how such interfaces could be implemented for developing collaborative building design and construction applications for global AEC design projects.

BACKGROUND OF USING IT/ICT IN ARCHITECTURE ENGINEERING AND CONSTRUCTION

Over the last 30 years, emergent ICT has matured and has enabled construction organisations to fundamentally restructure and enhance their core business functions; and it is now widely accepted as being a crux of the business (Isikdag et al, 2008). Moreover, priority themes for ICT research are increasingly embracing such issues as "interoperability, collaboration support, intelligent sites and knowledge sharing" (Isikdag et al, 2009).

On the other hand, Sampaio et al. (2008) argued that the main objective of using ICT in construction field is supporting management of digital data, namely to convert, store, protect, process, transmit, and securely retrieve datasets. They acknowledge the commencement of 3D visualisation techniques as an important stepping stone for data integration in construction design and management as they are capable for holding and presenting the whole information about buildings (e.g. size, material, spatial relationships, mechanical and electrical utilities, and etc) in a single file. Similarly, Zheng et al, (2006) proposed the use of 3D visualisation to reduce the time and costs in product development and to enhance quality and flexibility for providing continuous computer support during development cycle. This type of data visualisation led to emergence of VR in the AEC industry.

IMPLEMENTATION OF VIRTUAL REALITY APPLICATIONS IN THE AEC INDUSTRY

Regenbrecht and Donath (1996) defined VR as a component of communication which takes place in a computer generated 'synthetic' space, which embeds humans as an integral part of the system. They defined the tangible components of a VR system as a congruent set of hardware and software, with actors within a 3D or multi-dimensional input/output environment, where actors can simultaneously interact with other independent objects. According to the most popular definitions, a VR system usually includes a computer capable of real-time animation, controlled by a set of wired gloves and a position tracker, and using a head-mounted stereoscopic display for visual output. For instance, (Yoh, 2001) asserted that VR is an electronic simulation of an environment experienced via head mounted eye goggles and wired clothing – thereby enabling end users to interact in realistic three-dimensional situations. Wheareas, Greenbaum (1992) noted that VR was an alternate 'world' created by digital objects that interacts with human by the aid of stereophonic advanced I/O devices.

Early studies which used VR in the AEC industry used it as an advanced visualisation medium. Since almost 1990, VR has been widely used in the AEC industry as it provides an intuitive medium for designing 3D models which can be spontaneously manipulated and collaboratively used in order to reveal various phases of the building construction (Whyte et al., 2000). Building industry has also used VR as a design application to provide joint visualisation for improving construction processes (Bouchlaghem, 1996).

However, expectations of VR have been changed during the current decade. According to Sampaio et al. (2008), it is increasingly important to incorporate VR 3D visualisation and decision support systems with interactive interfaces in order to perform real-time interactive visual exploration tasks. This thinking supports the position that a collaborative virtual environment is a 3D immersive space in which 3D models are linked to databases which carry characteristics. This premise has also been followed through other lines of thought, especially in construction planning and management by relating 3D models to time parameters (Fischer and Kunz, 2004) in order to design 4D models which are controlled through an interactive and multi-access database. In similar studies, 4D VR models have been used to improve many aspects and phases of construction projects by: 1) developing and implementing applications for providing better communication among partners (Leinonen et al, 2003), 2) supporting conception and detailed design (Petzold et al, 2007), 3) introducing the construction plan to stakeholders (Khanzade et al, 2007), and, 4) following the construction progress (Fischer, 2000).

IMPLEMENTATION OF VR IN EDUCATION OF THE AEC INDUSTRY

ICT applications are now increasingly being used as a part of the teaching and learning process. According to Zudilova-Seinstra et al (2009), the use and application of ICT as a teaching tool can contribute to the trainee's professional future by developing some learning activities beyond what is available in conventional training system. With respect to educational issues in the AEC industry, Sampaio et al. (2010) argued that the interaction with 3D geometric models can lead to active learner thoughts which seldom appear in conventional pedagogical conditions. Moreover, Juárez-Ramírez (2009) asserted that when augmented to 3D modelling, VR could lead to better communication in the process of learning particularly in the processes with sequential stages (e.g., in new curricular subjects). Furthermore, Gomes and Caldeira (2004) suggested development of some communication platforms which let trainees and trainers exchange information about specific domains, interact, and learn collaboratively.

Based on all benefits discussed above, it could be anticipate that in a very close future the world will be witnessing progressive use of VR 3D models in the AEC industry's education. For instance, Gibbon (2008) tested some laboratories augmented with operational amplifiers and a resonant circuit, embedded in 3D modelling tools to improve the understanding of circuit issues which are presented in formal lectures. The other examples in which VR projects support the education in engineering are distant physics experiments (Ozvoldova et al., 2006), simulation control testing (Su et al., 2006), and virtual laboratories (Safigianni and Pournaras, 2008).

Reviewing preceding studies reveals that majority of attempts towards employing VR in education of construction technology are related to either 3D visualisation of the construction in an immersive environment or simulation of the actual data communication with the aid of decision support systems; however, in some cases, the simulators comprise of a sequential combination of a decision support system with an immersive visualisation of the result. Consequently, such systems lack the integration of visualisation and decision support tasks in order to support decision making by experiencing and experimenting as recommended by Goulding et al. (2007). Recently, a new generation of VR applications so called game-like interactive virtual reality interfaces have been introduced in order to fill in the mentioned gap. Although, the use of game-like virtual reality interfaces is not yet evident in the AEC industry, currently, there is a substantial amount of relevant publications in some other fields of study.

USE OF INTERACTIVE GAME-LIKE VR INTERFACES IN EDUCATION

Wellings and Levine (2010) argued that digital media must be a part of educational schemes as they already formed an indispensible part in next generation's lives in modern societies. Literature highlights various benefits of using advanced digital media in education. For instance, according to International Society for Technology in Education (2008), advanced digital media can serve education by: 1) supporting trainees' achievement in reading, literacy, mathematics, and science,

2) adding 21st century expertise to ordinary academic subjects, 3) increasing access to education, virtual communities, and expertise, and 4) engaging trainees in learning and content creation.

