



FOSTERING TOMORROW DESIGNERS

AN APPROACH TO INCORPORATE SUSTAINABILITY INTO THAI DESIGN EDUCATION

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ABSTRACT

While designers can be the cause of ecological, economical, social and cultural problems threatening us, they can be a key to lead us in a sustainable direction. Therefore, sustainability education for design students - our future lifestyle shapers - is undoubtedly crucial to our sustainable future. This paper investigates whether a design project-based approach improves or deteriorates sustainability education. Three sustainable design projects for industrial design undergraduates were compared and analysed in terms of key factors influencing each project learning outcome. The implication of this study is that to achieve sustainability learning outcomes of design project-based learning, not only are the appropriate teaching and learning strategies required, but also the contents of the sustainability topic as well as the scope and complexity of the project need to be consistent with the students' maturity, knowledge, experience and design skills. Otherwise, students' proposed sustainable design solution will be rather conceptual, and sustainability will remain theoretical for students so that they will not be able to integrate sustainability into their professional practice.

Keywords: Sustainability Education, Sustainable Design, Project-Based Learning

INTRODUCTION

Unavoidably we have faced ecological, economical, social and cultural problems, which are the consequences of our unsustainable lifestyle. While

industrial designers can be partially the cause of our consumerist consumption patterns, they can be a key to lead us in a sustainable direction (Papanek, 1984 & 1995; Ramirez, 2006). Therefore, regarding educating industrial design students who will be in a position to shape the way we live, sustainability is undoubtedly crucial to our sustainable future (Ramirez, 2006; Vessel, 2003; Wankhade & Balakrishnan, 2010). To date, sustainability education has increasingly been integrated in design curricula around the world (Lehtonen, 2010). Various pedagogic approaches ranging from lectures, field trips, case studies, web-based to project-based activities have been used to achieve learning outcomes towards sustainability (Boks & Diehl, 2006; Fletcher & Dewberry, 2002; Hamza & Horne, 2007; Lehtonen, 2010; Ramirez, 2006; Triggs, 2010). Nevertheless, a challenge for design educators is to determine effective teaching and learning strategies on sustainability, which is a complex issue, within the constraints like their and students' knowledge and understanding of sustainability as well as experience of sustainable design practice.

It is recommended that to achieve our sustainable future, educators should plan learning experience empowering their students to develop and evaluate alternative visions for sustainable future. A wide range of teaching and learning strategies that can help students to achieve sustainability education have been proposed for example 'experiential learning' fostering students in critical thinking, problem solving and decision making in relevant contexts, 'enquiry learning' enhancing students'

thinking skills by enquiring them to process the data that they are working with to reach their own conclusions, ‘learning outside the classroom’ providing students with firsthand experience from different viewpoints and ‘community problem solving’ giving students an opportunity to apply their knowledge and skills into action to assist their community in achieving a sustainable future (UNESCO, 2002). ‘Project-based’ approach, one of the main teaching and learning strategies in design education allows design students to learn through hands-on experience. It provides students with an opportunity to apply their knowledge, critical thinking, problem solving skills and creativity into design practice - proposing design solutions that meet the project requirement. Furthermore, many studies have demonstrated ‘project-based’ approach to be effective teaching and learning strategy for sustainability in design education (Anderson & Hughes, 2010; Lehtonen, 2010; Triggs, 2010).

At the School of Architecture and Design (SOAD), King Mongkut’s University of Technology Thonburi (KMUTT), sustainable design has been incorporated into the undergraduate Industrial Design curriculum as an elective entirely dedicated to sustainable design, conventional studio courses included a project on sustainability and some lectures of theory courses. This paper describes a study conducted at SOAD during 2008-2010 to investigate whether a design project-based approach improves or deteriorates sustainability education. The paper presents methodologies employed to collect information and discusses key findings from the comparison and analysis of three sustainable design projects for undergraduate industrial design students in terms of key factors influencing each project learning outcomes - the students’ knowledge and understanding of sustainability and sustainable design as well as their ability to apply the acquired knowledge and understanding into design practice. Finally, the paper concludes with recommendations gained from this study for preparing more effective design studio courses on sustainability for the future and may also be applicable to other pedagogic approaches for sustainability education.

