Cumulus Beijing CAFA 2023 Parallel Conference Proceedings

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Narratives of Love

爱的阐释

Narratives of Love
Cumulus Conference Proceedings CAFA Beijing 2023
11/2024 Beijing

Cumulus conference: Narratives of Love
Hosted by the School of Design, Central Academy of Fine Arts, China on November 22-24, 2023
Conference website: https://cumulus2023beijing.cafa.edu.cn/

Published by Cumulus
Cumulus the Global Association of Art and Design Education and Research. Aalto University, School of Arts, Design and Architecture PO BOX 31000, FI-00076 Aalto www.cumulusassociation.org

ISSN 2490-046X
ISBN 978-952-7549-04-9 (pdf)
No. 11 Cumulus Conference Proceedings Series

Editor-in-Chief: Cumulus President Lorenzo Imbesi

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Design for the Deprived: Lamp Design for Underprivileged Children Based on the Cradle to Cradle Concept

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Abstract

This study explores the application of the Cradle to Cradle (C2C) concept in lamp design for underprivileged children through the illuminable stationery box design case. Firstly, the relevant theoretical knowledge of the C2C concept is reviewed. Then, the unsustainable problems of the existing lamps for underprivileged children are identified. Finally, the illuminable stationery box is designed based on the unsustainable problems of the existing lamps for underprivileged children and the three principles of the C2C concept. By integrating the C2C concept into the design process of lamp for underprivileged children, sustainable lamps that meet local situations can be developed, thereby better solving the challenges faced by underprivileged children.

keywords

Cradle to cradle; C2C; Lamp design; Sustainability; Sustainable design; Design for poverty alleviation; Underprivileged children; Poor children; Stationery box design.

Introduction

Light is very important for people's visual activities, without it, there is no vision (Wang et al., 2014). Especially at night, artificial light sources are an important guarantee for production and life. For people in developed regions, obtaining light at night is a quite easy thing because they have high brightness lamps and sufficient electricity. However, for the poverty population in underdeveloped regions, nighttime lighting is a luxury. Due to the impact of geographical environment, these areas often face power outages or insufficient power supply, and it's hard for people here to afford expensive electricity bills. Therefore, they rarely use light bulbs and instead use candles or kerosene for lighting. However, living in an environment with insufficient light for a long time can have serious psychological and physiological impacts on people. Although adults can tolerate such living environments, children are unable to learn normally and grow healthily. At the same time, the United Nations has also proposed sustainable development goals such as no poverty, quality education and affordable clean energy. So, the researchers believe that this is an urgent problem to be solved, and designers also have a responsibility to contribute their meager efforts to the vulnerable groups in society and help them

live better. In summary, this study aims to develop a sustainable lamp based on the C2C concept for children in underdeveloped regions, solving a series of challenges they are currently facing.

Overview of Cradle to Cradle Concept

Since the Industrial Revolution, product design and manufacturing have followed a linear pattern from cradle to grave, extracting resources from nature, processing them into products, and discarding them after use (Chen, 2022). People not only view the environment as an inexhaustible warehouse of resources, but also as a garbage bin with no capacity limit (Shedroff, 2009), arbitrarily extracting and discarding resources, which leads to severe resource depletion and environmental pollution. To address this challenge, people have adopted the 3R (Reduce, Reuse, and Recycle) principles throughout the product lifecycle, which aims to slow down resource consumption and mitigate environmental pollution by reducing resource use and waste, repeatedly using products, and reprocessing waste into raw materials. Nevertheless, the product will eventually enter the grave, consuming resources and polluting the environment. So, William McDonough and Michael Braungart further proposed the Cradle to Cradle concept (McDonough & Braungart, 2002).

Cradle to Cradle is a sustainable design approach, inspired by nature and aims to encourage designers to develop high-quality products that are ‘eco-effective’ instead of eco-efficient. This means that this approach is used to develop truly sustainable products, rather than products that merely reduce environmental impact (van Boeijen et al., 2013). Compared to the traditional design approach, it views the product lifecycle as a closed-loop process, ensuring that products do not become waste at the end of their lifespan, but rather transform into resources that can be reused, thereby preventing resource depletion and environmental pollution.

