PROJECT REMA: THE REGIONAL ECO-MATERIALS ARCHIVE

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ABSTRACT

This paper argues the emerging needs of incorporating regional eco-material archive in design education from the perspective of the constructivist point of view and active learning approaches. It is a critical reflection on the pedagogical development on sustainable product design education in School of Design, The Hong Kong Polytechnic University since the 90's. Action research method is carried out into the longitudinal reflective study in which the continuous refinement of the educational approaches will be reviewed with the illustration of different types of cases and initiatives of the teaching activities. The summary includes the recommendations of a framework to support active learning with physical eco-materials archive and cases to enable the design exploration about the cycle of local resources, local production, local consumption, and local recycling.

Key Words: Regional Eco-materials Archive, Active Learning, Material-driven Approach

1. INTRODUCTION

Design studio training, design thinking methods, and tools within the conventional pedagogy are not capable enough to facilitate the exploration of a creative and viable sustainable product design solution. We have explored various pedagogical strategies in environmental consciousness design (Leong & Manzini, 2006) into the curriculum of design school for almost three decades ago. Sharing the same vision of other design schools, upcycling design, product and service system approach, and design for behavioural change are also the meaningful attempts that we find it relevant. (Leong, 2002; Leong & Lee, 2014). In the last couple of years, we further push forward the momentum of the development of a sustainable society through exploring the people-centric design, participatory design, revitalization of local assets, and social innovation (Lee, 2008; Leong & Lee, 2011; Turner, 2013). Unfortunately, experienced design educators are not satisfied with those approaches because of the limited teaching resources such as the limited subject's credits and contact hours with students. In particular, we identified that lacking the understanding on diversified people's consumption behaviour, material cultural background, and the knowledge in material properties and environmental impacts as well as choices of applicable eco-materials in our city or region may hinder the development of real impactful projects. Thus, we carried out a few unique educational and research initiatives to address those enquiries (Leong & Lee, 2016).

In the discussion of facilitating active or self-directed learning for the sustainable design education, we realized that the ordinary student project in sustainable design in one semester term (around thirteen to fourteen classes within three months) usually encounters learning difficulties in the activities of (i) identifying substantial local upcycled resources with proper categorization to address life cycle and material's properties, (ii) understanding the mechanical and emotional qualities of eco-materials exploratively and systematically, (iii) prototyping innovative concepts with eco-materials scientifically, (iv) implementing sustainable service model to facilitate participatory design and service addressing the four Ls (local resource, local production, local consumption and local recycling), and (v) critically evaluating the solutions and making modification. In particular, the tacit knowledge (the know-how and hands-on experience) acquired by the students cannot be transferred and further developed effectively in next year. Adopting previous learning experience in other design projects cannot be ensured. One of the reason is that a design project is unique and situated in different contexts. In most cases, students start over the above learning processes from scratch, uncertainties or the limited and unstructured previous works. Continuous knowledge building (student-wise and school-wise) is one of our goals.

The conventional teaching platform for sustainable product design is facilitated by three learning components (as stated in figure 3), including (a) the scenarios of real design practice, (b) the hands-on prototyping experience, (c) the coded knowledge resources/ archive. For instance, upcycling is one of the popular teaching approaches. As mentioned earlier, we cannot ensure the effective active learning and knowledge internalization of the students as the knowledge construction or transfer (including commercialisation) cannot be sustained. This paper will describe our reflective analysis of our actions in design education and research (Swann, 2002) to approaching the continuous improvement of the sustainable product design education in our school. The next sessions of the paper will elaborate our proposal of a 'knowhow' resources archive which is expected to bridge the coded knowledge (e.g. theories on sustainability), hands-on experience training about tacit know-how, and the experimental material-driven practices in real-world settings.

