

PAPER

Bottle Light: Upcycling Bedside Lamps from Used Plastic Bottles

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ABSTRACT

Plastic bottle waste is still an environmental problem because it is often used once, is easily dispersed, and requires consistent management. On the other hand, the need for cheap, safe, portable, and aesthetic room decoration increases along with the trend of creative products based on recycling. This article discusses the development of Bottle Light, which is a decorative night lamp that utilizes the top of a used plastic bottle as a lampshade, galvanized wire as a frame, macrame rope as a pole covering, glitter foam as an ornament, beads or flower stickers as a visual sweetener, and battery LED candles as a source of warm light. The method used is the Eco-Recycle approach through the observation of waste materials, user needs analysis, competitor study of decorative lighting products, visual planning based on design thinking, prototype production, lighting function testing, and conceptual evaluation using the rubric of safety, aesthetics, portability, cost, and environmental value. The development results show that Bottle Light can transform used plastic bottles into a functional product with a modern lantern look, warm white light, low risk of heat due to using LED, as well as potential as a creative product of UMKM, room decoration, and environmental education media. This product still needs more extensive consumer testing, standardization of bottle sizes, and development of environmentally friendly packaging to increase sales.

KEYWORDS

Bottle Light; Upcycling; Plastic Bottles; LED Night Light; Eco-Recycle

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1. INTRODUCTION

The problem of plastic waste is an issue that is getting closer to the life of the urban community as well as the educational environment. Disposable plastic bottles are widely used because they are light, cheap, and practical, but the same character also makes them quickly become trash. When plastic bottles are not managed properly, the material has the potential to accumulate in landfills, enter waterways, or turn into small-sized trash that is difficult to handle. The literature on the circular economy emphasizes that the management of plastic is not enough only through final disposal, but needs to be directed at reduction strategies, reuse, recycling, and increasing material value or upcycling [1]-[3]. In that context, creative products based on used goods have an important role because they can show that waste is not just a burden, but a raw material that can be transformed into a valuable new product.

Upcycling differs from normal recycling because it does not only reprocess materials, but increases the use value, aesthetic value, and economic value of used materials. This approach is relevant for entrepreneurship and creativity education because the process encourages students to understand environmental problems through the activities of creating, testing, and improving prototypes. Sustainable design research shows that upcycling project-based learning is able to increase environmental awareness as well as train problem-solving skills [1], [4]. The example of the application of the circular economy in Medan also shows that waste management can be combined with education, increasing economic value, and strengthening community participation [5]. Therefore, product innovation from used plastic bottles needs to be designed not just as a simple craft, but as a product that has a clear function, is safe to use, and has a look that is worthy of competing in the creative market.

The trend of consumer needs for room decoration also opens up opportunities for Eco-Recycle products. Bedside lamps and room decorations are no longer only judged by their ability to illuminate the room, but also by their ability to create atmosphere, beautify the corner of the room, and provide a comfortable visual experience. A study on architectural lighting explains that a good light design should pay attention to aesthetics, function, and efficiency in a balanced way [13]. For bedroom use, warm lighting with soft intensity can create a calm atmosphere, while portable lighting makes it easy for users to move the product to a study table, bedside table, or corner of the room. Thus, bedside lamps from used materials have an opportunity when they are able to combine environmentally friendly aspects, attractive visuals, affordable prices, and operational safety.

The Bottle Light product was developed to answer the opportunity. This product utilizes the top of a used plastic bottle as the main body of the lampshade. The bottle part is then decorated with glitter foam, beads or flower stickers, and

combined with a pole made of galvanized wire covered with colored macrame rope. The light source uses a small battery-powered LED candle, not a natural flame and not a cable connection. The selection of LEDs is based on the characteristics of LEDs that are efficient, relatively low heat, and flexible for various small lighting products [11], [12]. With this configuration, the Bottle Light is designed as a decorative bedside lamp that is safe to place on the table, does not pose a risk of open fire, and provides a comfortable warm white glow when the room is dark.

