Extended Abstract
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Design for Evolving Play: Exploring Levels of Adaptability in Toy Design

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Introduction

The short lifespan of children's toys, driven by rapid child development and desire for novelty, causes significant resource loss and waste (Robertson-Fall, 2021; Watkins & Mestre, 2019). Many parents discard still-usable toys, and children often lose interest in new ones quickly (Choi & Kennedy, 2024; Robertson-Fall, 2021). Addressing this issue requires rethinking toy design, production, and use.

Open-ended (Fousteri & Liamadis, 2021) and emotionally durable toys (Heljakka, 2022) tend to last longer. A promising approach for these is developing evolving toys adopting half-way design approach. Half-way design involves partially designing and manufacturing products, allowing users to complete and personalise them (Fuad-Luke, 2009). Such adaptability can extend toy lifetimes by fostering product attachment and meeting changing user needs. Evolvability requires modularity and rethinking product structures as component systems (Doğan, 2017). Local production of these also offers environmental, social, and economic benefits (Doğan & Walker, 2008). Existing toy systems such as Free Universal Construction Kit (Stephensen & Hansen, 2015) and TOYI (toyi.io, n.d.) exemplify how modularity and adaptability can support evolving play experiences.

This paper addresses limited research on applying these principles to toy design by presenting a project conducted at Yaşar University, Department of Industrial Design. It explores design considerations for toy connectors that promote adaptability, evolving play experiences, and extended toy lifetimes.

Design Project and Method

In the “toy connection parts for evolving play” project, 3D-printed connectors allowing children to construct personalised and evolving toys in the design and use phases were created. Adopting half-way design approach, third-year design students developed downloadable connectors for local production, allowing form, size, color, and texture adjustments. Designed to combine with household waste like cork and cardboard, the connectors promote personalisation, rebuilding, and upcycling.

Eight students developed five toy kits targeting specific age groups and toy types. The researcher conducted visual content analysis to assess their adaptability, followed by expert discussions to develop themes.

Results and Discussion

Table 1 summarizes each project. Four adaptability levels—*surface, form, function, and structure*—were identified, fostering toy evolvability (Table 2).

Surface adaptability involves altering a toy’s visual qualities (e.g. color, texture) through personalisation of re-used materials and 3D-printing without changing form, function, or structure. All projects enabled this, allowing children to personalise toys and narratives, which can foster a personal connection with the toy—an element often missing in mass-produced toys. However, surface adaptability alone may not extend toy use as it may not alter how the toy is played. For instance, P4 supports only surface adaptability and one product form, limiting open-ended play.

Form adaptability involves changing a toy’s form during use. *Part variety* (P2, P3) and *versatile design details allowing multi-angle connections* (P3, P5) supported this. Adaptable forms influence how toys are interpreted and played with, enabling evolving functions and narratives. Changing function without altering form relies on children's imagination, as they adapt the same object to different scenarios, making adaptable forms valuable for open-ended play.

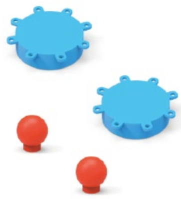
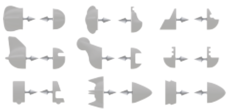
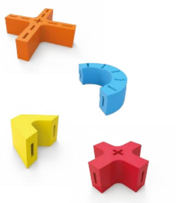
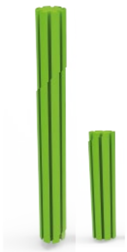
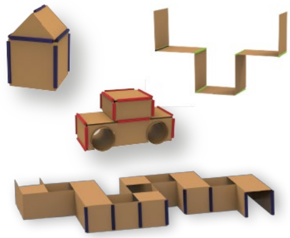
PROJECT EXPLANATION	CONNECTORS	RE-USED MATERIALS	VARIATIONS
P1 lets children create musical toys by attaching a cardboard tube to connectors, adding sound materials, and using pencils and spheres as mallets, all of which can be personalised through decoration, alternative pencils, and varied sound materials. By Yağmur Doğan, Deniz Kızıldereli			
P2 features 18 connectors that attach to corks to create vehicles, which can be personalised by decorating the corks. By Utku Serinoğlu			
P3 involves connectors attaching popsicle sticks at different angles, allowing structures to be built and further personalised by decorating the sticks. By Ece Öner, Sena Tokul			
P4 has five parts connecting cardboard tubes and a rubber band, forming a wind-up toy that is personalised through decoration. By Berkay Kazak			
P5 features a connector 3D-printed at different heights, attaching to cardboard at various angles with further personalisation by decorating cardboard. By Melisa Alşan, Zeynep Tuğrul			

Table 1. Summary of the student projects

Functional adaptability changes a toy's primary purpose. A vehicle toy that remains the same after user intervention lacks functional evolvability, but one that transforms into different vehicles can evolve. P2, P3, and P5 evolve functionally due to part variety (P2, P3) and versatile design details (P5), while P1 and P4 do not, which retain their initial functions. Functional adaptability can be the most critical for toy longevity as it increases open-ended play possibilities, encouraging imaginative play, problem-solving, and storytelling.

Structural adaptability involves expanding a toy in one or more directions. P1 expands in one direction *using a longer tube,* while P3 and P5 expand in multiple directions due to *part variety*

(P3) and *versatile design details* (P3, P5). Structural adaptability in multiple directions, facilitates adaptable forms and functions, and promote open-ended play and continuous experimentation, which can extend the useful life of a toy.

	Surface	Form	Functional	Structural
P1	+	-	-	+
P2	+	+	+	-
P3	+	+	+	+
P4	+	-	-	-
P5	+	+	+	+

Table 2. Adaptability levels offered by each project.

The half-way design approach added construction play to the play experience as seen in P1, where a maracas became a construction toy. Thus, the approach may enhance the play value of toys. It also enabled personalisation through integrating re-used materials, which may promote attachment that needs to be studied further.

Part variety and versatile design details contribute to evolving forms, functions, and structures, which are essential for open-ended play. P5 demonstrates that even without part variety, versatile design details alone can support evolvability. However, when part variety does not allow structural evolvability, as in P2, the number and diversity of parts become crucial for maintaining open-endedness and functional evolvability.

Conclusions

This study explored how toys can evolve adopting half-way design approach, identifying four adaptability levels—surface, form, function, and structure—and their implications for toy longevity. Functional adaptability emerged as the most critical for open-ended play and longevity, enhancing toys' versatility for various play contexts. Surface adaptability alone may foster attachment but be insufficient for longevity. Part variety and versatile design details can facilitate evolvability and open-ended play. Designers can consider these adaptability levels and design attributes when creating toy connection parts for evolving and enduring play experiences.

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