The Cradle to Cradle concept includes two cycles: biological cycle and technical cycle, as shown in Figure 1. Products for biological cycle are made of 100% biodegradable materials that can be returned to natural environments such as soil and oceans after use to provide nutrients for other organisms. Products for technical cycle can be returned to the factory after use to make new products. Everything is a resource for something else. Additionally, it also follows three principles: waste as raw materials, using renewable energy, and respecting diversity (McDonough & Braungart, 2002).

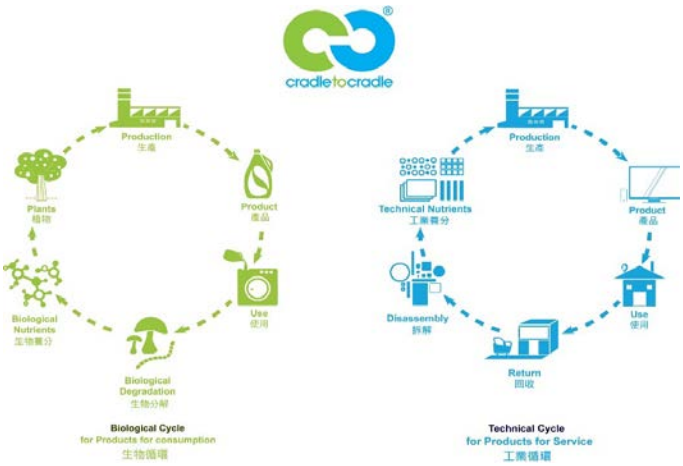

Figure 1. Two cycles of Cradle to Cradle (Source from https://www.c2cplatform.tw/en/c2c.php?Key=1)

Existing lamps for underprivileged children and their unsustainable problems

At present, lamps for underprivileged children mainly include two types. The first type is the universal lamp, which refers to the ordinary lamps currently available on the market. These lamps generally rely on traditional power supplies. For example, Philips has previously collaborated with government departments to develop donation activities of LED light bulbs in Xinjiang and Yunnan, China, aiming to improve the lighting environment of underdeveloped regions with green and energy-saving lamps, further improving the living standards of local residents and students' learning conditions (Signify, 2017), as shown in Figure 2. These lamps are not only suitable for people in underdeveloped regions, but also for the general public. So, these lamps lack pertinence in design, which not only can't adapt to the actual usage environment of certain underdeveloped regions but also can't meet the lighting needs of people in that area. The second type of lamp is specifically designed based on the actual situation in underdeveloped regions. For example, the team of "Heart Lamp Action" designed solar LED lights for children in underdeveloped regions to improve their learning environment, as shown in Figure 2. These lamps do not rely on traditional power supplies and can be charged through solar energy ("Design for Public Benefit - LED Lights Designed for The Faraway Children," 2014). Another example is the Gravity Light, designed by Martin Riddiford and Jim Reeves for populations in underdeveloped regions of Africa, which can generate electricity and provide lighting for people through gravitational potential energy (Santos, L. A, 2014). People only need to install it on a sturdy crossbeam, and then hang some heavy objects on the chain. As the heavy objects slowly fall, the chain drives the DC generator inside the lamp to generate electricity and lighting, as shown in Figure 2. However, Gravity Light is not convenient to carry and requires the coordination of heavy objects and supports to work, making it more complex to use.

