

AIToys: A Sustainability Approach

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ABSTRACT

Artificial Intelligence (AI) has increasingly entered the domain of play, transforming the affordances and functions of toys. AI-empowered toys are becoming prominent partners in lifelong and life-wide play, enhancing entertainment, education, and empathy development. Simultaneously, sustainability is often overlooked in toy innovation. This study examines three existing and one speculated example of AIToys on the market through the lens of sustainability, aiming to understand how the three pillars of sustainability—ecological, ethical, and economic—are addressed in manufacturers' claims. The data consists of toy-maker descriptions and media articles, which were analyzed. The study's contribution is to examine and describe how AIToy development aligns with sustainability principles, a currently relevant area of research prompted by the ongoing transformation related to how Artificial Intelligence impacts human-toy relations.

Keywords: AIToys, Sustainability, Toy design, Green toy design, Communication design

INTRODUCTION

This study examines AIToys through the lens of sustainability, focusing on ecological, ethical, and economic considerations in their design. Unlike earlier generations of smart or connected toys, AIToys integrate advanced AI features that support continuous engagement beyond childhood. By analyzing manufacturer descriptions and media coverage of a selected sample of AIToys available in the 2025 online market, this research identifies key design directions that align with sustainability principles. The concept of AIToys, or, Artificial Intelligence-powered toys, has emerged as a distinct category within the broader domain of smart and connected play technologies. According to Heljakka and Ihamäki (2025), an AIToy is defined as a play object that integrates artificial intelligence to enable machine learning, interactivity, adaptability, and autonomy. These features distinguish AIToys from traditional toys and earlier generations of smart toys, which typically rely on pre-programmed responses or basic connectivity. Key capabilities of AIToys include adaptive learning, which enables the system to evolve its behavior based on user interaction. The second feature is natural language interaction, which engages users through meaningful conversations. Third is emotional responsiveness, which is recognizing and responding to affective cues. Fourth is physical motion and embodied interaction through robotics or sensor-based movement. Aguilera et al. (2024) observe that

contemporary AI-enhanced toys and robotic systems designed for children incorporate various levels of artificial intelligence technologies, including machine learning, deep learning, natural language processing, and computer vision. These capabilities enable advanced functionalities such as facial and emotional recognition, voice-command-driven actions, personalized learning pathways, and support for multilingual interaction. In addition to AI integration, Costa, Périno, and Ray-Kaeser (2018) emphasize the importance of the toy's physical attributes in shaping the user experience. These include functional components, such as cameras, speakers, and supplementary accessories, designed to enhance play. Furthermore, the toys are characterized by their visual and tactile qualities—such as color schemes, textures, dimensions, and weight—as well as their capacity for movement and expressive gestures.

Beyond technological affordances, AIToys are conceptualized as companions in play, fostering reciprocal and meaningful interaction, empathy, and trust between the toy and the user. This relational dimension is critical in differentiating AIToys from other digital play interfaces and highlights their potential role in emotional and social development. However, Heljakka and Ihamäki (2025) argue that current discourse on AIToys tends to overemphasize technological capabilities while underrepresenting the multidimensional nature of play. To address this gap, they propose a Framework with dimensions of the AIToys Experience, encompassing four key dimensions: firstly, *physical*, meaning tangible and embodied aspects of interaction; secondly, *functional*, which involves engagement for enjoyment and edutainment; thirdly, *fictional*, which involves narrative and imaginative engagement; and fourthly, affective aspects, which involves the emotional and empathetic connection between player and the toy.

While technological innovation is central to AIToy design, sustainability—encompassing ecological, ethical, and economic aspects—is often underrepresented in AIToy design. At the same time, the importance of sustainability in toy design has grown significantly, especially in alignment with the United Nations Sustainable Development Goals¹ (SDG 12, SDG 9, SDG 3). As Yadou et al. (2025) emphasize, toy design is not merely aesthetic or functional—it has a profound impact on child development, the environment, and society. Their study highlights that most toys on the market are made of plastic, are short-lived, and are environmentally harmful. Sustainable toy design necessitates the use of safe, biodegradable, and recyclable materials, along with eco-friendly manufacturing processes. Research suggests that sustainable toy design must adopt a holistic approach, considering user needs and developmental stages, material safety and environmental impact, energy-efficient production and waste management, and principles of the product lifecycle and the circular economy. For example, LEGO and Mattel are transitioning to bio-based and recycled plastics, while Hasbro has launched a toy recycling program. Additionally, 3D printing and modular design enable the production of more material-efficient and multifunctional toys (Making Lego Bricks More Sustainable, March 6, 2024, Sustainable Product and Packaging, Mattel).