2. THE NEEDS OF PEDAGOGICAL REFINEMENT

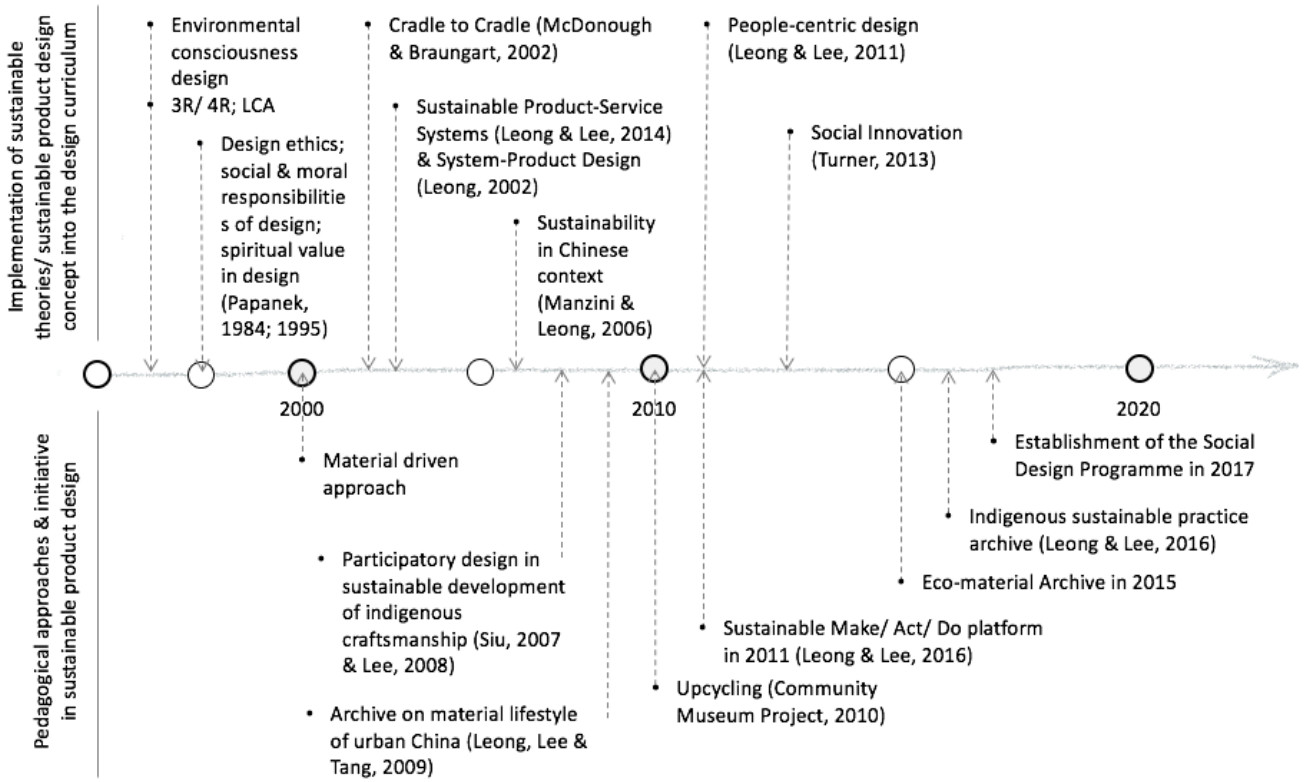
We commenced on building the local material archive to support student's learning from 2000 to 2010. Afterward, we covered both consumer practices and physical materials for the inspiration of sustainable production. The Sustainable Make, Act, Do (SMAD) platform1 is an online platform that we launched in 2011. This online platform aligns the current favourable blended learning called flipped (or inverted) classroom approach (Strayer, 2012) on the demand to promote active learning in the university. SMAD showcases an open source research platform through co-creating the archive on the indigenous environmental problems and sustainable practices in different cities in China. It can inspire the students the awareness and reflection of specific sustainable related practices of different people and cultural background.

In the review of school-led community projects on the promotion of design for sustainability, projects initiated by NGOs and local designers, there is a need to bridge the learning gap between the design process and material science. Regional (or local) materials and samples can support and inform the student's curiosity, appreciation as well as creative confidence in the design process. It is a good foundation for undergraduate design training. Thus, our team conducted a case study called Regional Eco-materials Archive (REMA) on identifying and mapping the existing eco-materials in Hong Kong and Pearl River Delta area in 2013 to 2015. The collections of eco-materials with the assessment factors to indicate the carbon footprint (material's sources and location of production), renewability, and recyclability are showcased. We proposed an integrated labelling system to facilitate easy and quick understanding of the eco-material's properties and the impact on carbon footprint. The label system is used to code the collected eco-material, and a handbook on defining eco-materials are prepared as an educational tool to support teaching.