Figure 2. Existing lamps for underprivileged children (Philips LED light bulbs(a), source from https://www.signify.com.cn/zh-cn. Solar LED lights(b), source from https://mp.weixin.qq.com/s/QobQHoPQCSE7MbQbudq5tg. Gravity Light(c), source from https://mp.weixin.qq.com/s/F2dJAPkuEP5fv-Vzf-xJrg)

After analyzing the existing lamps for underprivileged children, it can be seen that these lamps have provided light to underprivileged children and improved their learning and living conditions. However, these lights still have certain unsustainable problems. The first problem is that the lamps have limited functionality. Currently, most lamps only provide lighting functions, but the challenges faced by underprivileged children are diverse and not limited to lighting. They also face other challenges, such as a lack of stationery, clean water, and toys (Chen, 2018). However, current lamps cannot address these additional challenges. The second problem is that the materials used in lamps are non-degradable or difficult to recycle. Currently, most lamp components are mainly made of non-degradable or difficult-to-recycle plastic or metal. Once the lamps reach the end of their lifespan, these materials can only be discarded, resulting in resource waste and environmental pollution. The third problem is the lack of flexibility in the power supply type of the lamps. Currently, most lamps rely solely on traditional electricity or renewable energy sources, which leads to poor adaptability, making them unsuitable for long-term and effective use in underdeveloped regions. Because traditional electricity supply in these areas is often interrupted due to geographical limitations (Chen, 2018), lamps powered solely by traditional electricity are frequently unusable. Additionally, for lamps that rely solely on renewable energy sources, when the energy module fails, these lamps also become unusable.

Illuminable Stationery Box Design Case

Through theoretical research on the C2C concept and an analysis of the unsustainability problems of existing lamps for underprivileged children, the researchers aim to design a sustainable lamp based on the C2C concept, in order to better address the challenges faced by these children. The following sections will focus on the design process of this lamp.

Design Investigation and Conceptualization

The researchers first visited primary schools and families in Zhuolu County, Zhangjiakou City, Hebei Province, where they interviewed local teachers, children, and parents. They then summarized the findings from the investigation from both user and environmental perspectives, as shown in Figure 3. Finally, they conceptualized and proposed design solution based on the investigation findings, the unsustainable problems of the existing lamps for underprivileged children, and the C2C concept.

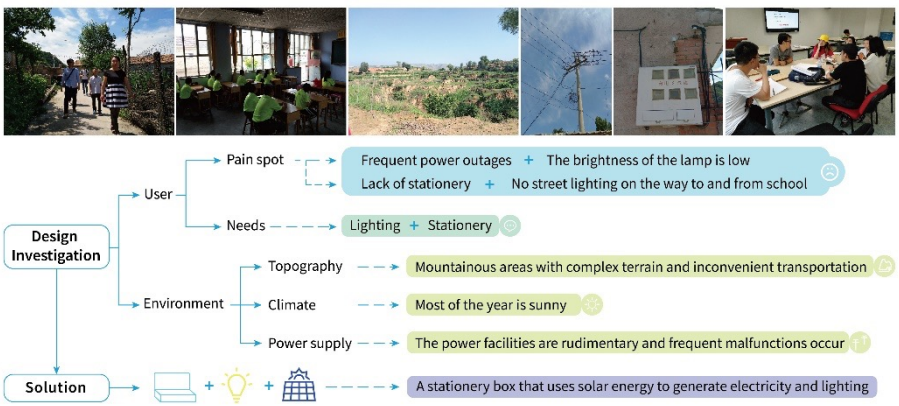

Figure 3. Design investigation and conceptualization (created by the author).

Design Principles and Solution Display

Waste as Raw Material

It is also the first principle of the C2C concept, aiming to make materials or products beneficial to humans and the environment during production, use, and recycling, and ultimately safely enter biological or technical cycle, once again becoming equivalent or higher quality materials or products. Based on this principle, the researchers determined the shell material of the illuminable stationery box as polylactic acid (PLA) plastic through comparison and analysis of existing materials. This is a new type of bioplastics made from starch extracted from plants, which has good biodegradability and can be degraded by nature after use (Huang et al., 2020). After the life cycle of the stationery box ends, PLA plastic can not only enter the biological cycle as a biological nutrient, but also enter the technical cycle to become a new material or product again.

