Actions for Sustainability: The implementation of Recycling Thermoplastics in Furniture Design for Painting Community in Jakarta

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Abstract. Concern for the environment, especially the pile of plastic waste, is an issue that needs attention, especially for designers and the communities. How can both of them contribute to environmental care through the application of sustainable design into existing facilities in the community? The focus of this paper is how the implementation of thermoplastics recycled materials (HDPE) for furniture in the painting community can be an inspiration and educational value for the painting community's action in sustainability. The paper will be discussed the design process of design inspiration with the implementation of thermoplastics (HDPE) as a recycled material that can be an inspiration for the painting community and analyze the application of thermoplastics (HDPE) as recycled materials in the design process carried out. The research was conducted in descriptive qualitative research consists of literature review on sustainable design, thermoplastics (HDPE), recycled materials, and painting community activity and by doing some observation on related design implementation and how the design process could extend the series of furniture for painting community. The results of this paper are how the furniture design can be used by the painting community as an inspiration and educational action for sustainability. The resulting design is expected to be an inspiration and educational value for other communities and society on how thermoplastics (HDPE) as recycled materials from waste products can be implemented for sustainable living.

1. Introduction
Plastic is a widely used material in modern furniture. It was first developed in the 1950s and is still regularly used today. Plastic implementation has numerous benefits; yet, the detrimental influence it has on our environment exceeds its positive characteristics. Plastic is currently the ideal material for packaging and transportation. It's light, inexpensive, flexible, durable, resistant to environmental changes, and enormously long. All of these benefits have allowed the plastic to take the place of less environmentally friendly materials such as wood, paper, cardboard, and glass. Plastics are classified into different categories, with thermoplastics being the most often used polymers in industry. They're frequently used in packaging and containment applications. The significant issue with plastic packaging is the negative environmental impact it has in compared to the limited timeframe it is reused. The packaging primarily acts as a means of transit or protection; once the material inside has been obtained, the container is discarded. The majority of this plastic does not have a long-term application, resulting in a substantial trash problem.
The potential to re-use thermoplastics is an important environmental benefit. However, the industry has remained uninterested in using recycled plastic in their goods due to low prices in virgin materials, a lack of technological advancements, and degradation after consumer use. Since the demand for plastic will increase, re-cycling is the greatest solution for the time being. The number of products that can be made from renewable thermoplastics needs to be enhanced. Since current market trends require eco-friendly products, there is no better time than now to promote and produce goods made with recycled. Then, to promote the use of eco-friendly products that are made from recycling, designers need to explore more creatively recycled material as an alternative material in their design.

This paper aims to discuss and explore the use of recycled material thermostats (HDPE) as an alternative material for furniture in a community specifically a painting community, where is community as a place for people to collaborate, learning and education together. Community is a proper place to encourage and educate people in the community to be more aware of living sustainably. Through the community, engagement and awareness about sustainable living can be developed slowly. As Daniels and Daniels defined that a community is people who live nearby, share public services and private institutions, and interact socially with one another [1].

Through community activity, people can work together with designers to design a place that is suitable for people doing art activities. A community that uses its resources to meet current needs while ensuring that adequate resources are available for future generations. A sustainable community seeks a better quality of life for all its residents while maintaining nature's ability to function over time by minimizing waste, preventing pollution, promoting efficiency, and developing local resources to revitalize the local economy. Decision-making in a sustainable community stems from a rich civic life and shared information among community members. A sustainable community resembles a living system in which human, natural and economic elements are interdependent and draw strength from each other [2].

2. Method
The method used in this study is descriptive analysis, which started from collecting data from the literature reviews regarding the issues of sustainable design, sustainable material, and painting community activities. Then, the data were analyzed based on the criteria of sustainable design and material, and assessment facilities in the painting Community. From those aspects, the data will be developed into the design process, including an interactive design process and design development process.

![Figure 1. Process of developing data & design.](image)

3. Results and Discussion
3.1. Designing for Painting Community
Art can play a powerful and valuable role in healing the community and fostering dialogue about public policy. Some research shows that programs in Art community includes the painting community foster art education in society and are effective to bridge the gap between art and community. By using arts activities such as painting in the community people can learn together and create a creative solution for a community member. Activities in the painting community can benefit members to learn the art and also use facilities that support environmental sustainability. To support the message of environmental awareness, the community can start by using existing facilities in the community using recycled materials.