As another advocator of employing new digital media in education, Apple Inc. (2009) lists benefits of this technology as follows: 1) facilitating differentiated instructions for every case, 2) strengthening career and technical education by providing the trainees with cutting edge knowledge and expertise that are desired in competitive industries, 3) extending the learning day, 4) supporting teachers' quality, and 5) enabling diagnostic, timely, and innovative assessments.

At the same time, Wellings and Levine (2010) suggested redesigning existing text based lessons into problem-based learning processes in which the training is via collaboration for development of solutions into real world problems. They argued that this is possible only with using immersive visualization and simulation environments embedded in games and interactive interfaces for increasing engagement of trainees and trainers. In a similar attempt, Thai et al. (2009) ascertained that educational digital games can offer an intact opportunity to empower trainees' engagement and help transform teaching and learning into a new stage.

Finally, ACS (2009) summarised the benefits of the currently developed interactive game-like immersive environments as follows: 1) exploring knowledge by clicking on objects with linked information, 2) strengthening of education by providing a repository of aids, tools, etc., associated with 3D objects, 3) offering collaborative workspaces, e.g. 3D informal discussion forums, 4) traditional instructor-based education via a distance delivery method and, 5) simulated learning by modelling a process or interaction that closely imitates the real world in terms of outcomes.

The next section reviews the existing paradigms for system implementation in construction management simulation in order to proffer optimal solutions for supporting integrative solutions.

TECHNICAL IMPLICATION FOR IMPLEMENTING GAME-LIKE VIRTUAL REALITY INTERFACES IN THE AEC INDUSTRY

Existing VR simulators have ostensibly been formed based on a single idea: creating 3D models and incorporating them with some pieces of information so that both 3D models and information are editable through an interactive real-time interface. Contrarily, they differ from each other based on their architecture and the utilised methods for data creation and retrieval. Data creation and retrieval methods in VR simulators can be investigated from two different perspectives, namely creating 3D bodies of constructional elements per se and defining characteristics of the elements.

Although, creating 3D objects directly in VR environments is not impossible, they are usually preferred to be created in CAD applications since doing so in VR is extremely cumbersome and time consuming. Consequently, current VR simulators could be categorised considering how they convert CAD models into VR elements. In terms of transforming constructional elements from CAD into VR, there are three de facto approaches used by different practitioners. As noted by Whyte et al. (2000), the three approaches for this translation are as follows: 1) Straightforward translation approach and importing the whole environment from CAD to VR; 2) Library-based approach and putting the elements of construction in the library of VR environment then calling them when and where necessary; and 3) Database-oriented approach with a central database for controlling the module characteristics. Here the database utilises both CAD and VR environments as graphical interfaces. Therefore, the third approach can be characterises as a combination of computer graphics and web programming. Due to the ease of creating the environments by direct translation, most of the current VR systems in construction management are using this method; nevertheless, the new generation of simulators have to migrate to the third paradigm in order to continuously let decision makers see the results of their decisions throughout the simulation process. Moreover, this is the only way that can help participants share ideas from distance locations. VR simulators in the AEC industry vary also based on the method of manipulating the objects within the environment and the adapted programming method in VR simulator. In total, followings are the three major kinds of programming applications currently used by VR programmers:

3D Application Programming Interfaces (APIs) (e.g., Open GL and Direct 3D) are principal environments for VR programming in C++ and Visual Basic. Falling in category of computer graphics, they are capable to either create all models directly inside the space or/and import them from CAD applications. They are perfect environments for advanced programmers for creating Win32 console applications which are used in developing computer games; however, integration of such interfaces with web programming is quite difficult and often leads to failures in cases of complicated works.

Virtual Reality Modelling Language (VRML) and 3D web technologies in their first version was made as a division of Open Inventor and afterwards have become the international standard for 3D web modelling. These applications provide variety of facilities for manipulating immersive library based web interfaces; however they lack the capability of integration with interrelated databases as they are not essentially database oriented applications.

Recent commercialised VR programming packages contain built-in modelling environments for creating VR spaces directly or importing them from CAD applications. Such VR programming applications also contain logical libraries for defining behavioural links among the objects and simulating physical phenomena. Although the architecture of such applications is made based on APIs of C++, in some aspects they can offer a higher level abstraction for programmers. Nowadays, there are two frontier commercial VR programming applications, namely EON Reality™ and Virtools™. The outcomes of both mentioned applications are directly deployable into C and Visual Basics web programming platforms (EON Reality, Inc., 2008). This makes them extremely flexible in terms of integrating VR programming (which is a part of computer graphics) with web programming and data mining. They also come with full Software Developing Kits (SDKs) in order to help advanced programmers add some building-blocks and prototypes to create rationales or behaviours which are not originally provided by the application. Besides, the SDKs let programmers integrate their simulators with particular VR I/O devices, e.g. Head-Mounted-Displays (HMDs) and data gloves. In this respect, it is now possible to launch game-like virtual reality interfaces as a new paradigm for simulating truly immersive AEC design collaboration - the proposed technology of which could quite easily embrace a database-driven approach using structured modelling phases and API based programming for the development stages. By linking 3D objects to datasets through a web environment, such systems would therefore be able to optimise performance during detailed design stages which contain collaboration among multiple designers.