[1] *Website of SMAD- www.sd.polyu.edu.hk/sldi/*

Almost within the same period, our school establishes the Material Resources Centre (MRC) since the end of 2014 to enable students and researchers who can get in touch with innovative physical materials. The centre showcases more than 1,000 material samples collected by a global materials consultancy with the world's most extensive library of innovative materials and processing methods. The samples cover fabrics, upholstery, furniture and construction materials for the interior, product, and industrial design, and other materials related to communication, digital media and interaction design as well. Nearly all samples are acquired from overseas such as America and Europe. The collection only includes a small portion of eco-materials, and there is no local sample. Thus, we expanded the REMA to around sixty samples and displayed all samples in MRC since 2015. In the last couple of years, there are more local design firms and design graduates develop the small start-up businesses based on the exploration of new eco-materials which sheds light to new possibilities and feasible solutions. It is important to note that there are not many cases can meet all the criteria of our proposed eco-materials criteria as indicated on the label. Surprisingly, more students and practitioners go to visit the MRC and review the material's samples.

To conclude the pedagogical development of product design discipline in School of Design, The Hong Kong Polytechnic University (HKPolyU) in the past two decades, we recalled and illustrated the major theories and concepts being incorporated to facilitate sustainable product design education (Figure 1). The below diagram indicates that we spent more than fifteen years on developing and articulating the material-driven approach in product design education.



[Figure 1] Timeline on the implementation of theories and concepts for pedagogical development in sustainable product design in the product design discipline of School of Design, The Hong Kong Polytechnic University

3. ACTIVE LEARNING THROUGH MATERIAL-DRIVEN APPROACH

Curriculum design never meets the latest, complex, and fast-changing scenarios. In HKPolyU, the development of active learning platforms such as massive open online courses (MOOCs), small private online courses (SPOCs), and flipped classroom is the emerging pedagogical direction in the coming years. Though active learning is essential to the quality of education, we have a reservation to the support of merely the intangible (online) interaction and resources.

In the movement of designing for social and moral responsibilities (Papanek, 1995), design educators and designers asked about the 'what if' the creative 'form-giving' may scrutinize the appropriateness in the process of sustainable production and consumption. The teaching team in School of Design, for instance, Philine Bracht and Benny Leong, had incorporated material-driven approach as a teaching method to promote understanding and appreciation of material's properties, and identification and exploration of potential product concept out of the characteristics (essence) of the materials in the middle of 1990's. One of the attempts was framed in a theme called 'design alchemy' in which the students explored and transformed the urban waste. The essence refers to the advocation of forging the spiritual value of a designed object. This inspiration, as argued by Victor Papanek (1995, p.53), remains valid nowadays that yielding spiritual value in an artefact is both the intention of designer and user.

The material-driven approach is not a new practice. In the review of the approach in design arena, it embraces different dimensions of designer's intention. First, there was emphasis on the expressive or sensory identity of materials such as the exploration during the Italian design movement in 1970s (Ferrara & Lucibello, 2012). Second, the Material Driven Design method proposed by Karana et al. (2015) aims to facilitate designers to explore materials in the perspective of user experience. Third, there is an approach to materials and fabrication processes that focusing local and cultural resources (Souza et al., 2017). We identified that the material-driven approach receives constructive and stable quality assurance from both teachers and students. It is usually being implemented into project-based learning subjects. We had explored teaching instructions with minor changes. Throughout years of iterative modifications, there are two different instructions at the beginning of the project. Approach one is to limit the choice of reusable material such as all students explore PET water bottles as the key material for further study. The tutor can plan the preparation of lecture notes (e.g. specific theories and cases on PET or synthetic materials) and uses of equipment. Approach two is to encourage the students to search and explore reusable materials in the city. This approach usually more time consuming however some students may identify meaningful resources.

4. THE ARCHIVE TO SUSTAIN THE INTELLECTUAL OUTPUTS

We have collected eco-material samples for years. In early 2013, they received a teaching grant to build the Regional Eco-materials Archive (REMA) (figure 2) and improve two major learning problems identified in teaching activities. The students are expected to focus on learning identification of problems and solutions, and integration and justification for proposal formulation. In practice, there is limited information about local and regional resources of eco-materials and real design exemplars in particular the lack of physical samples and real cases in Hong Kong and Pearl River Delta area which the scanty first-hand learning experience weakens student's learning actively. Students rely on online resources and books to understand the eco-materials. REMA is a source of inspiration rather than a source of reassurance (e.g. technical knowledge on lifecycle analysis). It aims to inspire designers who can actively and painlessly to i) acquire visual and tactile experience on the tangible materials which provides physical and aesthetical properties; ii) understand basic characteristics of sustainable materials with lower hurdle on professional knowledge of material science through referring to the label system on the material board; iii) appreciate the source, production and consumption of materials simply through the perspective of the transportation distance of the materials that induce emission of carbon footprint; iv) recognise the types, chemical properties, and general sustainable characteristics (recyclable, reusable, …) of the materials quickly; v) co-create the regional eco-materials archive and share the exploration with other stakeholders. In short, the archive is expected to enhance the prototyping process of the designer and to co-construct the learning experience with others.