RESEARCH QUESTIONS AND METHODOLOGY

The study aimed to bring to light: (1) Does a design ‘project-based’ approach enhance sustainability study in undergraduate industrial design education? (2) If it does, to what extent and how does ‘project-based’ approach enhance sustainability study in design education? (3) What are key influent factors in the approach’s success and failure? To investigate on these three issues, a qualitative research was conducted. During the study, the authors as design studio instructors followed students participating in the second year design studio project in 2008, the fourth year design studio projects in 2009 and 2010 from the beginning of each project to the end. The data related to the study were gathered through the authors’ observation, class tutorial sessions, discussions with the students as well as the students’ final design presentation and submission. After all the course finished, the derived data from all the projects were compared and analysed by the authors in terms of design briefs; project topics related to sustainability; project duration; teaching and learning methods; roles of instructors and students; students’ maturity, knowledge, experience and design skills; design outcomes as well as learning outcomes.

SUSTAINABLE DESIGN PROJECTS AT SOAD

METABOLIC TOY

The first project, one-week intensive workshop, was the only project on sustainable design from the four projects included in the second year design studio course conducted in 2008. The objectives of this studio course were to introduce students to basic industrial design process and methodology as well as develop their creative thinking and other design skills. Sustainability was integrated into the last project as the topic of the project. First, this project aimed to fulfil the course main objectives - introduction to industrial design. Second, it intended to raise students’ awareness of sustainability and design profession. Finally, it meant to teach students how to optimise manufacturing materials and extend product life - sustainable design approaches focusing on production, consumption and disposal stage of toy’s lifecycle. To equip students with sustainable design knowledge, relevant lectures,

reading materials, sustainable design related videos, field trips to toy manufacturers and life cycle analysis were provided for them at the beginning of the project. Then, students were asked to design a 'metabolic toy' - a toy that grows with children - out of leftover materials from local toy factories and received in-class tutorial during their working process. As the students were from the first semester of the second year, they had premature design knowledge and skills, no knowledge in toy design, no background knowledge in sustainable design as well as no knowledge in material and manufacturing process. At the end of the project, the students learnt how to design a toy, understood concept of sustainability and sustainable design to some extent. However, they were not able to apply the given sustainable design approaches to their design successfully. Their final design outcomes were various toys, which were relatively conceptual, yet they could not neither optimise the use of manufacturing materials nor truly extend the product's life. Nevertheless, the design outcomes yielded out the good and fun exploration.

'Monster Hero' was one of the project's design outcomes designed by Miss Amonrada Tardthong, Mr. Kengchakaj Kengkarnka, Mr. Sarunyu Kittiwattananont and Miss Supaksirim Wongsilp from an inspiration to create a kind of toy that can transform itself from a doll into another type of toy. its main objective is to raise children awareness and teach them about global warming through a biodegradable toy. After people had thrown away their used cotton textiles, a 100% natural material, the students collected the textiles as an essential material for making a weird creature doll. Several single dolls can be sewed together to become a sail of a boat and then the sail from several dolls can be combined with a boat to construct a one-seat sail boat used when the world is full of flood. The sustainable design in terms of prolonging the life cycle of the product and the material reuse were explored throughout the project. Although it is not a realistically commercial project as the instructors' first intention, yet the concept of sustainable design was well introduced to the students through their firsthand design experience. Even though, their design outcome is relatively conceptual, but the

students had well explored the concept of sustainable design and also creatively applied it to their design process and final design.



Figure 1: 'Monster Hero' as a single weird creature doll



Figure 2: 'Monster Hero' as a sail boat constructed from several weird creature dolls

SUSTAINABLE FOOD

The second studio project, which was entirely dedicated to sustainable design, was a design project in the fourth year studio course conducted in 2009, once a week for 15 weeks. The objective of this studio course was to introduce students to system design in the scope of social and cultural human

factors. The project started with giving students a design topic, 'sustainable food in Thai cultural context'. Then the students were provided with a two-day introductory workshop pertaining to sustainable food and videos of related cases. After that, a user-centred design approach was used throughout the project. Firstly, they were assigned to conduct related literature reviews and user studies. Secondly, they were asked to reconsider the existing local food culture and thirdly, design and develop a sustainable food system based on the three dimensions: environmental, economic as well as social and cultural aspects. The students participating in this studio were from the first semester of the fourth year. Therefore, they already had solid background in design. Some of the students had a prerequisite class and knowledge in sustainable design. Furthermore, they were mature enough to guide themselves with their relatively good design skills throughout the project without always relying upon approval of the instructors. As a result, the students had good knowledge and understanding of sustainability and were able to apply them to their design effectively. At the end of the course, several practical environmentally and culturally sustainable design systems such as street vendor, fast food, restaurant, delivery, religious community and takeaway were proposed with promising marketing plan.