CONCLUSION

This paper critically reviewed seminal literature on ICT tools within the AEC sector in order to highlight the existing theoretical and technical gaps between implementing immersive interactive interfaces. Specifically, new approaches using game-like immersive educational interfaces were discussed in order to highlight the potential benefits this could have, particularly to help actors experience real-world problems in a risk free virtual environment. In addition, the feasibility of using existing computer graphics and web programming platforms using game-like immersive VR simulators were reviewed. Research findings noted that the next generation of VR simulators should be developed on a database (object-oriented) approach for modelling, with the API augmented to extol the benefits of shared working (through enhanced collaborative environments). The implementation of such approach could leverage significant benefits (e.g. Thai et al., 2009; ACS, 2009; Apple Inc., 2009; and Wellings and Levine, 2010), not least improve users' engagement in the process. Whilst several systems are now being promoted in the marketplace (e.g. Cisco, 2010; Autodesk, 2010; Bentley, 2010), the use and propensity of these have yet to reach maturity. However, further development (with an AEC focus) could lead to the emergence of truly immersive environments. Moreover, the concatenation of a Game-Like Virtual Reality interface could offer global AEC detailed design and implementation projects further enhanced opportunities.

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ECOTECT: AS PART OF THE LEARNING EXPERIENCE FOR YOUNG ARCHITECTURE STUDENTS TO RAISE AWARENESS IN ENVIRONMENTAL RESPONSIVE BUILDING DESIGN.

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Abstract
This study investigates the feasibility of introducing environmental analysis software called Ecotect to final year LAM Part 1 Architecture students in the International Islamic University Malaysia (IIUM). The study evaluates the students' response and perception towards the software after completing the environmental analysis assignment. The assignment was given during the Environmental Conscious Design course and the students were required to conduct natural daylight analysis and average indoor thermal analysis of their studio design project using the Ecotect software. A student feedback survey on the Ecotect assignment was conducted among 64 students. Rather positive feedbacks were obtained from the students. In overall, 72% students were fully satisfied and 22% students were neutral with the Ecotect Assignment. However, 89% of the students agreed for the assignment to remain within the Environmental Conscious Design course since they had benefitted from the exercise. Majority of the students suggested the assignment to be introduced at earlier stage. Based on the high percentage of positive feedbacks from the IIUM architecture students, the teaching and exercise of Ecotect should be extended to more students and a brief introduction of such software to students in the 1st year of LAM Part 1 Architectural Studies could make the learning experience more effective.

Keywords: *Ecotect, Integration, Environmental Design, computer simulation.*

Introduction

In the Department of Architecture in IIUM, students normally attend lectures and in conjunction with that, they are given studio design projects to apply what they were taught in the same semester. However, it is often the case that students did not manage to inject the information fed to them during lectures, onto their studio design project. Evidently, their design work mostly complied with the concept, building type and space requirement written in the design project brief. However, the students often lack in producing environmental responsive building design. Therefore, the Ecotect assignment was given to students within the Environmental Conscious Design course, with the intention of integrating the course assignment with their studio design project. This was intended to also introduce Autodesk Ecotect as sustainable analysis software, including its range of simulation. This study then looks into the response and perception of architecture undergraduate students towards the Ecotect assignment, after completing the proposed assignment. In overall, this study was carried out to review wider learning issues (beyond IIUM) with regards to the students' deficiency in producing environmental responsive building design.

Literature Review

It was not the Department of Architecture's first attempt in engaging young architecture students into testing their studio design project with environmental simulation software. It has been done in 2006 but there is no proper survey on the significance of the exercise on the students' progress. However, an interview session with the former Head of Department back in 2006 was conducted on the students' perception towards the environmental simulation assignment. It was concluded that the students were very much receptive on having the opportunity to explore environmental software within the Environmental Conscious Design course back in 2006 under the guidance of Assistant Professor Dr. Puteri Shireen Jahn Kassim (Zuraini, 2012). During the course, the students were given a demonstration of the environmental software once and then, followed by close guidance by three senior students whom have been trained using the software. Unfortunately, such exercise has not been repeated in a regular basis until the Ecotect assignment this year.

The Ecotect software was developed by Dr. Andrew Marsh as part of his PhD thesis in the University of Western Australia (Thoo, 2007). It is a very useful tool for architects to test the environmental impact on their design scheme even at an early design stage (Thoo, 2007). In 2001, integration of Ecotect into the learning experience was evaluated among undergraduate students in the Welsh School of Architecture. 43 students responded to the survey questionnaire on their overall perception towards this integration and 85% of them agreed or strongly agreed on the integration of Ecotect into their learning experience (Marsh and Roberts, 2001). In Egypt, the integration of

Ecotect daylighting simulation software in architectural education was successful. 70% of the students found it to be "powerful" and "very useful", whereas, 85% of the students found the software as user-friendly (Sabry et al., 2010). By introducing such building performance simulation (BPS) early, the design process usually delivers interesting results, reflecting students' critical understanding of how the buildings work (Charles and Thomas, 2009).

Research Objective

The issue with regard to the students' deficiency in producing environmental responsive building design is the rationale behind the three main objectives for this study, which are listed below:

- To investigate the students' overall perception towards the Ecotect assignment as a method of integrating the Environmental Conscious Design course with the studio design project.
- To evaluate the significance of the Ecotect assignment on the students' studio design project.
- To enquire the potential of maintaining the Ecotect assignment within the course in the future.

Methodology

The 3rd year students of LAM Part 1 Architecture were introduced to the Ecotect software and they were required to complete an assignment within 4 weeks. The assignment was given near to the end of the Semester and it comprises of natural lighting and thermal analysis of an indoor zone, selected from their studio design project building. Each student was required to submit the Ecotect assignment in a poster form that should contain the Floor Plan of the building showing the location of the selected zone, Shadow Casting onto the analysed zone, natural lighting and thermal analysis results in graph form, and the design synthesis which were to be concluded from the result. After completing the Ecotext assignment, a student feedback survey was conducted where each student was given a set of questionnaires. The questionnaires enquired their perception on the adequacy of the time given, the significant of Ecotect assignment to their studio design project and their suggestions for future improvement. 64 students completed the feedback survey questionnaires.

Results and Analysis

The students presented their Ecotect assignment in a poster during their studio design project final presentation assessment. The following figures are extracted from some of the best posters examples among the posters presented by the students.