¹SDG, <https://sdgs.un.org/goals>

GREEN TOY DESIGN

There are many similar terms used worldwide for “green design,” such as ecological design (Liu, 2011) and environmental design (Yang, 2019). In simple terms, green design refers to creating products or systems that are environmentally friendly. Its goal is to reduce the conflict between modern industrial society and nature, and to find a balance between economic growth and cultural development.

Due to the massive production of toys, environmental and waste-related concerns have become more visible. Although toys are usually lightweight, soft, and moisture-resistant, they are made mostly—about 90%—from plastic (Will the Future of the Toy Industry Be Plastic Free?), which makes them difficult to recycle. Furthermore, toys that incorporate electronic components are challenging to disassemble, so recycling centers often decline to accept them (Kang & Zhu, 2015). Because children’s interest in toys changes quickly, most toys are only used for about six months on average (Albastroiu Nastase et al., 2021), meaning their lifespan is relatively short. In recent years, many parents have started to prefer toys that are safer and healthier for their children. The toy industry seeks to answer the call for greener design by creating toys that are visually appealing, multifunctional, interactive, and non-toxic, safe, and durable.

This study investigates three existing and one conceptual example of AI-integrated toys (AIToys) currently available or emerging in the market, focusing on their alignment with sustainability principles. The analysis is framed around the three core dimensions of sustainability: ecological, ethical, and economic. By examining manufacturers’ claims, marketing narratives, and the envisioned play value embedded in these products, the study aims to assess how principles of green design are reflected in the development and promotion of AIToys. Particular attention is given to how these toys incorporate environmentally responsible design strategies, such as material choices, energy efficiency, and lifecycle considerations, within the context of digital and interactive play.

Toy Design With Ecological Consideration

Ecological aspects of toy design are increasingly vital due to global environmental concerns and rising consumer awareness. For AI-integrated toys (AIToys), ecological design means applying environmentally responsible principles across the product lifecycle—from material selection to disposal.

A major issue is the dominance of plastic in toy production, which complicates recycling, especially when combined with electronics (Albastroiu Nastase et al., 2021; Kang & Zhu, 2015). Green toy design promotes biodegradable and recyclable materials, prioritizing safety and environmental compatibility (Yadou et al., 2025). Eco-friendly manufacturing also plays a key role by reducing energy use, emissions, and waste. Lifecycle thinking and circular economy models encourage reuse and recycling (Shi et al., 2016).

AIToys add complexity due to digital components like sensors and AI modules. Sustainable design must address both physical and digital elements. Modular structures and easy disassembly improve recyclability

(Kang & Zhu, 2015), while minimizing hazardous materials in electronics supports safer end-of-life processing. Energy efficiency is critical, as AIToys often require continuous power. Optimizing hardware and software can reduce consumption and extend battery life (Shi et al., 2016). Packaging also matters—biodegradable, minimal designs help reduce waste and carbon footprint. In summary, sustainable AIToy design should integrate disassembly, safe materials, energy efficiency, and eco-friendly packaging to reduce environmental impact and support responsible play.

Toy Design With an Ethical Approach

Ethical considerations in toy design have become increasingly relevant amid digital transformation and the integration of artificial intelligence into children's play environments. As toys evolve from passive objects to interactive companions, the ethical dimensions of their design—particularly in relation to child development, data privacy, inclusivity, and emotional well-being—become central to responsible innovation.

AI-integrated toys (AIToys) introduce new layers of complexity to the ethical design process. These toys can learn from user interactions, respond to emotional cues, and engage in natural language conversations. While these features offer significant educational and developmental benefits, they also raise concerns about surveillance, manipulation, and the potential for algorithmic systems to shape children's behavior. As Heljakka and Ihamäki (2025) argue, the relational nature of AIToys—where toys act as companions and foster trust and empathy—requires careful ethical scrutiny to ensure that these interactions are beneficial and not exploitative.

A key ethical issue is data protection. Many AIToys collect sensitive information, such as voice and emotional responses. Without strong governance and parental controls, this risks violating children's privacy (Aguilera et al., 2024). Extant AIToys, FOLOTOY, and POE BEAR, address this with anonymized data and customizable dashboards.