'Fresh and Fast' by Miss Benjaphornwan Tang-Aree-Arun, Miss Kamonechonok Mitmoonpituk, Mr. Polkrit Rattanasirivilai, Miss Ployailin Meevassana and Mr. Panuwat Minchainant was a good example of the students' design outcomes. It is a system designed based on the current local Thai street food dining culture. Thai people tend to shop ready-made food which is relatively low priced and available everywhere especially at the nearby market in most of the neighbourhood. Unfortunately most of food comes with over packaging and mostly one-time use container and plastic bags. Because of the economic and accessibility of these plastic bag to the vendors; As a result, these convenient lifestyle and easy going fast paste dining habit has created tremendous environmental problems to all stakeholder involved. The students considered an alternative system design for a more sustainable street food system to promote

local market in the community as a food centre by applying well-management system. The main target group are new generation families who prefer to have meal at home but probably are unable to cook or unable to cook well because they are lack of cooking skills and time in preparing good home-cooked food, yet they still desire a good together family meal time. The service allows users to order their take-home food through phone or online service with their requested deliver time. Then the ordered food will be delivered by tricycle from the nearby market. Food will be packed in reusable containers or biodegradable containers, depends on user agreement (Figure 3 and 4). The proposed system design and service could help encouraging environmental sustainability in terms of reducing waste, fuel consumption and personal transportation while strengthen the local community to become more socially and economically sustainable.

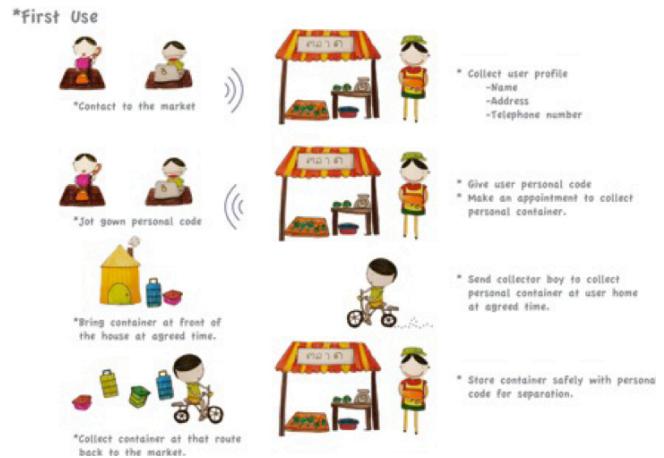


Figure 3: The first time usage scenario of 'Fresh and Fast' service



Figure 4: The second time usage scenario of 'Fresh and Fast' service

WASTE REDUCTION

The third studio project as part of the fourth year studio course in 2010. The objective and duration of the course were similar to that of the second studio. The course started with giving the students a topic, 'reducing waste in 4 different social contexts including inside schools, outside schools, office, and residential areas'. Then they were assigned to conduct related literature reviews and user studies. The students were also provided with field trips, introductory lectures and videos related to waste reduction cases. After that, a user-centred design approach and in-class consulting was used throughout the project. Same as the second studio project, the students in this course were from the first semester of the fourth year. Therefore, they had solid background and skills in design. Some of the students have a prerequisite knowledge in sustainable design. Moreover, they were mature enough to guide themselves throughout the project without always relying upon approval of the instructor with their gained knowledge and understanding of sustainability. As a result, various promising sustainable design solutions complementing with the user's social and cultural factors were proposed such as inside and outside school campaigns and activities, food container rental and washing service as well as waste management system for organisations.