The gap that this article wants to answer is that there are still many second-hand craft products that are only oriented towards visual form without analysis of materials, functions, safety, and product development models. Some decorative lamps from used bottles that are sold or featured on social media often highlight the decorative aspect, but have not always explained the reason for choosing the light source, the support system, the market potential, as well as the evaluation method of the product. In fact, studies on the acceptance of upcycled products show that consumers do not only consider environmentally friendly values, but also aspects of aesthetics, safety, quality, and the risk of use [20]-[22]. Therefore, the development of Bottle Light needs to be systematically explained so that the product has a strong design basis and can be developed into an exhibition product as well as an entrepreneurial product.

The purpose of writing this article is to describe the development process of Bottle Light as a bedside lamp based on the upcycling of used plastic bottles, explain the method of initial data collection and prototype production, present design results and conceptual evaluation, and analyze the potential impact of the product on the environment, users, and creative business opportunities. This article positions Bottle Light as an Eco-Recycle product that combines the functions of lighting, room decoration, environmental education, and moderate economic value. The main advantage of products on the use of materials that are easy to obtain, the production process that can be done manually, the safety of using LED battery candles, as well as the aesthetic appearance through the combination of macrame, glitter, and flower ornaments.

2. METHOD

2.1 Product Development Approach

Bottle Light's development method uses an Eco-Recycle approach combined with design thinking. Eco-Recycle is used because the product utilizes used plastic bottle waste as the main material and aims to increase the use value of the material. Design thinking is used to ensure that products are not only made based on the availability of materials, but also based on user needs, visual comfort, safety, and the potential for repeated production. The stages of design thinking used include empathy towards the problem of waste and room decoration needs, problem formulation, idea search, prototype making, as well as preliminary testing [1], [4].

At the level of empathy and data collection, the team observes materials that are easily found in the surrounding environment, especially used plastic bottles that are still in good shape. The bottle chosen is a bottle with a neck and upper body that is not dented, does not smell, and is easy to clean. In addition, the team did a conceptual observation of competitors on products such as bedside lamps, mini lanterns, decorative table lamps, and used bottle crafts that generally appear in the creative market or social media. Observation is done to see the character of the comparative product, such as shape, decoration material, lighting system, portability, and visual effect.

For the Eco-Recycle category, customer data collection is planned through three methods, namely a short preference survey, prospective customer interviews, and competitor observation. Because this article is compiled based on the product data that has been provided and has not yet been completed with field survey data, the results section does not claim the percentage of actual customer preferences. The recommended survey contains questions about interest in used nightlights, color preferences, willingness to buy, perception of safety, and price range. Prospective customer interviews can be done to students, teenagers, cost room users, and people who like table decoration. Competitors' observations are used to compare the uniqueness of Bottle Light with normal sleeping lamps and handmade decorative lamps. The multimedia and visual production process is done in three stages. The pre-production stage includes the preparation of the product concept, the sketch of the shape of the lamp, the selection of the color of the macrame rope, the determination of the position of the glitter foam, and the LED candle placement plan. The production stage includes bottle cutting, wire frame making, macrame rope winding, ornament assembly, and product photo documentation. The post-production stage includes evaluation of the display, repair of parts that are not neat, testing the LED flame in a dark room, as well as the completion of the promotional narrative. The visual principle used is the contrast between the old material and the new ornament, the repetition of the macrame wrap to make the pole look neat, and the focal point on the warm white light from inside the bottle.

2.2 Tools, Materials, and Functions of Components

Bottle Light's main ingredients are selected based on availability, ease of processing, safety, and aesthetic value. Table 1 explains the components used in prototype manufacturing.

Table 1. Materials and functions of Bottle Light components

No.	Materials/Tools	Function	Reason for Selection
1	Used plastic bottles	Lampshade/main body	Easy to obtain, light, translucent, and suitable for the concept of upcycling.

No.	Materials/Tools	Function	Reason for Selection
2	Glitter foam/glittered liver foam	Bottom decoration and top cover	Gives a luxurious, shiny effect, and covers the cut-out of the bottle.
3	Galvanized wire	Frame and gallows	Strong enough, easy to shape, and can support small lampshades.
4	Colored macrame rope	Pole/frame coating	Makes the texture more neat, thick, and aesthetic.
5	Battery LED candle	Lighting source	Portable, non-flammable, low heat, and easy to replace.
6	Flower beads/stickers	Surface decoration	Enhances visual appeal and handmade effect.
7	Scissors/cutter, glue gun, pliers	Production tools	Assists in cutting, assembly, and strengthening connections.