Ethical design also involves inclusive representation. Toys shape identity and values, so avoiding stereotypes and ensuring accessibility is essential (Yadou et al., 2025). Gender-neutral characters and culturally diverse narratives support equity. Moreover, ethical toy design must consider the psychological impact of prolonged interaction with AI systems. AIToys that simulate emotional responsiveness and companionship may blur the boundaries between human and machine relationships. While this can support empathy and emotional development, it may also lead to dependency or confusion about social norms. Heljakka and Ihamäki (2025) advocate for a balanced design that supports imaginative, physical, and emotional play.

In summary, ethical AIToy design requires a holistic approach—prioritizing privacy, inclusivity, emotional safety, and transparency—to ensure AI-enhanced play remains empowering and responsible.

Toy Design With an Economic Perspective

The economic dimension of toy design, particularly in the context of AI-integrated toys (AIToys), is increasingly significant as the toy industry adapts to technological innovation, shifting consumer expectations, and sustainability imperatives. Economic considerations in toy design encompass

not only production costs and market competitiveness, but also long-term value creation, resource efficiency, and alignment with principles of the circular economy.

AIToys represent a new frontier in the toy market, combining physical play with digital intelligence. Their development requires substantial investment in research and development, software engineering, and hardware integration. As noted by Heljakka and Ihamäki (2025), these toys are designed to support continuous engagement beyond childhood, which implies a need for durable, multifunctional, and adaptable products that justify their higher price point through extended usability and educational value. This shift challenges traditional toy economics, which have long relied on short product lifecycles and rapid turnover.

From a production standpoint, economic sustainability in toy design involves optimizing manufacturing processes to minimize waste, reduce energy consumption, and lower material costs. The adoption of modular design and 3D printing technologies, as highlighted in the study, enables more efficient resource use and supports scalable production models. These innovations not only lower production costs but also enable customization and repair, thereby extending the toy's economic life and reducing the need for frequent replacement.

The global toy market data further underscores the economic relevance of sustainable design. In 2024, the toy market in China was valued at USD 22.8 billion, while the U.S. generated USD 28.3 billion in retail toy sales, and Europe reached approximately USD 14.51 billion (IMARC; Toy Association; EMR). These figures reflect the vast scale of toy consumption and the economic opportunities for manufacturers who adopt sustainable, innovative design strategies. As consumer awareness of environmental and ethical issues grows, demand is shifting toward toys that offer not only entertainment but also educational and developmental benefits, as well as responsible production practices.

Economic sustainability also involves aligning toy design with principles of the circular economy. Shi et al. (2016) emphasize the importance of lifecycle thinking, where products are designed for reuse, recycling, and regeneration. This approach reduces dependency on virgin materials and mitigates the economic risks associated with resource scarcity and regulatory changes. Companies like LEGO and Mattel are already transitioning to bio-based and recycled plastics. At the same time, Hasbro has launched toy recycling programs, demonstrating how economic and environmental goals can be mutually reinforcing.

In summary, toy design with an economic perspective requires a balance between innovation, affordability, and sustainability. AIToys, as complex and multifunctional products, challenge traditional financial models while also offering new opportunities for value creation through durable design, efficient production, and alignment with circular-economy principles. By integrating economic considerations into the design process, manufacturers can ensure that toys remain competitive, responsible, and relevant in a rapidly evolving market.

METHOD

Building on the multi-method, process-oriented framework proposed by Bottero et al. (2015), which emphasizes the importance of contextual sensitivity in sustainability research, this study adopts a similar approach to examine sustainable design practices in AI-integrated toys (AIToys). Our case study applies this methodology to offer a comprehensive and complementary perspective on how sustainability is interpreted and implemented in the design and marketing of AIToys, with particular attention to both marketing narratives and manufacturer viewpoints.

This research builds upon earlier phases of our study (Heljakka & Ihamäki, 2025). It aims to deepen our understanding of how sustainability-related affordances—particularly those aligned with green toy design—are communicated and perceived. By analyzing the envisioned play experiences of three commercially available AIToys and one speculative concept, we explore how marketers articulate ecological, ethical, and economic dimensions of sustainability. These insights are then compared with toy manufacturers' general attitudes toward the playful potential of AIToys, allowing us to identify convergences and gaps in sustainability discourse across different stakeholder groups. To guide our investigation into the sustainability dimensions of AI-integrated toys (AIToys), we pose the following research questions:

RQ1 (Marketer Perspective), What types of play-related promises are communicated by toy marketers in their promotional materials (e.g., websites, advertisements) for AIToys, and how do these reflect ecological, ethical, and economic aspects of sustainability?