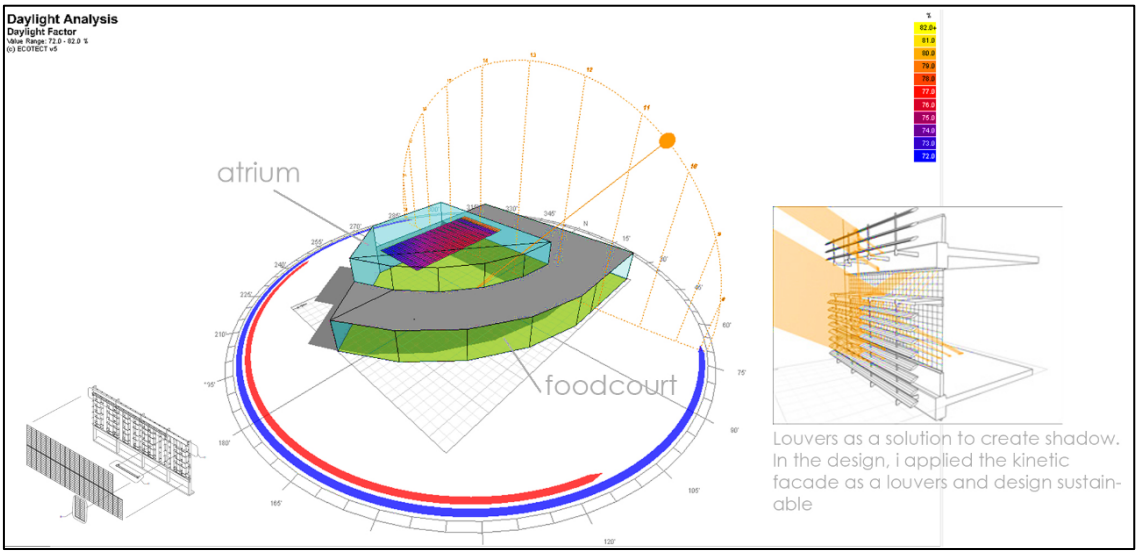


Figure 1: Comprehensive Daylight Analysis using Ecotect software and design synthesis
(Source: Mohd Fariq Adnan, Semester 2, 3rd year, 2011/2012)

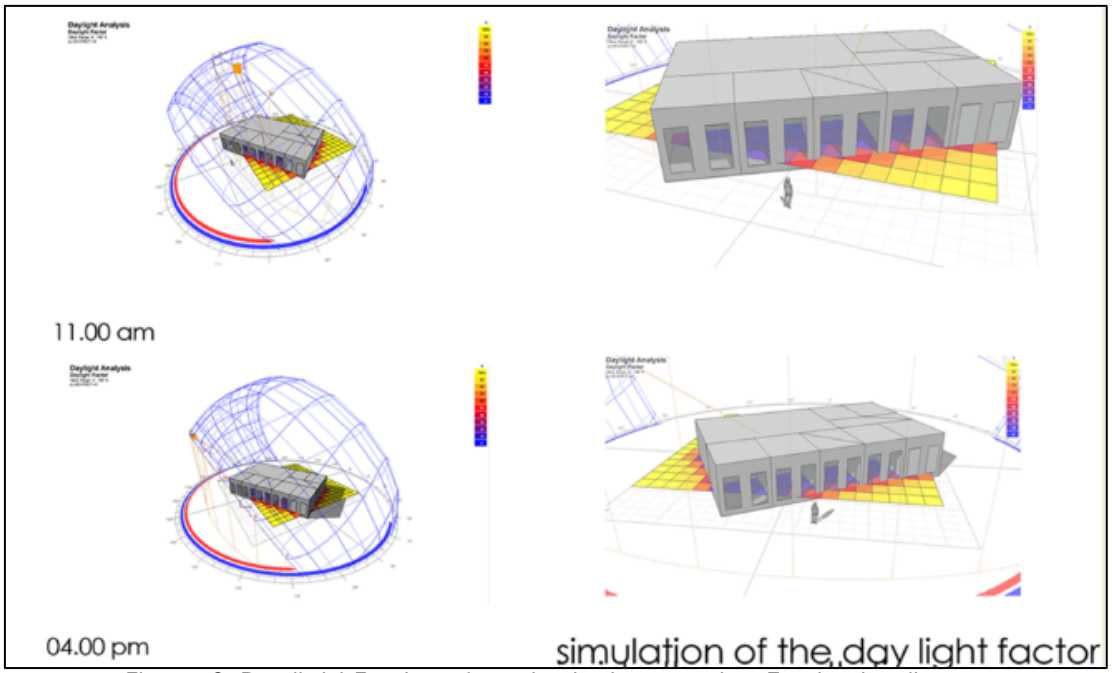


Figure 2: Daylight Factor of a selected zone using Ecotect software
(*Source: Mohd Shahrul Aizat bin Shahri, Semester 2, 3rd year, 2011/2012*)

Figure 1 shows a section of a student's poster board that shows rather comprehensive Daylight Analysis using Ecotect software with projection of 24 hours sun angles of one particular day in Kuala Lumpur. The poster was completed with a design synthesis on how to solve the issues of excessive glare from natural daylight.

Figure 2 presents a section of a student's poster board that shows rather Daylight Analysis with daylight factors using Ecotect software with projection of annual sun angles in Bangladesh.

