Plasticity Imaginaries as Sustainable Design Pedagogy

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Abstract: The sustainable approach in design education is ubiquitous, yet too many barriers exist to its application in the real world. Plastic waste, for example, has been a potential architectural building element for years. Still, its application is uncommon because of the gap between waste processing and consumers' demand and knowledge as the main contributors to the waste volume. The paper aims to discuss the possibility of design class pedagogy with the reflection from the class " Architecture and Waste: Plastic by UMN." How the sustainable approach could affect students towards the actual act daily became the intention of the course? The method uses a practiced-based methodology by dividing the class into two balance sessions of theory and practice, thus creating loops of the design process. They were ignited by the discussion on sustainable design approaches in design, architecture and construction, and plastic waste, both potential and problems, and projecting the issue into everyday life. Plastic is used due to its abundance and can be recycled in small units. The result shows that focusing on the process and relating what the class and workshop are doing to everyday life could effectively impact students' thinking about sustainability. Furthermore, by doing deep research on certain materials, the student has a broader illustration of how the networks of sustainability work that will affect more significant decision-making, especially in architecture.

Keywords: Plastic waste, Design pedagogy, Sustainable design, Recycle, Material.

Introduction

Plastics are the silent terror of today's society. We meet them in everyday life and expect them to be harmless things because they can be found in almost all products, such as mineral water, technologies, food containers, and the packaging of daily supplies. The exponential production and consumption of plastic nowadays are caused mainly by human lifestyle and broadly normalized by industry and retail.

Some countries developed regulations and facilities for plastic waste, yet some other efforts left many problems. For example, the Indian government forbids 19 single-use plastic items, Austria also limits their plastic consumption by targeting to reuse 25% of plastic waste, while Portugal sets a 30% by 2030 goal (Redjo, 2022). On the other hand, several developed countries want to reduce their plastic waste but fail to reach the reuse percentage, so they are exporting it to other countries, especially those in the Global South (Papanek, 2021).

Indonesia is known as the second biggest plastic waste producer after China. This country produces around 7,8 million tons of plastic waste annually (World Bank, 2021). The dependence on plastic bottled mineral drinks instead of tap water in everyday life is one main factor that increases the abundance of plastic waste (Data Tempo, 2022). It is worsened because only a few of the plastic waste can be recycled; the rest end up in garbage piles or incinerators, also being pollutants on earth. Over half of the total number, around 4.9 million, is mishandled. Another worrying fact is that Indonesia has become the world's most prominent plastic waste importer (Redjo, 2022). In 2020 around 138 tons of plastic waste came from several countries (Figure 1). Plastics are taken for granted, yet the public must inevitably deal with material afterlife problems. The user is close to the material but distanced from the waste's final destination (Parker, 2021; OECD.org, 2022).

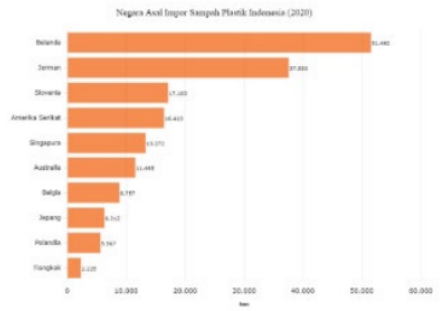

Figure 1: *Plastic Waste Exporter to Indonesia. Source: Redjo, 2022.*

Since the industrial revolution, plastic has become a significant material of designed objects and has impacted living standards through mass production. It is generally divided into seven types, PP, PET, PS, HDPE, LDPE, PVC, and others, making it more complicated to manage (Calkins, 2009). Plastic is known for its effectiveness in daily activities such as packaging, food, chemical storage, animal husbandry, and especially medical needs. It results in its volume being uncontrollable since they need between two hundred to four hundred years to degrade (Papanek, 2021).

Manufacturers' desires and customers' expectations for the design are central in waste production since all waste produced results from outdated and unintelligent design (Braungart & McDonough, 2009). Not only the final result but even between the process of the artifact of the design manufacturer also, a process that might harm our ecology (Papanek, 2021). Furthermore, Braungart & McDonough (2009) stated that such artifacts not considered ecology are called crude products. The gap between materials and waste opens up the potential of critical design pedagogy through reflective-practice methods. The design can reverse its current practice by critically reflecting upon its method. Specifically, design pedagogy focuses on the process rather than the final product.