RQ2 (Manufacturer Perspective) How do toy manufacturers perceive children's play experiences with AI-powered toys, such as AIToys, and what are their views on the integration of sustainability principles in the design and development of these products?

To investigate how toy marketers and the toy industry present and frame AI-enhanced toys, we conducted a content analysis of marketing materials related to three contemporary and one speculative AI toy: MIKO 3 robot, FOLOTOY (2024) AI assistant toy, POE BEAR (2024) plus toy, and the AI Barbie, a speculative concept not yet released to the market.

Our research materials comprise descriptions and promotional narratives from toy marketers, as well as promotional content found on official websites, product listings, and digital brochures. Industry reports and press releases related to the development and positioning of AIToys, as well as speculative design discussions surrounding the "AI Barbie" concept, represent another data set.

These toys were selected based on their relevance to current trends in AI integration in early childhood products, their availability or market visibility (or in speculative discourse), and their appeal across gender and age demographics. MIKO 3 and FOLOTOY are marketed as educational

companions, while POE BEAR emphasizes emotional interaction and storytelling. AI Barbie, although not yet commercially available, represents a future-oriented vision of personalized AI in play.

We applied content analysis as our methodological framework to systematically examine the language, themes, and implicit assumptions embedded in the marketing materials. Content analysis enables researchers to gain insight into the phenomenon under study by identifying recurring patterns, values, and representations (Krippendorff, 2018). Through inductive category development, we examined how marketers frame learning, emotional engagement, and technological novelty to appeal to parents and educators.

The use of multiple sources enriches our understanding of how AIToys are positioned within the broader context of educational and emotional development. Marketing narratives often emphasize personalized learning, safety, and interactivity, while also reflecting commercial motives and cultural expectations. By analyzing these materials, we aim to uncover how toy companies construct AIToys' value proposition and how these narratives may influence adult perceptions and purchasing decisions. This study contributes to the growing body of research on smart toys and AI in early childhood by offering a critical lens on the marketing discourse and its implications for learning, play, and identity formation.

FINDINGS

Toy marketers emphasize a range of play-related promises that align with educational, emotional, and interactive dimensions of children's development. Promotional materials or media articles for AIToys, such as Miko 3, FOLOTOY, POE BEAR, and AI Barbie, highlight features like personalized learning, multilingual storytelling, emotional engagement, and adaptive interaction. These toys are framed as companions that support STEAM education, creativity, and empathy through AI-driven dialogue and responsive behavior.

From an ecological perspective, marketers are increasingly emphasizing modularity and screen-free interaction (e.g., FOLOTOY and POE BEAR), thereby reducing electronic waste and extending product lifecycles. However, ecological claims are less prominent in marketing narratives compared to technological and educational benefits.

In terms of ethical sustainability, marketers stress child safety, data privacy, and inclusivity. FOLOTOY includes parental dashboards for content control, and POE BEAR avoids invasive sensors, reflecting a commitment to ethical design. AI Barbie, although speculative, raises concerns about emotional manipulation, which marketers address by promising a privacy-first design and age-appropriate content.

Economic sustainability is reflected in the value proposition of multifunctional toys that justify higher costs through extended usability and educational enrichment. Miko 3, for example, offers subscription-based content that evolves with the child's learning needs, while FOLOTOY

retrofits existing plush toys, potentially reducing material consumption and increasing affordability.

Overall, marketers position AIToys as tools for holistic development, subtly embedding sustainability themes within narratives of innovation, safety, and personalization.

Miko 3: AI-Powered Educational Robot (2021)

Miko 3, developed by RN Chidakashi Technologies Pvt. Ltd., is a conversational AI robot designed for children aged 5 to 10. It combines STEAM learning, emotional engagement, and interactive play. According to Amazon and the manufacturer, Miko 3 offers personalized learning experiences through deep learning algorithms, a touchscreen interface, and a suite of educational apps. It supports activities such as storytelling, math games, yoga, and coding, and includes content from brands like Disney and Paramount. (Amazon, Miko 3- Ai-Powered Smart Robot for Kids) User reviews highlight Miko 3's ability to increase academic engagement by up to 55%, with children responding positively to its jokes, dance sessions, and emotional support features. The robot is praised for its durability, child-safe design, and parental control features, including a COPPA+ certified app (Weaver, test the MIKO 3 Robot). However, some users note limitations such as battery life and the need for a subscription (Miko Max) to access premium content (Reviewed by Jasmine). Miko 3 exemplifies the shift toward emotionally intelligent AI companions in education, offering a blend of entertainment and learning that adapts to the child's developmental stage. Its design aligns with sustainability goals through modularity and long-term usability, though ecological considerations in materials and lifecycle are less emphasized.