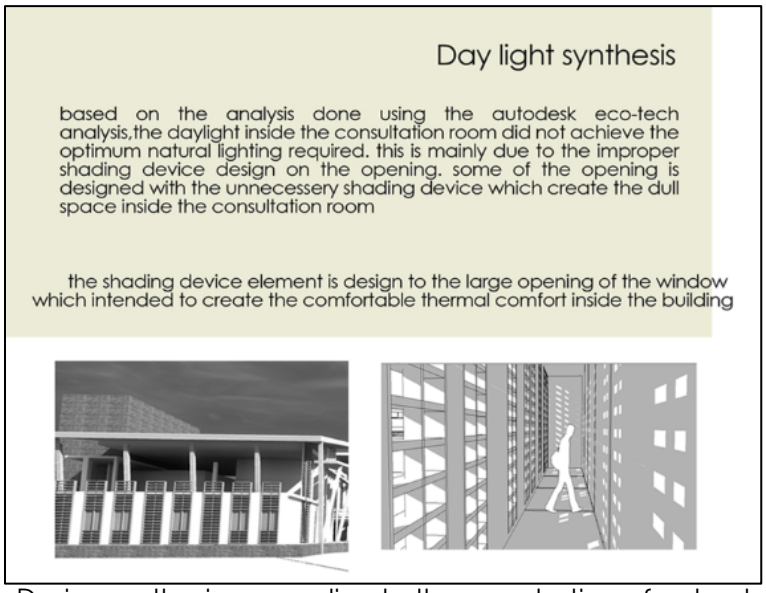


Figure 3: Design synthesis responding to the penetration of natural daylight
(*Source: Mohd Shahrul Aizat bin Shahri, Semester 2, 3rd year, 2011/2012*).

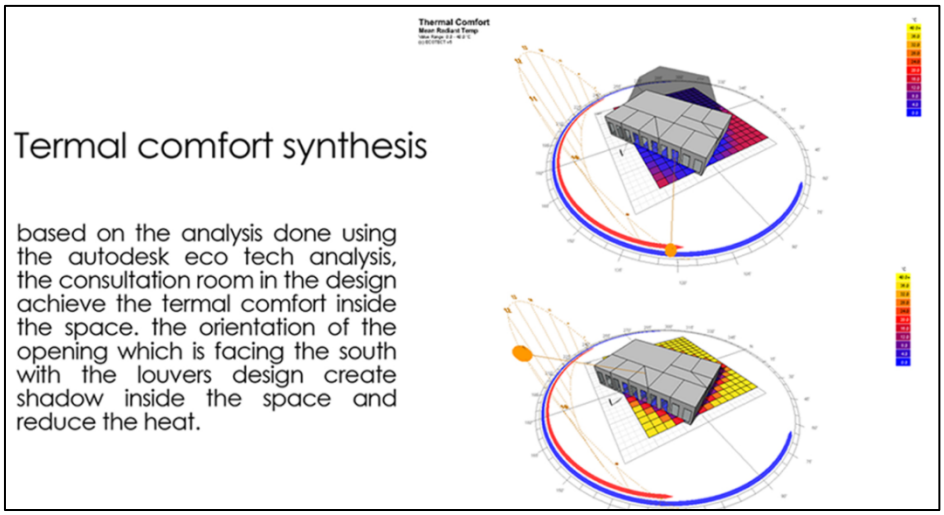
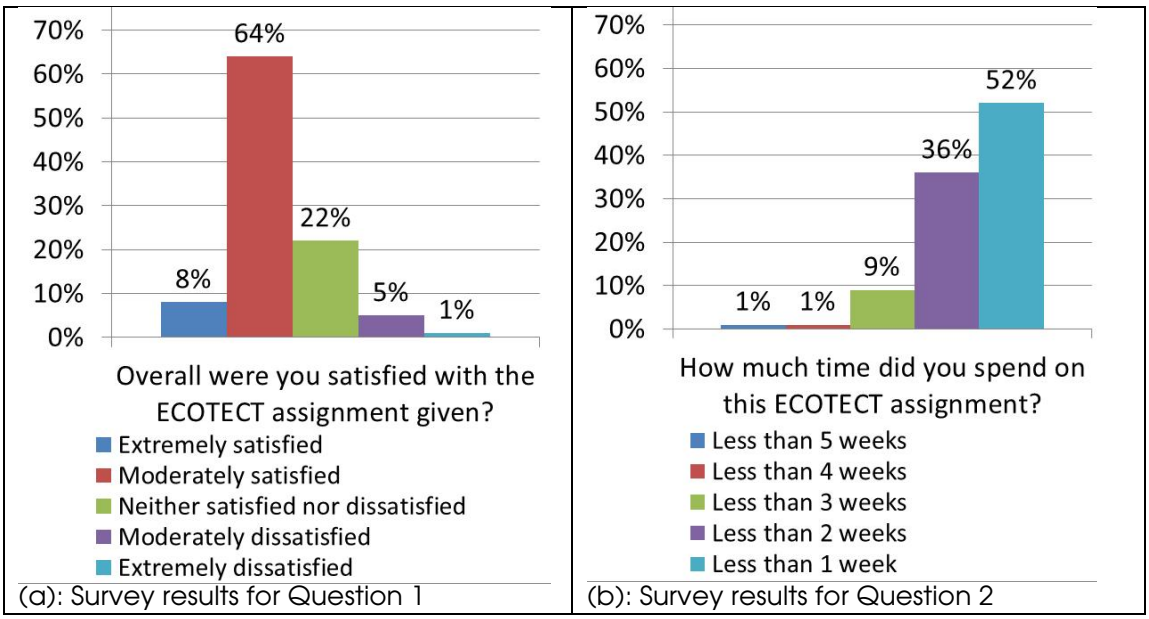


Figure 4: Thermal Comfort Analysis and Design synthesis for thermal comfort (*Source: Mohd Shahrul Aizat bin Shahri, Semester 2, 3rd year, 2011/2012*).

Figure 3 reflects the maturity of the students critical thinking after analysing his building with the Ecotect software and realising the importance of environmental responsive design approach to create a functional indoor space. Meanwhile, Figure 4 presents both the thermal comfort analysis and its design synthesis, which responded to the thermal comfort results.

As mentioned before, after the students completed and submitted their posters, they were given a set of student feedback survey questionnaires. The results from the survey were rather positive (Figure 5 and 6).



