

Strategic Eco-Play: Rethinking through Sustainable Design

Shivang Chauhan and Anupam Rana

Abstract

Different types of board games are created globally. Many of these games contribute to the use of plastic, wood, and paper, which affects the ecosystem of our planet. Getting rid of board games is an added burden considering the waste created and resources consumed. This research aims to address this growing issue and investigate the use of innovative product designs. A review of literature shows that sustainable design is becoming more important and popular for consumer goods. Thus, the study focuses on presenting a new way to design a board game sustainably as people become more aware of environmental issues. This innovation keeps trash out of landfills by using plastic waste to make the game board. It also encourages discussion about the power of recycling. The game pieces, made from coconut shells, promote the use of environmentally friendly materials that promote biodegradability and a better connection with nature. The goal of this research is to design a sustainable Checkers, a strategic board game using plastic waste materials, highlighting the usage of eco-friendly materials and production methods. The newly designed board game was conceptualized using the Double Diamond design process, which includes four phases: discover, define, develop, and deliver.

The developed prototype underwent user testing to assess consumer preferences for sustainable board game design and materials, as well as its effectiveness in raising environmental awareness. The redesign of the game prompted players to rethink recycling and build sensitization to the environmental impact of their choices. By bringing together sustainable materials with intentional design, the game aims to provide a practical learning experience while fostering eco-awareness.

This study points to the possibility of creating engaging and enjoyable products while maintaining environmental sustainability through integration of ecological awareness with an enhanced experience for the players. The results provide a direction in embedding sustainability in product design, thereby calling for a shift to more responsible and

eco-friendly alternatives. The study acknowledges potential concerns such as elevated production expenses, short-lived materials, and limited market attractiveness that can be addressed through further research.

Keywords: Game design, sustainability, plastic waste, eco-friendly play, environmental concern, recycling, natural materials

Introduction

In today's environmentally conscious world, integrating sustainability into everyday products, including games, is becoming increasingly significant. The use of eco-friendly materials, ethical production methods, and lasting designs encourages consumers to select products that meet their needs while at the same time minimizing the environmental impact. This approach shifts the focus from quick consumption to lasting value, aiming to redefine desirability for luxury goods (Manzini and Vezzoli, 2003; Ellen MacArthur Foundation, 2019). In fashion design, these principles might mean using organic fabrics or repurposed materials to create sustainable and unique apparel. Regarding eco-friendly home decor, one can select unique handcrafted pieces made from sustainable materials. Beautiful, sustainable products motivate individuals to acquire items that are environmentally friendly while maintaining style and functionality.

The need for sustainable game design

Across the globe, a wide range of board games, from simple to complex, are being produced and sold, catering to all ages. However, the growth of the board game sector comes at a significant environmental cost, as most games are created using resource-heavy materials like plastic, wood, and paper. According to research, the creation and disposal of board games adds to waste management problems, deforestation, and greenhouse gas emissions. Furthermore, the traditional game design approach of "take-make-dispose" supports a wasteful culture and ignores the chance to use circular economy strategies (Sharaai, Shah and Zulkipli, 2020).

Market trends in sustainable toys

According to a Verified Market Research report (2024), the green toys market size has experienced strong growth, rising from USD 22.47 billion in 2023 to an expected USD 60.14 billion by 2031. This represents a compound annual growth rate of around 12.7 percent during the forecast period 2024-2031 (Figure 1). A key trend driving this growth is the increased consumer awareness of environmental and health issues. As a result,

manufacturers are moving toward biodegradable and non-toxic materials such as wood, bamboo, organic cotton, and water-based inks to replace traditional plastics. Sports and outdoor toys lead the product segment, reaching \$3.91 billion in 2020, with a projected growth rate of 12.6 percent due to parent demand for active, team-based play. Dolls and action figures are also growing, particularly among five- to ten-year-olds, as parents look for engaging, educational, and collectible options. Recent research has explored consumer interest in sustainable games, indicating a rising willingness to pay more for eco-conscious products, especially among parents aged 30–45 and Gen Z consumers (ibid.). Studies indicate that sustainable attributes such as recyclable materials, ethical sourcing, and educational value are more important than brand loyalty for eco-aware consumers. A study by Peattie and Peattie (2009) revealed that aligning product messaging with environmental concerns increases consumer acceptance. Furthermore, the accelerating growth of the e-commerce market is improving access to green toys. These trends highlight a blend of environmental awareness, educational value, and new distribution methods that are shaping the future of sustainable toys (Verified Market Research, 2024).