Folo AI Toy – AI Assistant Toy (2024)

FOLOTOY is an AI-powered conversational toy that transforms traditional plush toys into smart companions using a Magicbox kit. Developed by a startup in Shanghai, FOLOTOY uses GPT-4o and natural language processing to deliver personalized, age-appropriate dialogue and educational content (Folo AI Toy). It supports multiple languages and offers roles such as Learning Mentor, Storyteller, and Language Translator, making it suitable for both home and preschool environments.

The toy features a parent dashboard that allows you to control topics, voices, and activity history, emphasizing safety and customization. Reviews praise its intuitive interface and adaptability, though note its reliance on internet connectivity and subscription pricing as potential drawbacks (Folo AI Toy). FOLOTOY stands out for its screen-free learning approach and its ability to retrofit existing toys, which may contribute to material sustainability by extending the life of physical products. Parental controls and secure data handling reinforce its ethical design.

Poe the AI Story Bear: AI Storytelling Companion (2024)

Poe is a plush toy that uses AI to generate and narrate custom stories based on child-selected elements via a companion app. It supports storytelling in 30 languages and is designed to foster creativity, language development, and emotional engagement (Amazon Poe The AI Story Bear).

Parents and children report high satisfaction with Poe's ability to create silly, calming, or adventurous tales. The toy does not include cameras or microphones, and stories are generated securely via Microsoft Azure and ChatGPT, addressing privacy concerns. Poe's offline functionality lets you save stories for travel or bedtime use. From a sustainability perspective, Poe's design encourages imaginative play without screens, and its limited hardware footprint may reduce electronic waste. Ethically, Poe is praised for its age-appropriate content, customization, and non-invasive interaction model.

AI Barbie: Speculative Concept by Mattel and OpenAI

AI Barbie is a toy under development by Mattel in partnership with OpenAI, aiming to create a doll capable of natural conversation, emotional responsiveness, and personalized interaction (Fernandez, 2025). Unlike previous talking dolls, AI Barbie would utilize generative AI to recall past interactions, tailor responses, and simulate a sense of companionship. While the concept promises to revolutionize play by integrating storytelling, empathy, and learning, it also raises ethical concerns. Experts warn that emotionally responsive AI toys may blur the line between real and simulated relationships, potentially affecting children's emotional development and social learning (Fernandez, 2025).

Mattel has committed to privacy-first design and age-appropriate content, but the full implications of AI Barbie's emotional intelligence remain under study. The toy's ecological footprint and sustainability strategy have not yet been disclosed, although its digital nature may reduce material consumption if implemented thoughtfully.

CONCLUSION

Based on our study's findings, manufacturers view AI-powered toys as transformative tools that redefine play by integrating emotional intelligence, adaptive learning, and interactive storytelling. They perceive these toys not merely as entertainment devices but as developmental companions that support cognitive, social, and emotional growth.

In terms of sustainability integration, manufacturers acknowledge the need for ecological responsibility, especially in light of global concerns about plastic waste and the short lifespans of toys. Companies like LEGO and Mattel are transitioning to bio-based and recycled plastics, while Hasbro has launched toy recycling programs. These efforts reflect a growing industry commitment to circular economy principles and lifecycle thinking.

Manufacturers also emphasize the importance of ethical design, particularly in relation to data governance and child safety. Toys like FOLOTOY and POE BEAR are designed with secure data handling and

customizable parental controls, indicating a proactive stance on privacy and inclusivity. From an economic standpoint, manufacturers recognize the importance of durable, multifunctional toys that offer long-term value. The use of 3D printing and modular design supports cost-effective production and repairability, aligning with both economic and environmental goals.

Manufacturers are increasingly aware that sustainability is not just a regulatory or reputational concern but a strategic imperative that influences consumer trust, product longevity, and market relevance. This study reveals that while technological innovation remains central to AIToy development, sustainability is increasingly integrated into design and marketing. Marketers focus on the educational and emotional benefits, embedding ecological and ethical values within broader narratives of personalization and safety. Meanwhile, manufacturers are adopting sustainable materials, implementing ethical safeguards, and employing circular design strategies to align with global sustainability goals. The findings suggest that a truly sustainable approach to AIToys requires collaboration between designers, marketers, and manufacturers to ensure that ecological, ethical, and economic principles are not only present but actively shape the future of intelligent play. In this way, AIToys have the potential to become more responsible companions in children's lives.