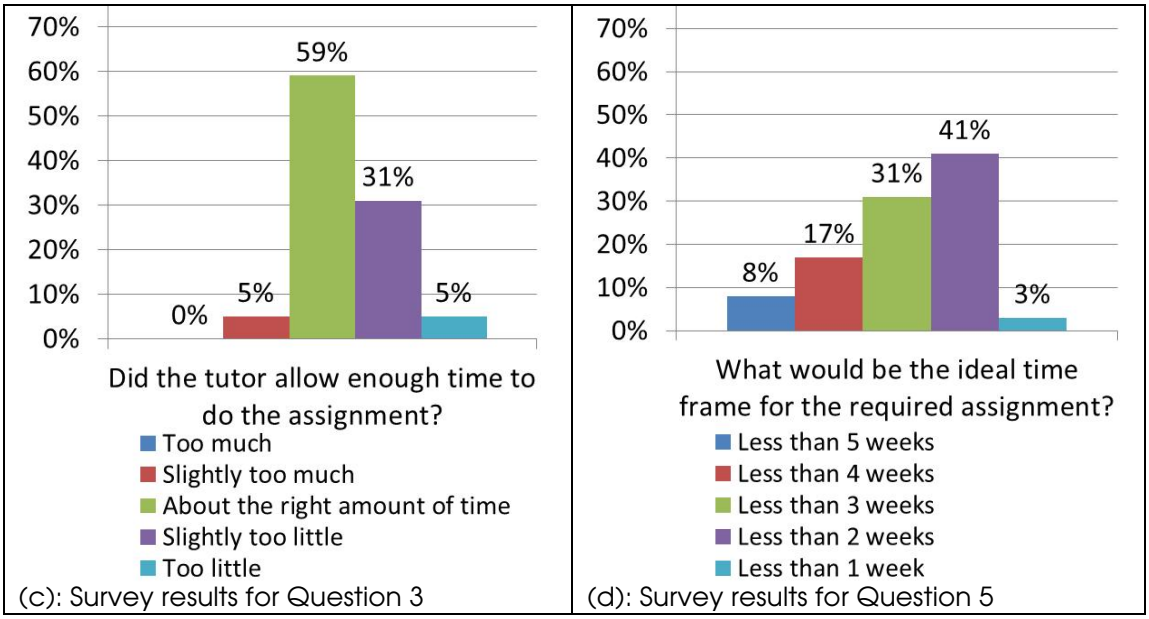
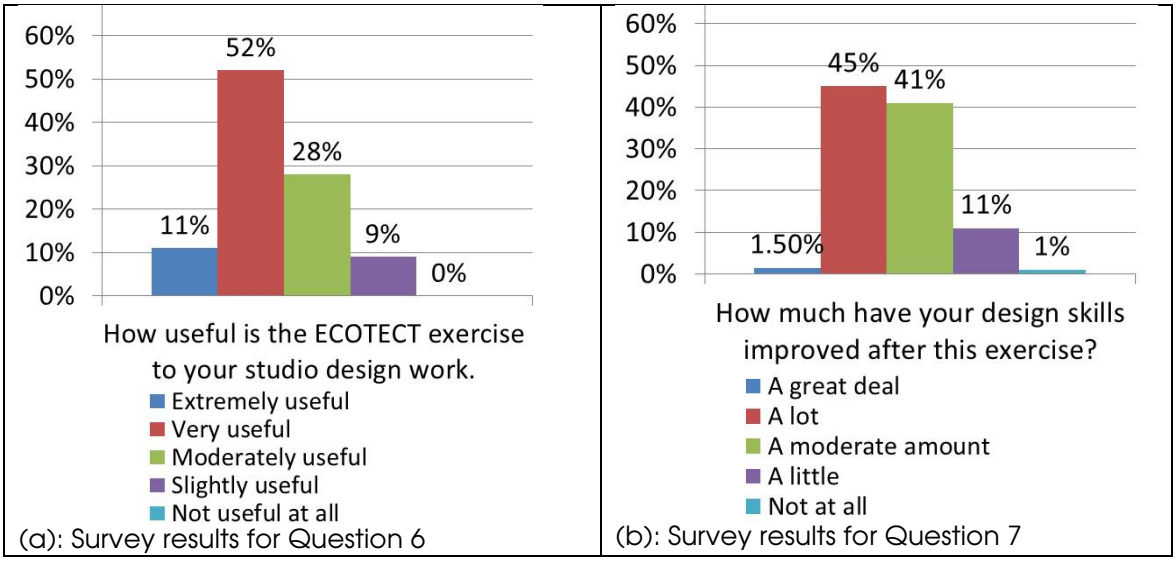


Figure 5: Results obtained from the students' feedback survey in overall of the Ecotect assignment and on the time-scale given to complete the assignment.

Figure 5(a), (b), (c) and (d) present the results obtained from the students' feedback survey on the Ecotect assignment in overall and on the time-scale given to complete the assignment. Figure 5(a) shows that in overall, 72% of the students find it either extremely or moderately satisfied. There were only 6% of the students find the assignment not satisfied. Meanwhile, 22% of the students were sitting on the fence. The uncertain 22% of the students was partly because they are not satisfied with the timing when the assignment was given but however found the assignment valuable (Figure 5(c)). Figure 5(c) shows there are 36% of the students have found the time given to do the assignment was either slightly too little or too little.