'Like Dish' designed by Mr. Chaiyapat Intawong, Mr. Kanet Hunnok, Miss Panida Tanchareon and Miss Prangkaew Srikaew is a system design dealing with waste management base on the existing canteens,

food courts and street vendor in living area setting. Since many new generation habitants mostly have to depend on ready-made food from canteens, food courts or street vendors nearby their place most of the time, 'Like Dish' was designed to compromise between the user lifestyle and their social life as well as the economics survival of local street vendors while encouraging more environmentally sustainable through a new system, service and product. It is a business model for reducing waste from single-time used containers in living space by providing a food container rental and washing service for street vendors and their customers. The rental and washing station (Figure 5) was designed to provide the users with convenience while preserving the environment through container waste reduction, renewable energy use, water treatment and bio-waste composting (Figure 6). The users will be encouraged to use 'Like Dish' containers (Figure 7) through their environmental concern as well as the provided social networking activity. The system concept received positive results form street vendor and customer testing in terms of its practicality and desirability. As a result, the proposed system design had proved to help encouraging environmental sustainability in terms of reducing and managing waste as well as encouraging more social interaction in the community. Most of all, living space is a good incentive and can help elevating sustainable design to be more lucrative as a promising business model and also environmental friendly solution at the same time.



Figure 5: 'Like Dish' food container rental and washing station in a community context



Figure 6: Environmentally friendly systems embedded in 'Like Dish' food container rental and washing station



Figure 7: 'Like Dish' food containers

FINDINGS AND DISCUSSION

PROJECT-BASED LEARNING

The outcomes of the second and third case studies demonstrated a similar finding to the studies by Anderson and Hughes (2010), Lehtonen (2010) and Triggs (2010) that using sustainability as a topic of design project within a proper setting appeared to

enhance students' understanding of sustainability and application of sustainable design. 'Project-based' activities used in the second and third projects shifted the class dynamic from 'teaching' to 'learning' and encouraged the students to acquire knowledge from different sources independently, think critically, construct their understanding of sustainability as well as apply their knowledge and understanding into design practice with the assistance of instructors. As a result, the 'project-based' strategy of both projects could be considered as 'experiential learning' and 'enquiry learning' since it allowed the students to build up their knowledge and understanding of sustainability as well as sustainable design skills through their learning by doing experience.

KEY FACTORS INFLUENCING THE SUCCESS AND FAILURE

After comparing and analysing three case studies, it becomes clear that successful or failed learning outcomes - knowledge and understanding of sustainability as well as sustainable design outcomes - depended on the students and the input gained from the instructors and other sources (Figure 8). In view of that key factors influencing the learning outcomes included project topics, design briefs, teaching and learning methods as well as students' maturity, knowledge, experience and design skills per se. The results showed that to come up with promising sustainable design outcomes fulfilling the project requirement, the students were required to have a good knowledge and understanding of sustainability issues learnt during the project. The second and third groups of students exhibited their understanding of sustainability in their design outcomes - 'Fresh and Fast' and 'Like Dish' - by

PROJECT DURATION

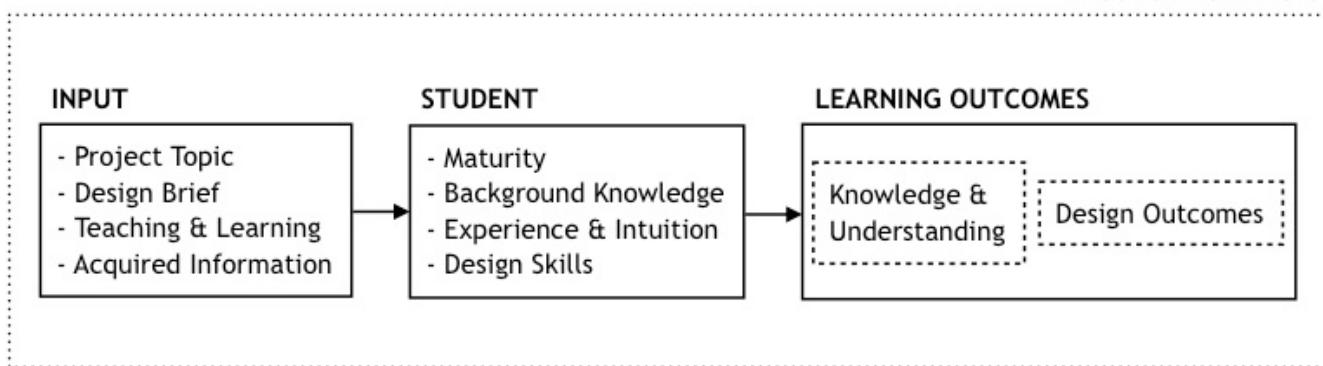


Figure 8: Diagram of learning mechanism and key factors influencing its success and failure