[Figure 2] The image at left showcases part of the Regional Eco-materials Archive displaying at Material Resources Centre in School of Design, The Hong Kong Polytechnic University[2]; the image at right shows the samples done by a team of product design students and the label system showing the material's characteristics.

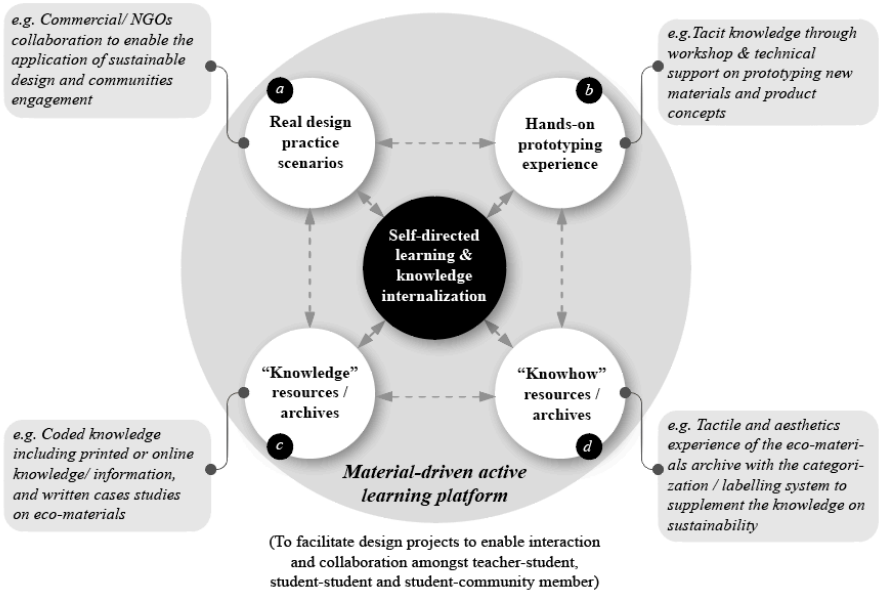
5. CONCLUSION

In terms of Piaget's constructivist learning, the material-driven approach in education is essential to the learning and prototyping such as the discussion in the maker movement (Halverson & Sheridan, 2014). REMA is a "knowhow" resources/ archives (area 'd' at below) to support student's learning at the subject level, programme level, and even cross-disciplinary collaboration.

As indicated above (figure 3), REMA can supplement the other three sources of knowing/ learning experience (indicated in areas a, b & c). We concluded with illustrating this material-driven active learning platform/ model to suggest the way to facilitating the holistic active learning. The eco-materials archive provides two dimensions of experience. The physical experience enables the students to understand the mechanical properties of the materials through tactile interaction. Through visual and tactile (texture) interaction, this mental understanding can inform

[2] The website describes the project REMA- http://www.polyu.edu.hk/greencampus/GreenNet/issue/6/.

and enhance the appreciation of the aesthetic qualities of the elements. Besides, it is also effective to encourage the students to explore their unique materials with the application of the visual driven labelling system. On the other hand, this co-created archive can contribute to active learning, ownership, updating and sustaining the archive continuously. As an open learning resource, it also enables collaborative learning out of the classroom and solving



[Figure 3] Material-driven active learning and knowledge construction platform for product design training

problems to address the local system. The major limitation of the REMA is the difficulty in investigating the exact origins of materials (in particular multiple compounds), proportion of different elements, any catalysts being used, and energy consumption efficiency in the production process, etc. Not all producers of the materials can distinguish or expose all information to us. In the perspective of providing an overall picture and concern of sustainable materials with less environmental impact, the current archive can satisfy the needs of the early phase of design practice. In the long run, we anticipate that different regions or cities can build their REMA which can share and benefit both the local design practitioners and overseas partners to adopt the regional eco-materials to deliver local resources for local production.

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