This paper aims to explain and discuss the process and the result from the course "Architecture and Waste: Plastic" by the Department of Architecture of the University of Multimedia Nusantara in 2022. The class intends to focus on something other than the result of the final product but on how the method might affect students in everyday life towards plastic waste. The class used the methodology of the sustainable design approach, which is based on ecology, by igniting the design inquiry, understanding plastic waste, and architectural contribution. It is divided into two main activities: the class and the workshop as a practice-based methodology class. Therefore, students not only know the theory but also understand the one real experience of dealing with waste recycling as an architectural product.

1.1 Design Matters

Design thinking has been expanded in our everyday life, as it is applied in many disciplines, such as education, business, politics, and economy, on a planetary scale. Design accommodates our future projection by reflecting on its possibility and creating new artifacts as its reflections which clearly shows our interdependency on it (Colomina & Wigley, 2016). Design continuously produces artifacts as the human desire to create and build something new is unstoppable. The paradigm shift in design practice is inevitably needed to

make designers more conscious of the process instead of orienting to the end product, which produces more wasted artifacts.

The impact of design should be understood as part of a more extensive system, not only limited to practical, profitable, efficient, and linear, as our current industry, designers, and engineers did (Braungart & McDonough, 2009). Instead, it potentially affects ecology through six cycles, including the choice of materials, the manufacturing processes, packaging, the finished product, transporting the product, and waste (Papanek, 2021). In many cases, the artifacts of undegradable design artifact filled our surrounding landfills since it is excluded from the conventional logic of design production. The accumulation of design artifacts becomes "anthropogenic mass," which is believed to surpass biological mass in 2020, showing the occupation of the natural world (Elhacam et al., 2020) (see Figure 2).

1.2 Designing Waste Pedagogy

The nature of design activities, from education to professional level, intertwined between problem-seeking and problem-solving processes (Nigel Cross, 2006). However, over decades, design practices have become more driven by the seek of progressivity, such as innovation of form findings, construction techniques, or materials, instead of re-use, modification, or transformation (Stockhammer, 2020; Waite, 2022). Meanwhile, the ability of design to inquire into the problem through practice enables the designers to question the impact of the design process itself, exemplified by some questions about the consequences of design on the surrounding ecology. The consciousness of the design process might lead the designers to investigate each consequence of their decision, including material choices, the footprints, and how to manage the wasted artifact of their design.

The term reuse waste is ubiquitous today, making industries and customers feel good for the environment due to 'minimizing' the volume of waste. In reality, they are transferred to another place (Braungart & McDonough, 2009). Recycling, on the other hand, is problematic. Most recycling is downcycling, reducing the quality of the material compared to its virgin material. Hild (Koralek et al., 2020) wrote between downcycling, which shows the inferior option, and upcycling, which is energy dependent; therefore, questioning the significance of upcycling is also considered, especially for artifact makers.

Architecture and construction play a significant role in anthropogenic mass, contributing 40% of the world's total carbon emission, with 11% being the carbon oxide from manufactured material (IEA, 2019). Concrete is an enormous mass after water and rapidly increases within decades, followed by other construction materials such as aggregates and bricks. However, many precedents intended to minimize the usage of such materials. For instance, Diener (Koralek et al., 2020) discussed the Garbage housing by Martin Paley in 1975 to Entrance Hall of the 'Italia' by Alejandro Aravena at Venice Biennale 2016.

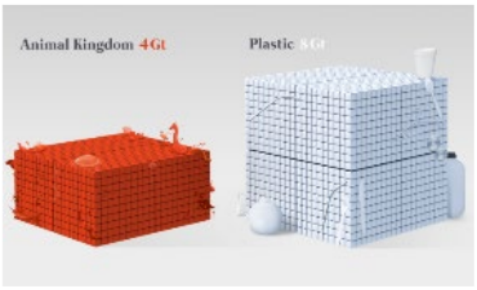

Figure 2: *Comparation between mass of animal kingdom and plastic. Source: (Venditti Graphics/Design:, Visualizing the accumulation of human-made mass on Earth 2022)*

Nevertheless, Diener (Koralek et al., 2020) stated that the motive behind recycling and reuse in the exemplary case studies is fear rather than ecological based. We could also see it in Braungart & McDonough's Cradle to Cradle: Remaking the way we make things (2009), which also started with fear in the first chapter. These depict "fear" could be the starting point of awareness. However, understanding the ecological condition is even more critical by expanding the plasticity of design methods as pedagogy over thousands of possibilities.