including all the principles of sustainability as the first priority of their design and then form, function and other design criteria while the first group of students failed to demonstrate their understanding of sustainability in their design outcomes, 'Monster Hero', which was crafted from a variety of leftover manufacturing materials provided and could be considered as a shallow design for not having any strong point in extending the toy's life.

Teaching and learning methods, role of instructors and students as well as project duration were key factors influencing the students' learning outcomes. In the first project, where students being completely provided with information by the instructors in a very short time, the students did not have enough time to process and analyse the provided data. As a result, they could not fully understand the sustainability issues and sustainable design approaches taught. In contrast, learning by doing of the second and third projects changed a role of students as a novice waiting for instructions to a self-learner with the assistance of the instructors.

Searching key information from different sources and getting hands-on experience from field research and design validation at their own pace allowed the students in both projects to gain holistic understanding of sustainability and its context, and that led them to find more creative and appropriate sustainable solutions concerning 'People', user needs and their social contexts; 'Planet', environment; as well as 'Profit', marketability.

Moreover, to incorporate sustainability into design studio courses successfully, besides, appropriate teaching and learning are required, topics and contents of the sustainability issues as well as scope and complexity of the project need to be consistent with the students' maturity, knowledge, experience, intuition and design skills. Unavoidably, the product life cycle stages - extraction, production, distribution, consumption and disposal - are complex and requires deep understanding to employ proper sustainable approaches ranging from material selection, production method, transportation, packaging, product's life and consumption to disposal in order to propose alternative design solutions that maximise a positive impact while minimise a

negative impact. According to the study, sustainability was a new issue for most of the second year students while many of the fourth year students were quite familiar with the issue and had prior reasonable knowledge on sustainability from their earlier attended courses. Consequently, 'Metabolic Toy' topic dealing with production, consumption and disposal of toys appeared to be too abstract and difficult for the second year students to relate the issues to their prior knowledge and experience and intuition. As a result, they struggled to come up with concrete ideas fulfilling the design brief. In contrast, 'waste reduction' and 'food consumption' were familiar topics to the fourth year students. The students could relate the topics to their knowledge, experience and intuition right from the beginning and were able to propose promising design outcomes. Evidently, for students who are unfamiliar with sustainability, a project topic related to the life cycle stages that are closer to their everyday experience such as consumption or disposal should be the main focus.

Designing sustainable food consumption and reducing waste in residential areas, the design briefs - scope, requirement and complexity - of the second and the third projects provided the students with an open-ended space to relate the topics to their prior knowledge, experience and intuition. Therefore, their design process was independently explorative and generated positive learning outcomes including good understanding of sustainability and promising sustainable design outcomes. On the contrary, the first design brief - designing a toy that grows with children by using toy manufacturing materials - was close-ended brief intended to provide the inexperienced students with knowledge of sustainability and sustainable design approaches in a short time. However, while specific design brief can quicken the research phase and reduce pressure within a tight and stressful academic timetable (Anderson & Hughes, 2010; Triggs, 2010), it can be a drawback by taking away benefits of self-learning (Triggs, 2010). Furthermore, the given design brief of the first project was rather too complex for the second year students to guide themselves based on their prior knowledge, experience and intuition. As a result, the students' design process was mostly

dependent on the instructors, they did not fully understand sustainability issues taught and failed to demonstrate their understanding of sustainability in their design outcomes. In other words, the learning outcomes could not be fulfilled successfully. In summary, as the younger students are inexperienced as well as lack of sustainability knowledge and design skills, a sustainable design brief should be kept simple and guide the students how to come up with sustainable design solutions. ‘Metabolic Toy’ project provided the students a clue by giving them specific sustainable design approaches to work with. However, the project requirement was considered to be too complex for the second year undergraduate students because the students were required to extend toy life cycle and at the same time reuse toy manufacturing waste. It would be more compatible with the students if the students were asked to come up with design solutions that either extend product life cycle or reuse manufacturing waste. On the contrary, for the older students, who have more experience, sustainability knowledge and design skills, sustainable design brief can be more open-ended to allow the students to learn and explore appropriate sustainable design solutions more independently in the light of their maturity, knowledge, experience, intuition and design skills.