The product development flow is organized so that the manufacturing process can be replicated consistently. Figure 1 shows the work sequence starting from waste identification to functional testing.

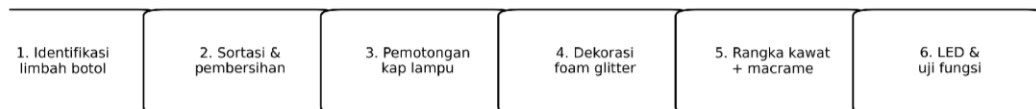


Figure 1. Bottle Light product development flow

2.3 Prototype Production Stages

The first step is preparation of materials. Used plastic bottles are selected, the labels are removed, then the bottles are washed using clean water and dried. Important cleaning is done so that there is no residual liquid, odor, or dirt that interferes with the appearance of the product. After drying, the top of the bottle is measured and given a cut mark. The part used is the area near the neck of the bottle to part of the body of the bottle, because this area has a curved shape that resembles a lampshade.

The second stage is the cutting and firing of lampshades. The bottle is cut following the mark using a cutter or scissors. The edges of the cut are then trimmed so that they are not sharp. The bottom of the hood is given glitter foam to cover the cut line while adding a decorative effect. The upper part near the neck of the bottle can also be covered with glitter foam so that it looks neater and resembles a hanging lantern. At this stage, flower decorations or beads are attached to the surface of the bottle according to the desired visual composition.

The third stage is the manufacture of poles and hangers. Galvanized wire is formed into a free-standing stand with support legs, vertical poles, and hanging arches at the top. Once the basic shape is stable, the wire is wrapped using colored macrame rope. The winding is done tightly so that the wire is not visible, the texture is smoother, and the product looks more premium. Standing strength is tested by placing a bottle cap on a hanger and seeing if the pole tilts or stays balanced.

The fourth stage is the installation of the lighting system. A small LED candle is inserted into the bottle cap. The LED source was chosen because it does not produce an open flame, does not require cables, and has relatively low heat compared to small incandescent lamps. LED safety literature shows that LEDs are generally used as an efficient light source, but product design still needs to pay attention to glare, flicker, and excessive display [12]. At Bottle Light, the light is made as a soft ambient light, not as the main reading light, so its main function is decoration and the comfort of the atmosphere.

The fifth stage is preliminary testing. The test is done by lighting the LED in a bright room and a dark room. In a dark room, the product is observed from the side of the intensity of the illumination, the color of the light, the shadow that appears from the ornament, and the stability of the pole. Evaluation is also done on the glue connection, the tightness of the rope winding, the ease of replacing the LED battery, as well as the safety of the edges of the bottle cut. If sharp parts, loose connections, or unstable LED positions are found, the product is repaired before presentation.

The customer and competitor data collection plan is explained in Table 2. This table is used as a guide for further market validation before more products are produced.

Table 2. Plan data collection and market validation

Method	Object	Data Searched	Benefits for Products
Competitor observation	Night lights, mini lanterns, decorative bottle lights	Shape, material, price, color, features, and weaknesses	Define Bottle Light's differentiation.
Prospective customer survey	Students, boardroom users, teenagers, decoration lovers	Purchase interest, favorite color, perception of security, price range	Validating display and selling value.
Short interview	Prospective consumers and prospective gift buyers	Reasons for choosing decoration products, concerns about used items	Reasons for choosing decoration products, concerns about used items

Test usage	Early adopters/prototypes	Ease of use, stability, light comfort	Correcting the design before production.
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3. RESULT AND DISCUSSION

3.1 Product Design and Implementation Results

The results of the implementation show that Bottle Light succeeded in turning parts of used plastic bottles into decorative lampshades. Bottles that previously only functioned as disposable packaging were given a new function as a light diffusing medium. The transparent or semi-transparent nature of the plastic bottle allows the LED light to spread softly around the room. With the addition of glitter foam on the bottom and top, the former cut bottle does not look rough. Beaded decorations or flower stickers provide visual details that make the product look friendlier for bedrooms, study tables, and room corners.