In Building From Waste, Hebel et al. (2014) portrayed waste as the possibility of building materials such as agricultural waste, paper, aluminum, and especially plastic waste. Together with ETH Zurich, Hebel et al. (2014) created courses to develop and document the exemplars of how the waste can be processed as ongoing prototypes by using methods starting from sorting and categorizing waste based on the type of process, which are densified, reconfigured, transformed, designed, cultivated. Then the inventory shows prototypes as potential development in the future (Figure 3). Using specific projects (for example, plastic) would make teaching environmental thinking easier (Taylor, cited from Waite, 2022). Taylor stated that teaching environmental thinking is problematic if the object is abstract. Precisely what most design schools do by distinguishing the environmental theory or thinking from design. Furthermore, having both research and practice would create a reflective attitude for both the students and architectural community as critical evaluation (Wyckmans, 2008; Schiano-Phan et al., 2022).

2. Methodology and Data

The method uses practice-based workshops, combining problem-seeking and inquiry by design research (Nigel Cross, 2006; John Zeisel, 2006). Using practice as research, the student could critically reflect on their environment-behavior relation, including every step of the design process, and change the habit of waste production and design paradigms. Creating a loop of practice based on reflection, acting, and thinking would focus on the critical content of the work (Lucas, 2016) and create comprehensive practical activities.

The approach is divided into:

1. Intervention and provocation

Testing the development of material (plastic) by using ecology as a background

2. Experimentation

It also records the process of success and failure of the making.

The application of sustainable thinking throughout the class is divided into four main activities, which are background and intention, collect and sorting of waste, loop of research - design - making, reflection, thus creating a loop of practice and research. The method also mixed between individual and group works.

Figure 3: *Airless: plastic waste prototype by ETH Zurich. Source: (Hebel et al., 2014)*

Figure 4: *Sorting and analyzing plastic waste*
Source: (Documentation of student: Fathihah Az-Zahra, 2022)

2.1 Background and intention

class is designed by first telling the class's urgency and intention by showing humans' impact on ecology, architecture and construction activities, and plastic waste. Therefore, students can critically question their role as humans, students, and future designers or architects. The first class is opened by questioning the impact of the design, an explanation of the urgency of the class of awareness towards ecology, especially plastic waste, and the possibility of plastic as a building material. To have the same perspectives, the student must read and discuss Braungart & McDonough's Cradle to Cradle: Remaking the way we make things (2009) and creating a mind map.

2.2 Collect and sorting

Due to plastic abundance in the city, being used and produced daily starting on the individual scale, urban plastic mining is possible as a primary material to be developed. Try to see the waste journey comprehensively against the modern waste system by collecting, cleaning, and sorting plastic waste. Which later on will be analyzed further. This process should show facts on student consumption patterns and reflect on its alternatives.

2.3 Loop of research-design-making

This stage is conducted as a workshop based both in class and workshop. The class is divided into groups of seven categories of waste. Therefore, each individual will exchange plastic waste based on the selected categories. Sampling data: An example of the process by one group of students who handles LDPE waste and turns it into a prototype called Bubble Block.

2.3.1 Material sorting based on plastic type

One of the core activities in this class is the collecting phase. The student must collect all the plastic waste produced from their daily consumption. This activity is used for the technical goal of collecting the primary material and for the self-education process. By the time the collecting phase ends, the student can reflect on how significant and massive the number of products made by plastic is around them in everyday life. Besides, they also see that it transforms into many kinds of product types, not only a single product but many different products. In this phase, they also have to choose one plastic shape product after getting one of the seven types of plastic (Figure 5). For example, the LDPE group (plastic number 4) chooses bubble wrap products while sorting them later from the whole classroom plastic waste production. The reason for the chosen product has to be followed by an analysis of the material's volume and potential recycling aspect.