CONCLUSION

The study results have demonstrated that within an appropriate setting, ‘project-based’ approach considered as ‘experiential learning’ can be beneficial for sustainability study in undergraduate industrial design education by allowing students to build up their knowledge and understanding of sustainability as well as sustainable design skills through their learning by doing experience. The lesson learned from this study could contribute strongly towards planning future design studio courses on sustainability and may also be relevant to other pedagogic approaches for sustainability education. The implication is that to achieve sustainability learning outcomes of design project-based learning, not only are the appropriate teaching and learning strategies required, but also the contents of the sustainability topic as well as the

scope and complexity of the project need to be consistent with the students. Otherwise, the learning outcomes could not be met. In other words, students’ proposed sustainable design solution will be rather conceptual, and sustainability will remain theoretical for students so that they will not be able to integrate sustainability into their professional practice.

REFERENCES

- Anderson E. and Hughes K. (2010) Mobilising the garden: An adaptable systems approach, *Sustainability in design now!: Challenges and opportunities for design research, education and practice in the XXI century*, Proceedings of the LeNS Conference, September 29-October 1, Bangalore, India, 1012-1020.
- Boks, C., Diehl, J. (2006) Integration of sustainability in regular courses: experiences in industrial design engineering, *Journal of Cleaner Production*. Vol. 14, 932-939. [Online]. Available: <http://www.sciencedirect.com> [Accessed 15 June 2010].
- Fletcher, K., Dewberry, E. (2002) Demi: a case study in design for sustainability, *International Journal of Sustainability in Higher Education*. Vol. 3, No. 1, 38-47. [Online]. Available: <http://www.emeraldinsight.com/1467-6370.htm> [Accessed 27 June 2010].
- Hamza, N. and Horne, M. (2007) ‘Educating the designer: an operational model for visualizing low energy architecture’, *Building and Environment*. vol. 42, pp. 3841-3847. [Online]. Available: <http://sciencedirect.com> [Accessed 15 June 2010].
- Lehtonen, D. (2010) Sustainability eduction for design students: A lesson in teaching and learning strategies, *Sustainability in design now!: Challenges and opportunities for design research, education and practice in the XXI century*, Proceedings of the LeNS Conference, September 29-October 1, Bangalore, India, 1641-1648.
- Papanek, V. (1984) *Design for the real world*. New York: Academy Chicago Publishers.
- Ramirez, M. (2006) Sustainability in the education of industrial designers: the case for Australia, *International Journal of Sustainability in Higher Education*. Vol. 7, No. 2, 189-202. [Online]. Available: <http://www.emeraldinsight.com/1467-6370.htm> [Accessed 27 June 2010].
- Triggs R. (2010) Creating a shared mental space for sustainability awareness on university campus: Design student projects in sustainability awareness in the age of iPhone and social media at the University of Texas at Austin, *Sustainability in design now!: Challenges and opportunities for design research, education and practice in the XXI century*, Proceedings of the LeNS Conference, September 29-October 1, Bangalore, India, 897-905.
- UNESCO (2002) Teaching and learning for sustainable future: A multimedia teacher education programme. [Online]. Available: <http://www.unesco.org/education/tlsf/> [Accessed 12 May 2011].
- Vezzoli, C. (2003) A new generation of designers: perspectives for education and training in the field of sustainable design: experiences and projects at the Politecnico di Milano University, *Journal of Cleaner Production*. Vol. 11, 1-9. [Online]. Available: <http://www.sciencedirect.com> [Accessed 15 June 2010].
- Wankhade, K. and Balakrishnan, K. (2010) Sustainable settlements design: Innovation in curriculum, *Sustainability in design now!: Challenges and opportunities for design research, education and practice in the XXI century*, Proceedings of the LeNS Conference, September 29-October 1, Bangalore, India, 832-839.