To integrated the material with the design, the concept of furniture design will be dominated by dynamic and organic forms developed from the shape of the eye. One of the reasons because of the eye is the sense of sight that first captures when you want to start the painting. The eyes have an important role in painting activities, namely to determine the choice of color, shape, and composition. Eyes also have an implied meaning, language, and feeling. Feelings of sadness, anger, or happiness radiate from the eyes. Painting is an object that is enjoyed visually. The image will be caught by the eye and channeled to the brain, then the brain will process the meaning or feeling in the painting. It is for this reason that the eye became the shape inspiration for this design. The design focused on the facilities that supported the activities of the painting community with furniture that implementing recycled material.

The design concept implementing in designing the furniture facilities is 'Mata Guratan Hati' where the eyes are an important role in the process of painting and enjoying a painting. The eye plays a role in capturing a memory, where the memory is channeled to the brain which will then be processed to find out the meaning of a painting. The eyes also have an implied language that conveys a person's feelings or expressions. It's the same with painting, where painting creates an expression in the heart or feelings of the painter. Therefore, 'Mata Guratan Hati' is a place for the painting community to channel their expressions and feelings, and to be able to see and participate in appreciating the work of others. The application of the concept to the design can be seen from the form of furniture facilities which are the result of a study of the shape of the eye.

As a material combination for the recycled material will be used sungkai wood and plywood that are coated with wood grain texture HPL as a representation of the word 'stroke' because it has a texture and wood that looks like strokes. For the application of the word 'heart', it is found in recycled plastic bottles (HDPE) and iron pipes with powder coating finishing that has a smooth texture, where the heart in a person is sensitive and soft. The combination of materials from recycled bottle caps and plastic will produce attractive colors and are suitable to be combined with sungkai wood and plywood.

3.2. Thermoplastic is a sustainable material
There are two types of plastic, namely thermoset and thermoplastic. Thermosets are plastics whose constituent polymers are permanently bonded, so they cannot change when they are formed or harden at cold temperatures. In other words, thermoset-type plastic cannot be melted or recycled. While thermoplastic is a polymer plastic that hardens at low temperatures and melts at high temperatures. When heated, they become molten and harden as they cool.

A thermoplastic, on the other hand, becomes crystalline and prone to fracture when frozen. These irreversible properties, which give the material its name, allow it to be reheated, molded and frozen multiple times. Thermoplastics are thus mechanically recyclable. Polypropylene, polyethylene, polyvinylchloride, polystyrene, polyethylene terephthalate, and polycarbonate are some of the most prevalent thermoplastics. Thermoplastics are made in large quantities from plants but then transformed through chemical processing. Polyethylene [low-density polyethylene (LDPE) and high-density polyethylene (HDPE)], polypropylene (PP), poly (vinyl chloride) (PVC), and polystyrene are some of the most important thermoplastics [5]. These polymers can be applied in a variety of structural applications, including wire and light-duty utility. Natural and synthetic fibers are also combined with thermoplastic polymers. The qualities of thermoplastics that make them a good alternative material are their ability to handle caustic materials and conditions. They can transfer materials at high temperatures (hot or cold), making them suitable for almost any form of fluid transport application.

Even though several organizations such as the Forestry Stewardship Council (FSC) and the British Wool Marketing Board's 'OneWool' access information about green and sustainable materials, no one is focusing on creating a comprehensive understanding of environmentally responsible materials [3]. Following that, we will select some of the sustainability indicators that are generally explored when considering recycled material.

**Table 1.** Sustainability indicators for recycled materials

| Sustainability Indicators for Recycled material | Thermoplastics (HDPE) | Material for Furniture |
|-----------------------------------------------|-----------------------|------------------------|
| Recyclability                                  | V                     | made of recycled HDPE  |
| Aesthetics                                     | V                     | colorfull plastic board|
| Maintenance                                    | V                     | Same as plastic maintenance |
| Waste Construction                             | -                     | none                   |
| Moisture Resistance                            | V                     | Same as plastic resistance |
| Cost                                          | V                     | efficient cost         |
| Fire Resistance                                | -                     | same as plastic resistance |
| Durability                                     | V                     | durable for furniture |

**Table 2.** Process of making plastic board (sources: BrothersMake)

| Process of making plastic board                |
|------------------------------------------------|
| Use waste of plastic HDPE (code 2) and use colorful bottles and caps |
| However, do not use any transparent or glossy plastic |

4
| Image | Text |
|-------|------|
| ![Image](image1.png) | Cut them into small pieces or use the machine to crush the plastic into small items |
| ![Image](image2.png) | Put plastic into a metal tray, mix all the colors from the caps or plastic to create colorful materials |
| ![Image](image3.png) | Put the tray into the oven or hot pressed. Do it several times until the plastic can be shaped with a hand. Plastic HDPE can be melting using low-temperature heat so it won't create any toxic fume from the plastic. |
| ![Image](image4.png) | This is a piece of melting plastic that can be molded into the shape. |
| ![Image](image5.png) | Put the hot melting plastic into the molding and then press it several times until it is harder. |
| ![Image](image6.png) | After several times, the plastic is harder and can be taken out from the molding. |
| ![Image](image7.png) | Melting plastic can be shaped into anything using a cutter or sharpening tools. |