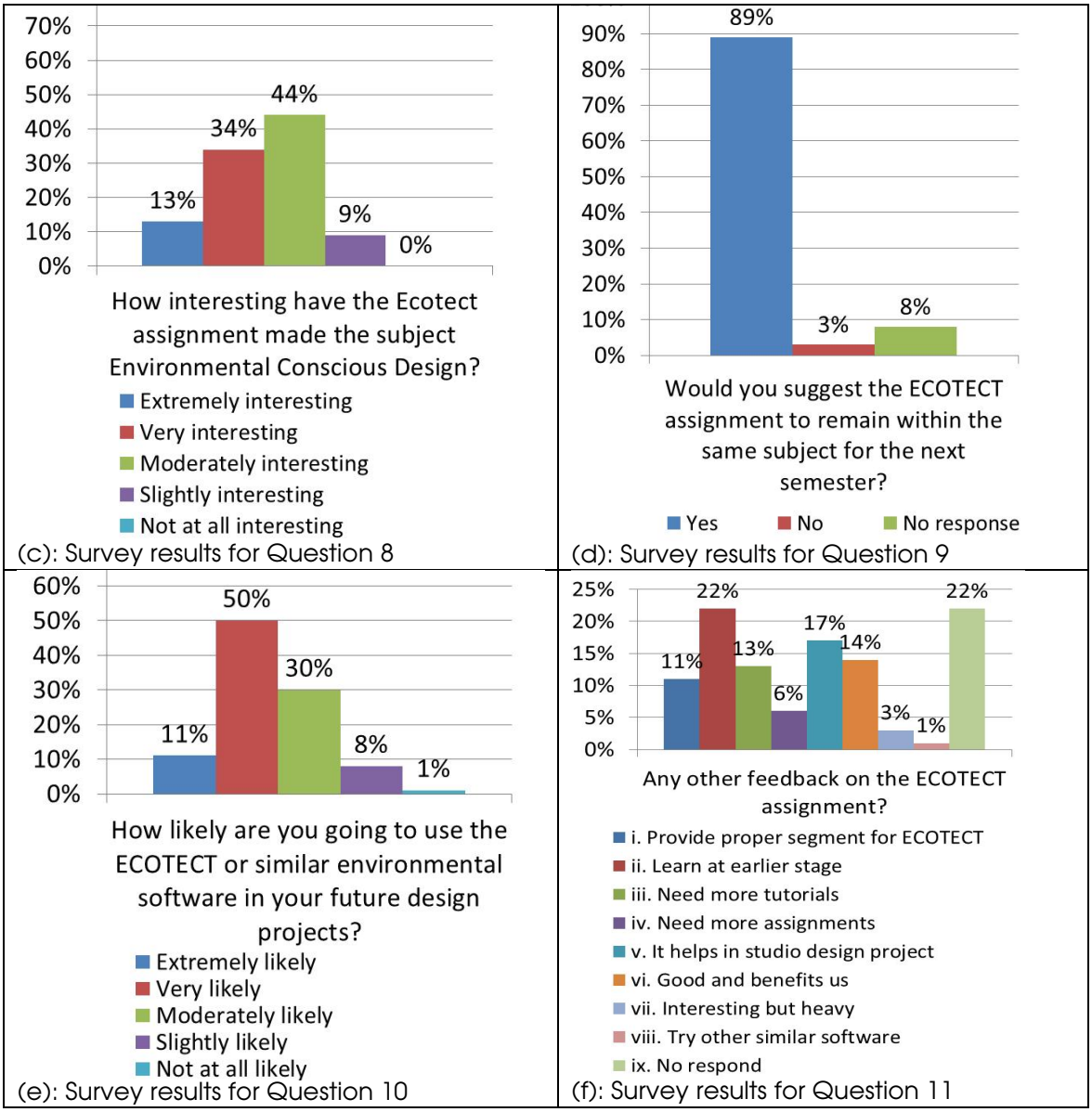


Figure 6: Results obtained from students' feedback survey on the significance of Ecotect assignment to the studio project and the students' future recommendation. Figure 6(a), (b), (c), (d) and (e) present the results obtained from the students' feedback survey on the Ecotect assignment on the significance of the assignment to their studio design project. Figure 6(a) shows that all students find the Ecotect exercise is useful to their studio design project, where 63% of them find it either very or extremely useful while only 9% find it slightly useful. Figure 6(b) shows that 99% of the students find that their design skill has improved after completing the Ecotect assignment. 87% of the students find the improvement is either moderately, a lot or a great deal. Meanwhile, Figure 6(c) shows that all students find the Ecotect assignment has made the Environmental Design Course interesting, although only 9% find it slightly interesting. 89% of the students think the Ecotect assignment should remain within the course and only 3% think it should not (Figure 6(d)). Furthermore, 91% stated they are either moderately, very or extremely likely to use the Ecotect software or something similar in their future studio design projects, while 8% stated they are slightly likely to use the software and only 1% stated they are not at all likely to use it (Figure 6(e)).

The students were then asked to add one extra feedback, comment or suggestion for future Environmental Conscious Design assignment. 78% of the students came up with 3 positive comments and 5 constructive suggestions. The most popular suggestion was to introduce or teach the Ecotect software at an earlier stage (Figure 6(f)). 13% of the students suggested to be given more tutorials while 11% of the students suggested that a proper segment should be provided to teach the Ecotect software (Figure 6(f)). The most common comment among the students, with 17%, was that the assignment has helped them in their studio design project. Whereas, 14% of the

students find it was a good assignment and that they benefit from it. The result reflects the insight on how Ecotect reflects students'critical understanding of how the buildings work (Charles and Thomas, 2009).

Conclusion

89% of the students agreed with having the Ecotect assignment remain within the Environmental Conscious Design course and only 3% did not agree. Therefore, since the Ecotect assignment is a method of integrating the Environmental Conscious Design course with the studio design project, majority of the students have a good perception towards the integration of course assignment with studio design project. However, only 72% of the students are either moderately or extremely satisfied with the Ecotect assignment given. After analysing the survey results, it is concluded that the lack of satisfaction were mostly due to the improper timing when the assignment was given to the students and also inadequate facilities provided.

The results also show that the Ecotect assignment is significant to the students' studio design project where 91% find it moderately to extremely useful to their studio design work, 87% of the students realised the Ecotect assignment has improved their design skill and 91% of them are likely to use the software in their future design projects.

The students' feedback has shown that the Ecotect assignment should remain within the Environmental Conscious Design course. 91% of the students find the assignment has made the course moderately to extremely interesting while 89% suggest the assignment to be remained within the course.

