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DESIGN OF FOLDABLE SNACK PACKAGING FOR CHILDREN AS AN EDUCATIONAL MEDIUM FOR WASTE RECYCLING CULTURE

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Abstract: This paper presents the design process of foldable snack packaging for children as an educational medium to promote waste recycling culture. The focus lies on the development stages, from conceptual exploration to prototype creation, without extending to testing or validation. The design innovation emphasizes foldability as a strategy to minimize waste volume and incorporates interactive and educational elements to encourage early environmental awareness. Twelve design prototypes were developed based on literature review, patent analysis, and iterative visual experimentation. The study highlights how visual communication design can contribute to sustainability education through packaging innovation. Future studies are encouraged to conduct usability testing and impact evaluation with children as users.
Keywords: children, education, packaging, recycling, sustainability

Abstrak*: Artikel ini memaparkan proses perancangan kemasan snack lipat untuk anak sebagai media edukasi dalam menumbuhkan budaya daur ulang sampah. Fokus penelitian terletak pada tahapan pengembangan mulai dari eksplorasi konsep hingga pembuatan prototipe, tanpa mencakup tahap pengujian atau pembuktian efektivitas. Inovasi desain menekankan aspek kemampuan lipat sebagai strategi pengurangan volume sampah serta mengintegrasikan elemen interaktif dan edukatif untuk mendorong kesadaran lingkungan sejak dini. Dua belas prototipe dikembangkan berdasarkan kajian literatur, analisis paten, dan eksperimen visual secara iteratif. Studi ini menyoroti kontribusi desain komunikasi visual dalam pendidikan keberlanjutan melalui inovasi kemasan. Penelitian lanjutan disarankan untuk melakukan uji kegunaan dan evaluasi dampak bersama anak sebagai pengguna.*
Kata kunci: *anak, berkelanjutan, daur ulang, edukasi, kemasan*

INTRODUCTION

The increasing environmental challenges posed by packaging waste, particularly in Indonesia, have created an urgent need for innovative solutions. While many studies emphasize eco-friendly materials, the issue of post-consumer waste volume remains critical. This research explores a design approach that integrates functional innovation and educational potential through foldable snack packaging for children. Children aged 7–11 years were selected as the target group due to their developmental readiness for interactive, educational design engagement. The research was conducted through literature review, analysis of existing patents, and the creation of prototype designs. Several patents related to foldable packaging and sustainable packaging materials were reviewed to identify structural approaches and material innovations, including foldable box systems and compostable packaging materials (Wong, 2013; Conroy T, 2010; Hietanen et al., 2020; Hui, 2009).

Research indicates that the incorporation of both verbal and non-verbal eco-information on packaging can effectively influence children's attitudes and behaviors towards sustainability (de Brabandere et al., 2022). Interactive design methods, including gamification and activities such as origami or scratch-off designs, have been shown to enhance children's cognitive engagement and foster environmentally responsible behaviors (Ahmed & Amir, 2021; Norton et al., 2023; Norton & Lignou, 2024). Educational interventions that integrate these strategies into curricula further reinforce sustainable practices (Buil-Fabregá et al., 2019; Mulder-Nijkamp et al., 2019). These findings provide a strong rationale for the current research focus on integrating educational and interactive elements into packaging design.

METHODS

This research applied a design-based approach emphasizing exploration and visual experimentation rather than empirical testing. The process consisted of three main stages: literature review, design development, and prototype creation.

Literature Review

A comprehensive desk research phase was conducted to determine key design directions. Findings confirmed that children aged 7–11 years are the optimal target group due to their ability to follow interactive instructions. Additionally, the research indicated the need for two packaging variations to cater to gender-specific preferences, alongside adopting a fun design approach to enhance user engagement.

Design Development

Building on a patented concept (IDS000008341 – “KEMASAN MAKANAN MAMPU LIPAT”), the research developed initial design templates featuring innovative folding and cutting patterns. Visual elements—such as vibrant colors, engaging characters, and interactive folding instructions—were incorporated to create an appealing and functional packaging design for children (Xiao, 2023).

Prototype Creation

The design development process culminated in the creation of 12 distinct prototypes. These prototypes showcased various themes, including designs inspired by game consoles, monsters, vehicles, and animals. The prototypes not only demonstrate the feasibility of reducing packaging waste

through foldable mechanisms but also embody the principles of sustainability education by integrating interactive design features.

Theoretical Modeling and Comparative Synthesis. To theoretically support the design's potential for reducing waste and serving as an educational medium, this study complements the design-based process with two non-empirical analyses: (1) a literature comparison identifying previous evidence on interactive packaging and school-based recycling behavior (Ahmed & Amir, 2021; de Brabandere et al., 2022; Norton & Lignou, 2024; Wardani et al., 2025), and (2) a conceptual modeling stage that maps the foldable mechanism to potential waste-volume reduction and environmental learning outcomes (Aydın et al., 2025; Bher & Auras, 2024; Chen et al., 2018).

This synthesis provides a theoretical rationale for the design choices while acknowledging that empirical validation through usability and behavioral testing is beyond the current research scope.