The galvanized wire frame gives important functional value because the Bottle Light is not just a lampshade that is placed directly on the table, but has its own standing. This stand makes the product look like a classic hanging lantern in a mini and modern version. The macrame rope serves as a visual cover of the wire as well as strengthening the handmade identity. The combination of plastic bottles, glitter, macrame, and warm white light creates an interesting contrast: old materials are transformed into decorative objects that look new. In the context of upcycling, this increase in value is in line with the idea that waste materials can have new value when combined with the right design, narrative, and function [6], [8].

LED components are one of the most important aspects of the product. Bottle Light uses battery LED candles, not real candle flame. This option makes the product safer to place in the room, on the bedside table, or in an area close to other decorative objects. Studies on LEDs show that LED lights can offer energy efficiency, long service life, and light color flexibility [11], [15], [16]. However, because the Bottle Light uses small battery-powered LEDs, the lighting function is not intended to illuminate the entire room, but to create a warm and comfortable ambient atmosphere.

Visually, the final form of the Bottle Light resembles a mini hanging lantern. When the LED has not been turned on, the product can still function as a table decoration because it has an interesting color, shine, and shape. When the LED is lit in a dark room, the warm white light reflects on the surface of the bottle and ornament, so that a soft flickering effect appears. This effect is in line with the claims of the product's function as a night light and night decoration. The use of warm light is also in line with lighting design recommendations that emphasize the importance of light color, comfort, and the reduction of unnecessary light disturbances [13], [14].

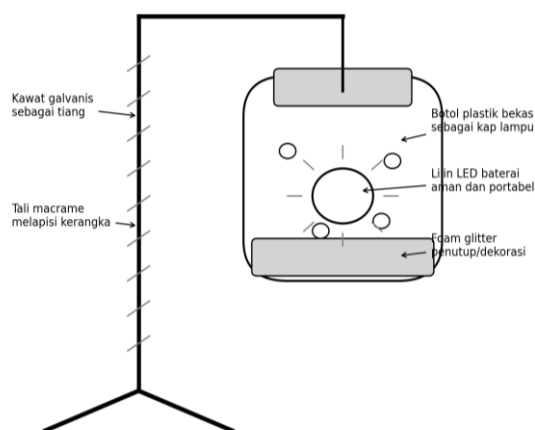


Figure 2. Schematic of Bottle Light components and structure

3.2 Business Model Analysis Brief Canvas

Even though Bottle Light falls into the Eco-Recycle category, business model analysis is still required so that the product has a clear development direction. Table 3 presents a summary of the Business Model Canvas to map values, customers, channels, activities, and sources of income.

Table 3. Simple Business Model Canvas Bottle Light

BMC Elements	Fill for Bottle Light	Development Implications
Customer Segments	Students, teenagers, cost room users, room decoration lovers, buyers of handmade gifts, communities that care about the environment.	The design and price should be suitable for the young market and affordable decoration buyers.
Value Proposition	Bedside lamps from used plastic bottles that are environmentally friendly, safe, portable, aesthetic, and give a warm white atmosphere.	The promotion needs to highlight the story of upcycling, LED safety, and the look of modern lanterns.

BMC Elements	Fill for Bottle Light	Development Implications
Channels	Product exhibition, school/campus bazaar, Instagram, TikTok, local marketplace, neighborhood community.	Before-after video content of used bottles becoming lamps can increase the appeal.
Customer Relationship	Environmental education, color customization, pre-order service, user testimonials, gift packages.	Customer relationships are built through personalization and product narrative.
Key Activities	Bottle collection, cleaning, production, quality control, content documentation, digital promotion.	SOP is needed so that product quality is consistent.
Key Resources	Used bottles, cutting tools, glue, wire, macrame, LED, design skills, social media.	Material availability and manual skills determine production capacity.
Key Partners	Garbage banks, canteens/cafes producing bottles, craft shops, environmental communities, resellers.	The partnership helps bottle supply and market expansion.
Cost Structure	Decoration materials, LED batteries, glue, tools, packaging, promotion, transportation.	Costs must be controlled so that prices remain affordable.
Revenue Streams	Unit sales, gift packages, custom orders, upcycling workshops, small event decorations.	Income is not only from products, but also education and experience making.