Using Renewable Energy

It is also the second principle of the C2C concept. Instead of passive energy conservation and reducing traditional power generation usage such as thermal power, it is better to actively develop and use renewable energy, such as solar energy, wind energy, hydro energy, and biomass energy. Through field investigation in Zhuolu County, the researchers found that the local sunshine is very abundant, and this region often faces power failure problems, so solar power generation is a good choice. During the day, the solar panel can charge the internal rechargeable battery, and at night, the rechargeable battery can power the lighting module to achieve lighting functions, as shown in Figure 4. In addition, to ensure the flexibility of energy supply types, the researchers have also incorporated charging ports into the illuminable stationery box. When the solar panel malfunctions or is temporarily unable to generate electricity due to weather conditions, underprivileged children can use an external power source to charge the illuminable stationery box, ensuring its continued operation.

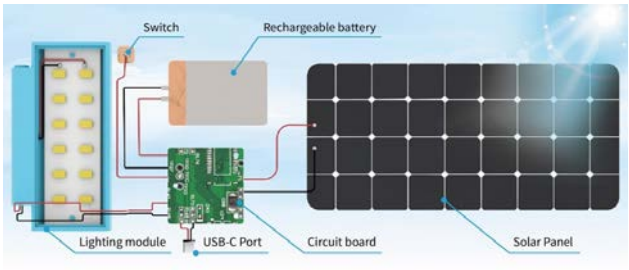

Figure 4. Design investigation and conceptualization (created by the author).

Figure 5. Usage scenario of illuminable stationery box (created by the author).

Respecting Diversity

It is also the third principle of the C2C concept, aiming to demonstrate the importance of diversity factors such as natural ecology, local culture, and individual needs in the product design process, which can be understood as localized product design. In the conceptualization of the design, the researchers thoroughly considered the unique needs and living conditions of local underprivileged children in order to propose effective localized solution. In addition to using sufficient solar energy for power generation, the illuminable stationery box also has dual functions (Chen et al., 2018). It can not only provide lighting functions for children in underdeveloped regions, but also help them store stationery or items, as shown in Figure 5.

Additionally, the illuminable stationery box is also equipped with a lanyard, making it convenient for children to carry it with them for charging or lighting purposes.

Prototype Test

In order to test the feasibility and effectiveness of the illuminable stationery box, the researchers created a prototype. First, 3D printing technology and PLA filament were used to construct the shell of the stationery box. Next, electronic components such as solar panels, wires, LED lights, switches, batteries, and circuit boards were connected using soldering equipment. Finally, the shell and electronic components were assembled together. After testing, the prototype implemented all the expected functions, as shown in Figure 6.

Figure 6. Prototype of the illuminable stationery box (created by the author).

Conclusion

Many underprivileged children around the world are facing various challenges, with even their most basic living needs not being met, such as lighting. Although there are existing lamps that meet the lighting needs of underprivileged children, these lamps still have certain unsustainable problems. Therefore, this study designed an illuminable stationery box for underprivileged children based on the three principles of the C2C concept. It not only provides them with lighting functionality but also helps them store stationery. By applying the C2C concept to the design of lamps for underprivileged children, sustainable lamps that are adaptable to local environments and meet local needs can be developed, thereby better addressing the challenges they face. However, this study still has certain limitations. The illuminable stationery box is currently a conceptual solution at the product level, and several important questions remain to be addressed, such as

how to produce and repair it, and how underprivileged children can obtain it. Firstly, due to the financial constraints of underprivileged families, it may be difficult for them to purchase this stationery box unless it is donated. Secondly, if the stationery box is damaged and cannot be repaired in a timely manner, its value will be significantly reduced. Therefore, future research should consider the production, maintenance, and donation of stationery boxes from a service design perspective to provide more comprehensive solutions for underprivileged children.

Acknowledgements

We acknowledge the research funding provided by the Eric C. Yim Endowed Professorship in Inclusive Design (PolyU Reference: 8.73.09.847K), the PolyU Research Postgraduate Scholarship, the "Lighting Up Taiyu" Public Welfare Activity, and the 2018 University Student Scientific Research and Entrepreneurship Action Plan (Beijing Municipal Project): "Social Innovation Design for Underprivileged children," Project Number: 201810011108. We also want to thank the local villagers, teachers, and students for their support of this research.

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