RESULTS AND DISCUSSION

The design process resulted in twelve prototype concepts reflecting both functional and aesthetic exploration of foldable snack packaging. Each prototype emphasizes visual engagement, material efficiency, and educational messaging. The results illustrate how packaging can function as a communication medium promoting environmental awareness through playful learning. Representative samples are presented in Figure 1-4:

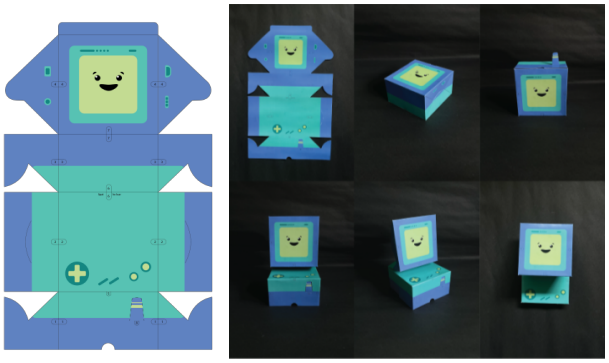

Figure 1. Prototype designed as a game console character, targeting both boys and girls
Source: Personal Documentation (2024)

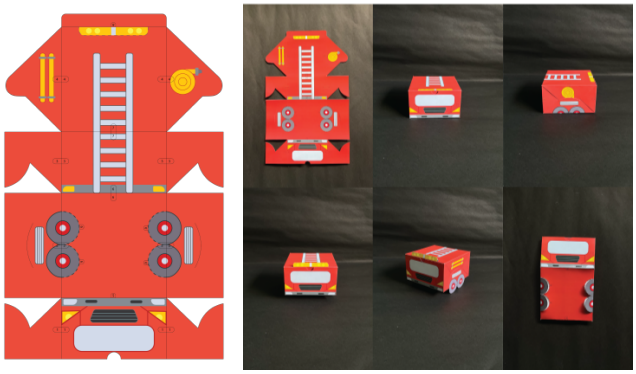

Figure 2. Prototype modeled after a fire truck, specifically targeting boys
Source: Personal Documentation (2024)

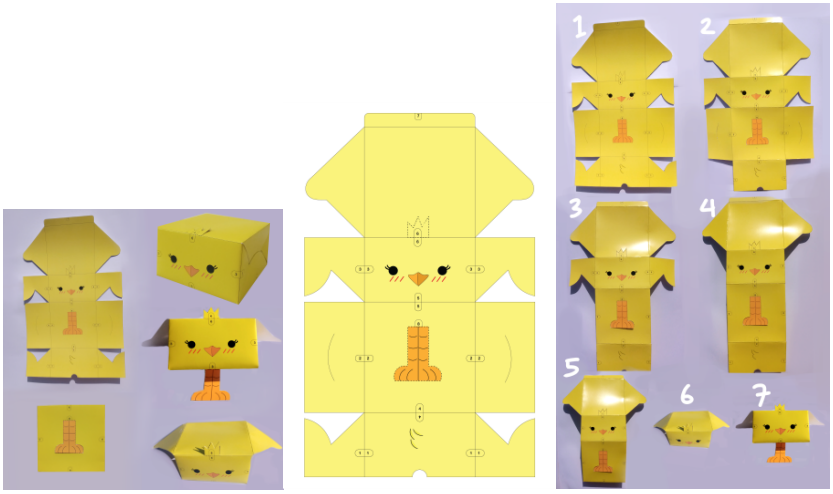

Figure 3. Prototype takes the form of a chick, intended for both boys and girls
Source: Personal Documentation (2024)

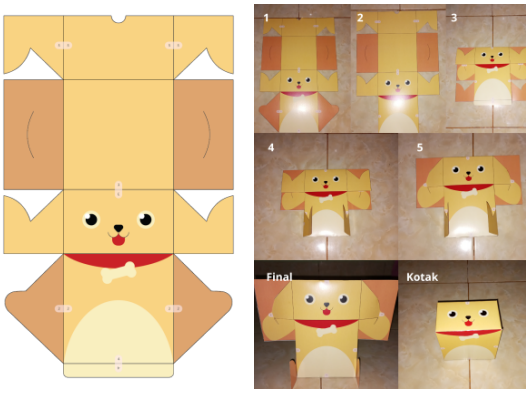

Figure 4. Prototype shaped like a dog, appealing to both boys and girls
Source: Personal Documentation (2024)

Figure 1 shows a prototype designed as a game console character, targeting both boys and girls, emphasizing playful interaction and visual familiarity. Figure 2 llustrates a prototype modeled after a fire truck, specifically targeting boys. Meanwhile, Figure 3 presents a chick-shaped prototype intended for both boys and girls, highlighting a softer and more universally appealing character form. Figure 4 shows a dog-shaped prototype designed to appeal to both boys and girls.

Studies have shown that eco-information on packaging and interactive design features can foster sustainable behaviors (Ahmed & Amir, 2021). This aligns with the current prototypes, which are designed not only to reduce waste but also to serve as a medium for teaching children about recycling and environmental responsibility.

Although the research objectives were fully achieved in the design development phase, the next logical step is user testing. It is recommended that future research incorporate comprehensive user testing to validate the usability and educational impact of the prototypes in real-world settings.

The scenario simulation of volume reduction was conducted to estimate potential volume savings from the foldable design (Aydın et al., 2025; Bher & Auras, 2024). Using a representative snack box (10 × 8 × 5 cm)

and a folded profile (10 × 8 × 1.5 cm), the design yields a 70 % reduction in occupied volume per unit. Scaled to 1,000 units per day, the folded configuration reduces the daily volume from 0.40 m^3 to 0.12 m^3, saving 0.28 m^3 per day under full-adoption assumptions. These theoretical estimates demonstrate the potential logistical benefits of foldable packaging and support its conceptual alignment with sustainability goals (Chen et al., 2018; Wardani et al., 2025).

CONCLUSION

This study highlights the design process behind foldable snack packaging as an educational medium for children. Through twelve developed prototypes, the study demonstrates the potential of packaging design to combine function, education, and sustainability values. The integration of foldability and interactive visual design offers a theoretically grounded approach to reducing waste volume and fostering environmental learning

The findings contribute to design discourse by emphasizing process-based innovation rather than empirical validation. Future work should extend toward testing usability and learning outcomes among children users to empirically validate the theoretical assumptions developed in this study.

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