3.3 Conceptual Evaluation and Product Achievement

Conceptual evaluation was carried out using a scale rubric of 1 to 5 on six aspects, namely environmental friendliness, security, portability, aesthetics, production costs, and ease of assembly. This rubric is an internal assessment based on design criteria, not the result of field customer surveys. The purpose of the rubric is to help the team identify the product's initial strengths and aspects that need to be improved before user testing is done. The evaluation results are shown in Figure 3.

The environmentally friendly aspect gets a high value because the product's main ingredient is used plastic bottles. The use of bottles as lampshades reduces the need for new materials and provides a concrete example of reusing materials. In the circular economy literature, material reuse in the form of valuable products becomes an important strategy to reduce dependence on linear consumption models [2], [3], [9]. However, the actual environmental impact of Bottle Light still needs to be calculated further, for example the number of bottles used per product, the product's shelf life, the type of packaging, as well as the possibility of repair or dismantling when the product is damaged.

The safety aspect is also highly valued because the product does not use open flames and does not require electrical cables. Battery-powered LED candles are more suitable for small bedside lamps because the risk of heat and short circuits is lower than cable lamps assembled without standards. However, the safety of the product should still be considered. The battery should be easy to remove but not easy to fall, the edge of the bottle should be smooth, the glue should not cover the switch, and the position of the LED should be stable. Research on LED mentions that the design of lighting products still needs to pay attention to glare, flicker, and heat management, especially when the power of the lamp increases [12], [18]. Thus, the next Bottle Light development needs to test the surface temperature and visual comfort more systematically.

The portability aspect is good value because the product uses a battery and has its own standing. The product can be moved without needing an outlet. This makes the Bottle Light flexible to be placed on a study table, bedside table, small shelf, or decoration corner. The downside is that the use of batteries also creates the need for battery replacement and the responsibility of battery disposal. For the advanced version, the team can consider the use of USB rechargeable LEDs or rechargeable batteries to be more environmentally friendly in the long term.

The aesthetic aspect is good value because the combination of macrame rope, glitter foam, and flower ornaments make the product look more attractive than a plain bottle. Research on the acceptance of upcycled products shows that aesthetic value and positive emotions play an important role in encouraging the attitude and intention to buy upcycled products [20], [21]. Thus, Bottle Light needs to maintain its visual strength through harmonious color selection, neatness of cut, and consistency of ornament placement. Products can also be developed in several themes, such as pastel, vintage, floral, or minimalist themes.

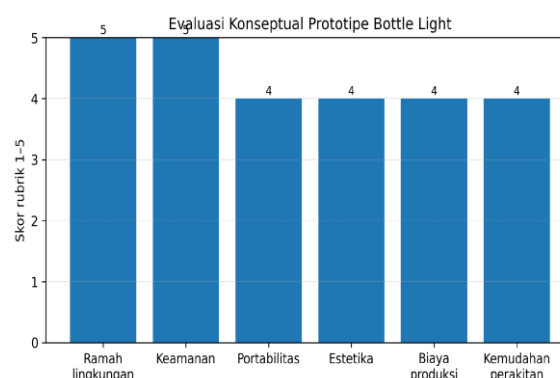


Figure 3. Conceptual evaluation of Bottle Light prototype based on internal rubric

3.4 Product Impact on the Environment, Consumers, and Entrepreneurship

Bottle Light's environmental impact lies in its ability to extend the life of plastic bottles. Each product unit utilizes one used plastic bottle as the main component. Although the contribution of one product to reducing waste is still small, the educational value is quite large because the product is easily understood by the community. People can see a direct connection between bottle trash and new products that have functionality. This kind of approach is important in sustainable education because direct practice can make environmental problems feel more real [1], [4].