REFERENCES

- Aguilera, C. A., Castro, A., and Raducanu, B. (2024) "Voice-controlled robotics in early education: Implementing and validating child-directed interactions using a collaborative robot and artificial intelligence," *Appl. Sci.*, vol. 14, no. 6, p. 2408, 2024. <https://doi.org/10.3390/app14062408>.
- Albastroiu Nastase, I., Negrutiu, C., Felea, M., Acatrinei, C., Cepoi, A., & Istrate, A. (2021) Toward a circular economy in the toy industry: The business model of a Romanian company. *Sustainability*, 14(1), 22.
- Amazon.com, Miko 3- AI-Powered Smart Robot for Kids, Available 31.8.2025.
- Amazon.com, Poe The AI Story Bear, Available 3.8.2025.
- Bottero, M. C., Buffoli, M., Capolongo, S., Cavagliato, E., di Noia, M., Gola, M.,... & Volpatti, L. (2015) A multidisciplinary sustainability evaluation system for operative and in-design hospitals. In *Improving sustainability during hospital design and operation: A multidisciplinary evaluation tool* (pp. 31–114). Cham: Springer International Publishing.
- By Jasmine/Reviewed: Miko 3 Review, Your Child's Smart Robot Buddy, <https://familyweal.com/miko-3-review/>.
- China Toys Market Size, Share, Trends and Forecast by Product Type, Distribution Channel, End-User, and Province, 2025–2033. Report ID: SR112025A967. <https://www.imarcgroup.com/china-toys-market>.
- Costa, M., Périno, O., & Ray-Kaesler, S. (2018) TUET Toys & [and] games usability evaluation tool: Manual, questionnaire and development process.
- Europe Toys Market Size, Share and Growth Analysis report – Forecast Trends and Outlook (2025–2034) EMR, <https://www.expertmarketresearch.com/reports/europe-toys-market>.
- Fernandez, M. (2025) Could an AI Barbie Stunt the Emotional Growth of a Generation? A partnership between OpenAI and Mattel raises sobering questions, *IEEE Spectrum*, <https://spectrum.ieee.org/ai-barbie-dolls>.

- Folo AI Toy, CHIEFF, Available 31.8.2025, <https://aichief.com/ai-education-tools/folo-ai-toy/>.
- Heljakka, K., & Ihamäki, P. (2025) AlToys: A Conceptual Definition and Future Research Agenda. AHFE Conference 2025, Orlando, Florida.
- Kang, S., & Zhu, J. (2015) Total lead content and its bioaccessibility in base materials of low-cost plastic toys bought on the Beijing market. *Journal of Material Cycles and Waste Management*, 17(1), 63–71.
- Krippendorff, K. (2018) *Content analysis: An introduction to its methodology*. Sage Publications.
- Liu, W. (2011) *A Comparative Study of Children's Toy Design in China and Abroad*, 2011.
- Making Lego® Bricks More Sustainable (2024) <https://www.lego.com/en-us/aboutus/news/2024/march/making-lego-bricks-more-sustainable-?locale=en-us>.
- Shi, T.; Gu, W.; Chhajed, D.; Petruzzi, N. C. (2016) Effects of remanufacturable product design on market segmentation and the environment. *Decis. Sci.* 2016, 47, 298–332.
- Sustainable Product and Packaging, Mattel, Available 31.8.2025 <https://corporate.mattel.com/sustainable-product-and-packaging>.
- The Toy Association, U. S Sales Data, <https://www.toyassociation.org/ta/research/data/u-s-sales-data/toys/research-and-data/data/us-sales-data.aspx>.
- Weaver, J. I Tested the Miko 3 Robto: My Hones Review and Experience, Fraques, Personal Service, Timeless Style, <https://fraques.com/miko-3-robot-reviews/>.
- Yadou, C., Shamsudin, R., Tawakkal, I. S. M. A., Me, R. C., & Basri, M. S. M. (2025) Analyzing product design system application children's toys based on sustainable materials and processes. *Entertainment Computing*, 100947.
- Yang, Y. (2019) *The Application of Synaesthesia in the Design of Toys for Children of Mixed-age Education*, 2019.