Same process of making plastic board can also be seen in: [https://www.youtube.com/watch?v=URl9I2h7PZM](https://www.youtube.com/watch?v=URl9I2h7PZM) with the Title “Pembuatan papan plastik dari sampah plastik HDPE”

### 3.3. Strategies to integrated recycled materials into furniture design.
The design will also be taken into account when incorporating this material into products, which in this case will be furniture. When it comes to applying eco-design to furniture, the goal is clear: use the least amount of resources and energy in the production process while ensuring that the material used is the most efficient in terms of environmental impact, cost, and social awareness [4].

The process of recycling plastic into furniture or other accessories begins with sorting plastic waste first, the selected plastic is High-Density Polyethylene (HDPE) plastic. After sorting, the plastics are cleaned first before being crushed or cut into small pieces. After that, place the plastic pieces into a heat-resistant container to heat to melt into a dough. Then when it has changed shape to become like dough, print the plastic dough into a mold or mold container to be shaped as desired. After the shape has hardened, then the recycled material is sanded to be smooth and then polished so that it looks shiny.

The materials used in the design of furniture and accessories are materials that are durable for a long time, sourced from nature, can be recycled, or are the result of recycling, easy to shape, and easy to clean. The choice of materials used is wood, rattan, metal, linen, and recycled materials from plastic bottle waste. The selection of recycled materials from plastic bottle waste will be applied to the painting table because the material is easy to clean and waterproof. In addition to the table, it will also be applied to furniture and other interior accessories. Especially for chair furniture, recycled plastic bottle material is applied in the form of a rope that is on the back of the chair.

3.4. The design processes
The design process for making furniture facilities for the painting community starts from the need felt by the community, namely having to find a table with a large size so that it can put the equipment needed during painting. After going through the design development process, here are the final results of the furniture and interior accessories in the painting workshop space:

a. Table
The table is designed using reclaimed wood and recycled plastic HDPE as the tabletop because the furniture criteria are using material that is easy to clean when exposed to water, durable, and has an aesthetic element. The table also can be used for placing canvas and watercolor painting media, and there is also a place to put paint palettes, glasses, cell phones, and there is also tissue holders.

b. Chair
The recycled plastic material contained in the chair is on the backrest in the form of a rope wrapped around the backrest circle. And the cloth material used is linen which is then coated with wax so that when exposed to spills water does not absorb into the foam.

c. Trolley
The trolley is designed for a workshop room with large easel furniture because the medium is canvas with large size. Because the room does not have a table for storage, the trolley is designed as a place to put various equipment and belongings of the user. Recycled plastic bottles are found on the top and bottom, as well as on the front and back in a circular shape.

d. Brush Box standing
The brush holder is designed to make brush storage more organized and easier to pick up and place brushes. Recycled plastic bottles are found at the bottom and as accents on the front and back in a semi-circle.

e. Wall Hanger
During painting activities, the user will wear an apron so that the clothes worn can be protected from splashes of paint or water. Therefore, apron hangers are designed according to the needs of space users as well as accessories in the interior of the workshop space.

Table 3. implementation of recycled material (HDPE) in furniture design.
| Activities          | Facilities | Description                                                                                                                                 |
|---------------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Painting Activities | Table for painting activities. Recycled plastic from HDPE is used as the top table because of durability, aesthetics, and maintenance from the material. |
| Seating activities  | Chair for Painting activities. Recycled plastic from HDPE is used as the back of the sitting chair because of its durability. As sitting upholstery, this chair uses fabric microfiber. Microfiber is a synthetic material designed for extra durability and water repellent. |
| Trolley table for art tools | Movable Trolley Table. Recycled plastic from HDPE is used as a top table and decorative element because of durability, aesthetics, and maintenance from the material. |
| Brush box standing  | Brush box standing. Recycled plastic from HDPE is used as a decorative element because of the aesthetic and maintenance of the material. |
4. Conclusion

The aim of this paper is to be seen as a contribution to the advancement of evidence-based biophilic interior design solutions for health care environments such as hospice care. Interdisciplinary research and the guidelines proposed are hypotheses as to how to further design for human well-being with nature. They provide support and design considerations for normal psychological responses in the healthcare environment. Because of the interdisciplinary complexity of biophilic interior healthcare architecture, one significant consequence for future work that stems from that interdisciplinarity can be emphasized here. Such features are also particularly relevant to consider in the sense of an indoor health environment since they can answer many of the patients' physical and psychological responses to well-being.

References

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