From the user's side, Bottle Light offers functional and emotional benefits. Its main function is a decorative bedside lamp with warm white light that gives a calm atmosphere. Its additional function is table decoration and room decoration. The product can also be a gift because it has a handmade character and can be customized. Studies on the acceptance of recycled products show that consumers tend to consider environmental benefits, quality perception, safety, risk, and emotional appeal [20]. Therefore, Bottle Light's promotional narrative needs to balance an environmentally friendly message with evidence that the product is neat, safe, and pleasing to the eye.

From an entrepreneurial perspective, Bottle Light has potential as a micro business product because the basic ingredients are easy to obtain and the production process does not require large machines. Production activities can be done by small teams with the division of tasks: collection and cleaning of bottles, cutting, decoration, frame assembly, LED installation, quality control, content documentation, and marketing. Products can also be developed into upcycling workshop activities for schools, campuses, environmental communities, and creative events. This kind of workshop can create service income while expanding environmental awareness.

The recommended marketing strategy is to highlight the before-after transformation, that is from used plastic bottles to bedside lamps. Short video content is ideal because the process of cutting, installing glitter, wrapping macrame, and changing the atmosphere when the LED is lit has visual appeal. Research on the marketing of environmentally friendly products shows that environmental knowledge, green values, and transparency of benefits can help shape purchasing attitudes [19], [20]. Therefore, the promotion of Bottle Light should not only mention 'environmentally friendly', but also show the materials used, the cleaning process, the reason for using LEDs, and how to care for the product.

Initial cost analysis shows that the largest components are likely to come from LED candles, glitter foam, macrame rope, and glue. Used plastic bottles can be obtained at low cost through internal collection or cooperation with canteens, waste banks, and cafes. In order for the selling price to remain affordable, the team needs to standardize the size of the product, determine an efficient material package, and reduce the amount of foam waste. The product can be sold in three variants: standard, custom color, and gift package. The standard variant is suitable for quick production, the custom variant is suitable for personal orders, while the gift package can use greeting cards and recycled paper packaging.

The main problem of the product is the consistency of quality. Because used bottles have different shapes, sizes, and levels of clarity, the appearance of the product can change between units. The quality of the cut of the bottle and the neatness of the macrame winding also depend very much on the skill of the maker. To overcome these obstacles, the team needs to create a production SOP, cut pattern, quality inspection list, and color guide. The criteria for a product worthy of sale include lampshades that are not sharp, poles that do not shake, LEDs that are easy to light, glue that does not fall apart, decorations that do not come off easily, and products that can stand stable during use.

Future expansion can be directed at increasing security, sustainability, and resale value. From the safety side, it is necessary to test the surface temperature after the LED lights up for a certain duration, test the stability of the pole on a flat table, and test a light fall. From a sustainability perspective, products can use recycled paper packaging, rechargeable batteries, or disassembly systems so that components can be repaired. From the sales value side, the design can be expanded into color series, flower theme series, minimalist series, and event decoration series. If developed further, Bottle Light could be an example of a creative product that combines environmental innovation, aesthetics, and small business opportunities.

4. CONCLUSION

The development of Bottle Light shows that used plastic bottles can be transformed into decorative bedside lamps that have utility, aesthetic value, and environmental education value. This product uses the top of a plastic bottle as a lampshade, glitter foam as an ornament, galvanized wire as a frame, macrame rope as a pole covering, beads or flower stickers as a visual sweetener, and LED battery candles as a warm white light source. The planning results show that Bottle Light is able to present a warm light atmosphere, portable, safe because it does not use an open flame, and flexible placed on a study table, bedside table, or corner of the room. From the side of Eco-Recycle, this product gives a real example of upcycling simple materials into creative products that have the potential to be marketed. From an entrepreneurial perspective, Bottle Light can be developed through unit sales, custom orders, gift packages, and environmental education workshops. The limitations of the current product are the lack of actual customer survey data, the lack of long-term temperature and durability testing, and the lack of bottle size standardization and complete production SOP. The next development recommendation is to conduct user tests with potential customer respondents, create production standards, use rechargeable batteries, develop environmentally friendly packaging, and expand design variations so that products are more ready to be exhibited and sold as upcycling-based creative products.

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