One of the LDPE groups chose bubble wrap, while the other chose plastic bag waste. The option for bubble wrap is rising because of a specific issue. Based on Statista (Published by Hanadian Nurhayati-Wolff & 20, 2020), The number of online shoppers in Indonesia is projected to grow from 20 million in 2017 to 65 million in 2022. With a total population of over 265 million, Indonesia is one of the world's largest online markets. One of the biggest problems is the waste from product wrapping. Plastic bubbles are used mainly to secure the goods or products in shipping. Sometimes it was overused since the seller wanted to avoid gambling with the risk of damaging the product. Other more sustainable options are pricey and take more time to prepare the package. These reasons make bubble wrap plastic popular to be used. Plastic bubble wrap is categorized as LDPE. With this background story, the group chose bubble wrap as their primary LDPE material and started collecting plastic waste. All the materials of the designed product will mainly use bubble wrap as the base. However, small numbers of LDPE from plastic bags waste only for giving variation and aesthetic pattern to the primary material.

2.3.2 Material research based on selected plastic type

There is a whole semester of exploration and research, which are divided into two. The 1st half-semester is used for collecting plastic waste while searching for secondary data research from literature and journals about the type of plastic and their characteristics. With that data, they have to design a draft, choose the products, and make the initial design based on the research (Figure 6).

All the group starts research to understand the material wholly. From the research, they will gain some essential data that can be used for making initial architectural element design. For example, sampling one of the groups that have researched LDPE finds that LDPE has the simplest chemical structure, making it the easiest and cheapest one to be recycled. LDPE is also categorized as plastic-type four, indicating that it can be used several times. LDPE is one of the polymers with a cradle-to-cradle cycle; it can be recycled many times and has the same quality as plastic. From the chemical characteristic, LDPE is categorized as thermoplastic that can be soft when heated and hard when cold. This character makes it easy to be formed and process. Besides, LDPE is also

Figure 5: *Example of plastic waste sorting from daily consumption of the student. Source: Documentation of student: Fathihah Az-Zahra, 2022*

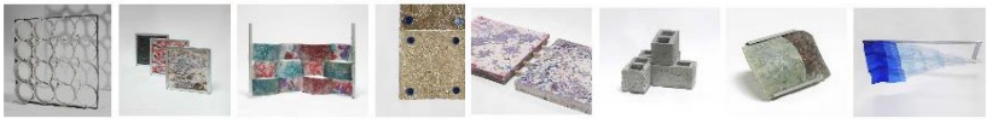

Figure 6: *Prototype examples based on plastic categories. Source: (Author, based on student's work, 2022)*

waterproof, damp proof, and has impact and chemical resistance. LDPE is also flexible and open to many explorations of design. The characteristic of LDPE that can be found explicitly in bubble wrap materials is its unique texture and heat durability, and it is more rigid than other types of LDPE. This characteristic is the potential as an architectural element (Figure 7).

2.3.3 Product development and method

The student can start designing the architectural element from the literature study based on the initial data from the previous research. In this phase, they must be critical to match the potential value of the particular type of plastic waste and the requirement of the architectural element they want to design. The student must also write down the production process steps to create the final prototype. In this production process, they need to calculate the prediction of material volume, time of the prototyping production, the tools used, and how to install the final product in the building (Figure 7).

2.3.4 Product making

The second half of the semester is the making process of the initial design. In this process, much trial and error happen. Some groups have changed the initial product they first intended to make. The other changes are the design of the products, whether the shape, the dimensions, the arrangement, or the way it will be installed in the building. This result happened because, after the student hands on the plastic materials, there are a lot of unpredict factors rising, e.g.:

1. The characteristics of the plastic waste material itself probably have a gap with the current research that has already been done.
2. The process or the method is still based on trial and error. It depends on the data of the chemical ingredients and how toxic they will be.
3. Limited access to the workshop equipment and the technology for processing the materials (Figure 7).