At the end of the course, most of the posters presented by the students reflect the maturity of the students' critical thinking towards designing an environmental responsive building. This paper contributes to instilling energy conscious design in architecture learning.

Future Recommendation

The 3rd year of LAM Part 1 Architecture students was exposed to the environmental software for the first time. In the beginning, it is common and expected to see the students' hesitation and repel towards the Ecotect assignment. Thus, it will be more effective if they could be introduced to such software briefly in the 1st year of their architectural studies. The exposure to such software should be repeated regularly throughout the academic years allowing students to develop their environmental analysis simulation skill gradually with increasing difficulties as they get to the higher level of their degree. The environmental software should be introduced during environmental science and system course or even computer skill courses. Since they have inherited Computer Aided Design (CAD) skills, learning Ecotect should not be too difficult for them. Thus, the time given to them to complete the Ecotect assignment was considered sufficient. The only part that had slowed them down was the process of downloading the software and trying to find and download the weather data. Another problem the students faced was the lack of guidance while using the software. It would be ideal to have several trained and skilled tutors who have used the software before to closely guide the students throughout their Ecotect learning experience. It might help the students especially the once who are rather slow in adopting new computer skills. This Ecotect or other relevant environmental software should be utilized more within the Department of Architecture. This Ecotect lesson and assignment should be integrated into other related courses and also studio design projects in order to avoid the lesson from becoming a one off-lesson and experience. Otherwise the skill will become a waste and forgotten.

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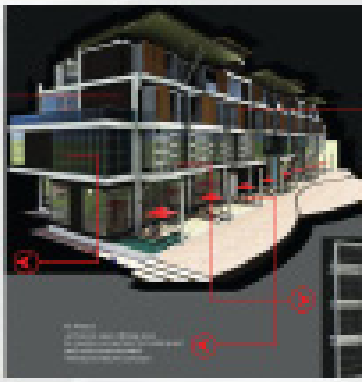

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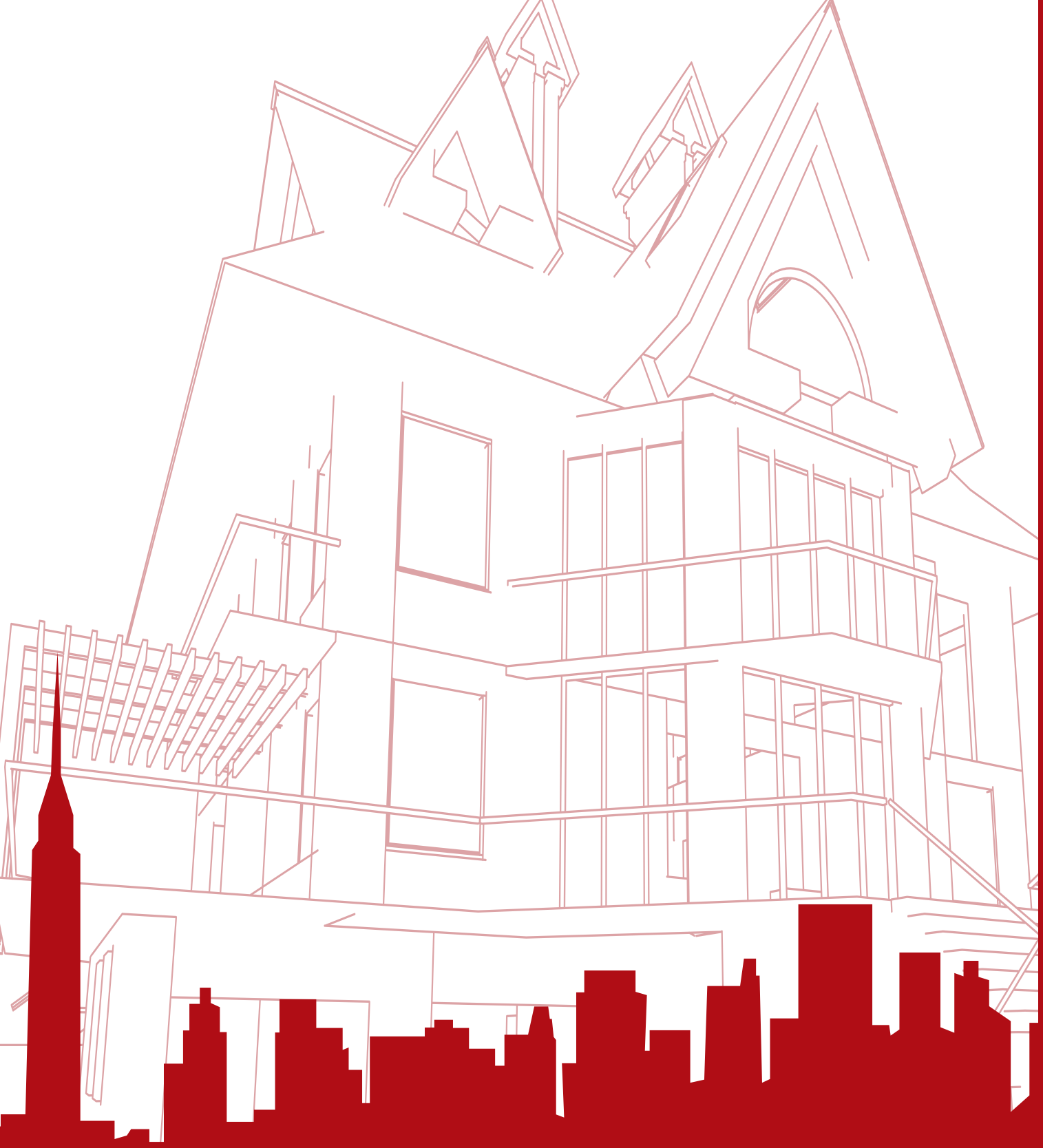

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