In this phase, the student has to make an independent decision after trying several methods to process the plastic waste, which one

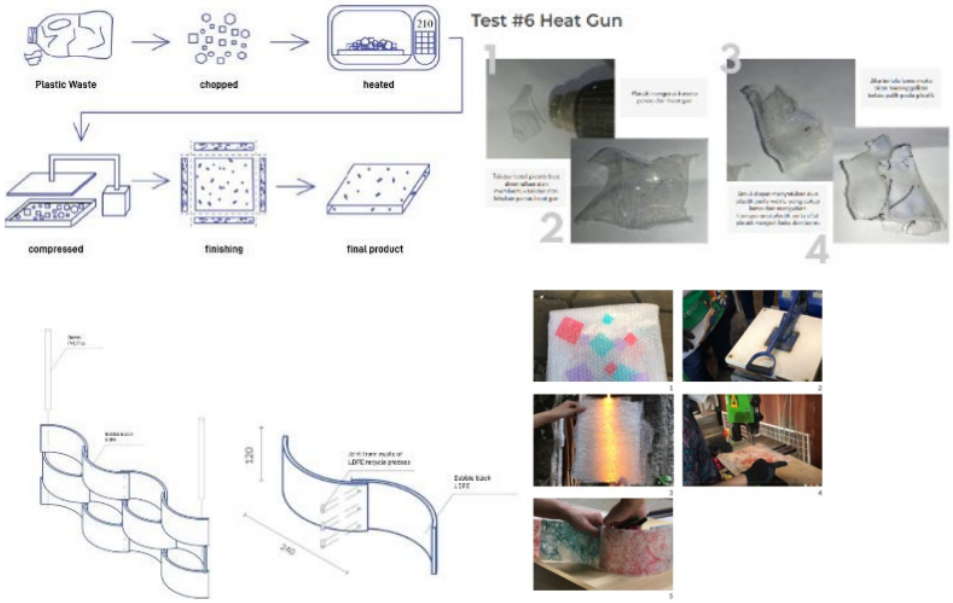

Figure 7: *Processing diagram from literature study, experimentation example using heat gun on the materials, Sketch of the process and product development, and prototyping design. Source: (Documentation of student: PP, PET and LDPE Group, 2022)*

is the most suitable depending on work time, the energy used for the processing, the characteristics of materials before and after the recycling process, the self-observation of the changing form. For example, The LDPE group chose the press methods with a temperature of around 195oC. This decision is coming after trying several times with documentation of data; The data consist of how many layers of the bubble wrap and how long it takes for the pressing time and temperature to have a particular texture that has both durability quality and visual quality, which meets the expectation of the architecture element products, in this case, is Bubble- Block room separator (Figure 7).

The making process is when the student can reflect on the long process of processing plastic waste. Is the amount of time and energy (electricity and human resources) worth the product? Which one is better, reducing the use of plastic or recycling it? Is the process of recycling plastic also considered sustainable and safe?

2.4 Reflection

At the end of the class, students reflect on their process of recycling plastic waste and the final product in the report. Afterward, this reflection was exposed to the public to create another discussion since the method used in the class is something the public can do. Also, the public has a significant impact on plastic waste daily. An exhibition and crits, therefore, became the end of the class. The student arranged and curated the exhibition. Interviews were also conducted with some students as samples to give a review and further elaboration on the class and how it affects their daily lives (Table 1).

The exhibition is titled "Rethinking the way we use things" in the university's main lobby for a month, from 10 June to 10 July 2022 (Figure 8). Based on students' curatorial notes, this exhibition intends to explore public addiction to plastic, also questioning both impacts on ecology. Besides exhibiting the exploration of plastic waste as the result of the "Architecture and Waste: Plastic" class, this exhibition also became an auto critic of plastic consumption on a massive scale and students' perception of daily waste management. Understanding the

Figure 8: *Crits during the Exhibition by student. Source: (Author, 2022)*

Table 1: *Overview Impact of The Class Methodology on Student Everyday Life. Source: (Author, 2022)*

	Sorting plastic waste experience in the past	**The impact after try to sorting waste**	**The continuity of the class on daily life on plastic waste**	**The last time consumed single-use plastic**
Student 1	Always sorting waste (plastic, cardboard, etc) due to part of waste bank in the neighborhood Table content	Understand the type of plastic	Ended choosing product with PP material since it is the chosen material for the group experiment	Last night, water bottle
		Understand the method of plastic recycling	Not for the time being. It is hard to reduce plastic waste due to dependency on food delivery and living in student dorm	
Student 2	Never (only during the class)	Understand the type of plastic	More aware of the impact of plastic by minimize the usage of plastic 1. Daily shopping with only one big plastic than many (reduce) 2. Avoid product with plastic packaging (drinks, etc) 3. Brings multiple use water bottle everywhere 4. Bring water from home or refill station	-
		Understand the output of plastic recycling		
Student 3	Never (only during the class)	Fact of household plastic waste is too much than what is expected	Have intention to sorting plastic waste in the future	-
			Reuse microwaveable plastic packaging	
			Shift from food delivery (single-use plastic) into catering with its own container	
Student 4	Yes, several times. Only collecting	Understand the process of plastic recycling	Shift from single-use water bottle into multiple use water bottle	-
Student 5	Never (only during the class)	Understand the type of plastic	Shift from single-use water bottle into multiple use water bottle	-
			using tote bag / paper bag while shopping (current condition rely on single-use water bottle, food delivery and online shopping)	
Student 6	Never (only during the class). Yet already aware by minimizing single-use plastic, no longer using straw or single-use plastic.	Understand the type of plastic	Being more consistent on minimizing single-use plastic waste. 1. Bring water bottle and food container 2. Not using plastic straw	-
		Understand the process of plastic recycling	Sorting plastic waste based on their type	
		Understand the output of plastic recycling		
Student 7	Yes, especially the type needed for the assignment	Supposedly becoming self-awareness and responsibility to minimize plastic waste	Chose tote bag vs plastic bag, especially offer in commercial area	-
			Try to minimize plastic waste by re-use plastic waste such as food container	
Student 8	Never (only during the class)	Understand high volume of household plastic waste	On using online service try to minimize plastic packaging	Yesterday, online package
		Online service had more plastic waste than cooking	Prefer to do more self-cooking rather to rely on online service or food delivery	
			Shift from plastic bag to fabric-based shopping bag	
Student 9	Never (only during the class)	Fact that plastic bag is the most abundance type of plastic	Shift from plastic bag to fabric-based shopping bag	Yesterday, food delivery
Student 10	Never (only during the class)	Understand high volume of household plastic waste	Shift from plastic bag to fabric-based shopping bag	
		Understand the inconsistency of processing waste	Shift from single-use water bottle into multiple use water bottle	
		HDPE and PET are the most collected materials		
Student 11	Yes, based on household culture especially PET due to lifestyle	Understand the types of plastic	Shift from rely on single-use plastic bottles into drinking gallon and multiple use water bottle	-
		Understand the method of plastic recycling		

complex and energy-intensive process of waste recycling, in this exhibition, the students ask the audience to rethink the way we use things that should contribute to waste reduction.

3.Results and Discussions

3.1 Process

During the class and workshops, we slowly banned producing plastic waste. Thus, resulting in alternative acts on students upon food or

drink as their majority plastic waste consumption. For example, one of the groups brought a gallon of water. This alternative thinking is needed to break out from the current consumptive lifestyle. Furthermore, on the waste collecting and sorting, the student started criticizing their consumption pattern, shown in their logbook (Figure 4).

Next, the workshop activities take time to achieve connectivity between the student, the material, and the issue. Several classes and discussions occurred to build students' argumentation on plastic recycling, which later will follow with joint and element development of architecture. The student's technical skill needs to be considered, such as their level of studies.

In terms of material, the most student still treats primary material (plastic waste) as something regular. Waste should be irregular in form, color, and type. Also, some groups tried to add outsourced 'waste' based on their type, affecting the prototype module development. Using waste means the designed module should be smaller.

3.2 Final product

The plastic processing methods students use are diverse, from reused, modified, and recycled—the reused method for PET bottles (raw, transparent panel). Seeing the potential of plastic bottles as translucent wall preserves the PET bottle's shape. Since the student understands the energy extensive of plastic processing, using reuse would make the second life of waste efficient. On the other hand, the modification method tries to minimize energy usage, although not as radical as the previous prototype. The intervention is minimum, by cutting the PET bottles into sheets and heating them until it is flat and able to stitch between one another (PET ocean ceiling). Lastly, turning plastic waste into another object also creates another waste. For example, the LDPE bubble block could reuse the waste and develop it as a joint between the modules. Other prototypes, such as the Polystyrene wall, use other types of plastic waste as the panel joint.

Some of the groups showed another environmental issue based on their prototype. PET ocean ceiling, for instance, depicts the ocean as one of the most affected ecosystems; also, the color of existing PET plastic bottle waste rendered the color of the ocean.

The exhibition's creation as a final project shows the reflection of each group up to the whole class. Showing students criticism of their work potentially be developed further

3.3 Daily practice

Student's logbook and inventory show that the seven categories of plastic could be found daily, although categories such as PVC or others, specific polycarbonate, are limited. However, indeed they are available to the public. The excess type of plastic, such as PET, PP, and LDPE, is food related. It shows the current lifestyle of food takeaway or delivery (dependency on online food service).

There is also an intention to minimize plastic waste products seen in Table 1 that provoked with impact on ecology and plastic waste processing. These acts, such as minimizing (reducing) plastic packaging from type to quantities, bringing bottled water or reusable food container, reusing plastic waste until it is broken, and changing lifestyles, significantly impact plastic dependency.

The pedagogy of design could be expanded and contract such plastic. Particularly in workshops and discussions, the quality of plasticity is the potential to present critical ideas by examining the student's primary common grounds, learning achievement, and class progress. Furthermore, the current issues are essential to be engaged in activities to make the student shows their act upon sustainability approach.

4. Conclusion

The class learning process demonstrated the gap between sustainable theory and practice. Student expectations of the result instead of the process sometimes make the problem-seeking and inquiry process overshadowed by the imagination of the final form. As shown in the product making, some students need more plastic waste or specific colors; some buy another plastic packaged water bottle rather

than using any existing waste.

Several times re-emphasizing the intention of the class are needed to make the students able to communicate specific design proposal based on the inquiry of selected materials. The form of drawings, mock-ups, and process-diagram gives an overview of the artifact and precise details (Cross, 2006). It is necessary to make full-scale mock-ups of the investigation so that the students can be communicated sufficiently accurately and reflect the consequences of the design decisions. Therefore, once the students understand the basic ideas about sustainability, it can also be seen in daily activities.

Consistent, sustainable thinking should be in any session to maintain their knowledge. As shown, recycling plastic needs additional treatment (such as energy, cost, and environmental impacts), which is hard to do effectively on a small scale. Showing the recycling impact does help develop the student paradigm of practicing sustainability daily, although the thinking supposedly occurs in all subjects. Thus, the class's design pedagogy can be used to minimize or even prevent the consumption of plastic.

The mix of class (theory-based) and workshop (practice-based) is also essential in design pedagogy. As the class ended, the student showed an attempt to contribute to minimizing plastic waste from small actions to bigger ones daily. As seen from the interview results, the process makes them aware of recycling plastic and how they pattern consumption over plastic. However, the quality and effectiveness of daily behavior are diverse and need to be studied more. Plastic as a material is only an example; thus, the paradigm should have plasticity quality, be adaptable to any condition and situation (such as material, technique, output, and even the student), and be flexible.

As stated by Colomina & Wigley (2016), firstly, we saw plastic waste as our imagination of thousands of possibilities by creating new artifacts from it that would contribute to a better ecology. By the time classes passed, we had realized that the process and reflection of design are supposed to be the core of the pedagogy on design sustainability. Since our first assumption could be wrong, using the loop process should give students reflection on their attempts.

This workshop demonstrates the design pedagogy to make plastic problems as close to the students as possible. Instead of reimagining something new in the design, this attempt also demonstrated the possibilities of utilizing the pre-existed artifacts to reimagine the reverse process. Plastic is used not as a matter of materials but also as a tool to reflect critically on the habit of plastic. Instead of wasting imagination to create new artifacts, we attempted to imagine the existing artifacts to learn critical ecological design practices.

This practice-based method is undoubtedly more effective on the longer hours course such as studio, as the current case is three credits. Therefore, the looping design method might occur repeatedly to create a particular pattern or behavior.

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Author Contributions: The authors confirm full responsibility for the research process until the finalization of the manuscript.
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