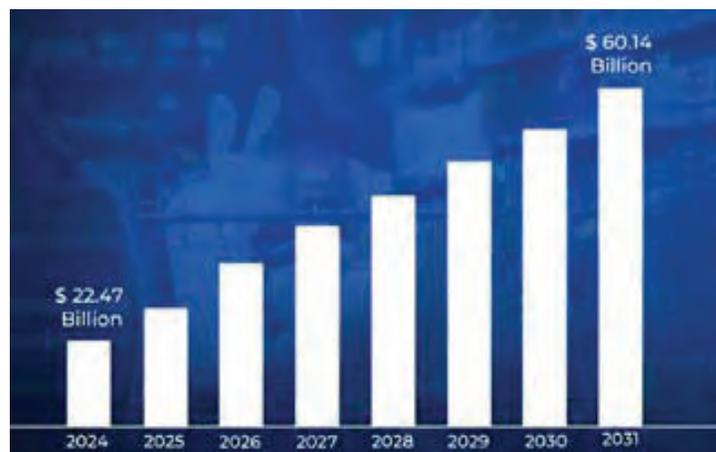


Figure 1: Green toys market size
Source: Verified Market Research, 2024

Plastic waste and repurposing

Understanding the different types of polymers, the waste management process, and the distribution elements is key to finding safe ways to turn trash into useful products to support the environment. This knowledge is vital for grasping the full extent of the problem and applying the best ways to cut down on plastic waste. Millions of recyclable or reusable plastics are incorrectly discarded. In the 1980s, only 2 million tonnes of

plastic were produced worldwide. However, plastic manufacturing has greatly increased over the years, reaching about 381 million tonnes in 2015. This data shows that between 1950 and 2015, the global production of plastic garbage was about 7.82 billion tonnes (Yadav et al., 2020).

The world's toy sector uses the most plastic of any industry. According to "Environmental Impact of Toys," plastic constitutes about 90 percent of toys bought in the United States (McGrew, 2024). Plastic-made toys are a major threat to the landfills and oceans, and if nothing is done to address the issue, the situation will worsen. The planet will suffer irreparable damage if consumers continue to buy plastic-made toys and discard toys in working condition. The toy sector is one of the sectors that uses the most plastic worldwide, implying the need to identify suitable alternatives like non-plastic or sustainably manufactured toys, which will significantly lower the carbon footprint of the toy industry. It is easy to purchase different types of toys, but one does not realize the impact of the same on the environment (ibid.).

Over the past few decades, the production and use of plastics have skyrocketed. This upsurge has led to the generation of a large amount of plastic waste. Due to the limited systems to manage plastic trash, much of it becomes a part of the landfills around the globe. These landfills are a major source of plastic waste that flows out into the environment. Once released, plastic can penetrate through different areas and lead to environmental concerns. Hence, it is crucial to trace and measure plastic leaching into the environment and the ways it happens to address these issues. Plastics in the ecosystem endanger wildlife, spoil their habitats, and also pose risks to human health; for example, marine animals can get entangled in plastic, be exposed to harmful chemicals, or ingest it directly (Yadav et al., 2020). Single-use plastic (SUP) items account for half of the world's plastic production. Various methods have been employed to lessen SUP usage. Existing research often concentrates on end-of-life plastic management, such as promoting proper waste sorting and recycling to combat pollution (ibid.). However, an important strategy in building a circular economy extends beyond mere disposal to the repurposing of plastic waste to develop new, valuable items. This approach not only extends the lifecycle of materials but also provides a tangible demonstration of sustainability in action (Huang et al., 2022). This principle of transforming waste into a resource directly informs the background of the proposed board game, which is designed from repurposed plastics to exemplify this sustainable practice.

Integration of sustainable design in education

The significance of sustainable design education has escalated in recent times due to the intensifying worldwide environmental problem. Teaching students to prioritize

sustainability helps them create products that meet practical needs and reduce environmental impact. Designing games with sustainable materials serves as a key platform for education and advocacy in sustainable design, creating a foundation for more thoughtful, future-oriented design practices (Lofthouse and Prendeville, 2018).

This research aims to develop an eco-friendly board game that promotes environmental awareness and responsibility. By following circular design principles and using sustainable and recyclable materials to reduce waste, this study aims to reduce the environmental impact of board games while educating consumers to think about sustainability in new ways. The study explores the appeal of sustainable design with eco-conscious choices to attract and engage consumers through visual and material appeal. The researchers attempt an “eco-play” concept by employing recycled and sustainable materials to subvert traditional board game design.

Objective

The main objective of the research is to design a sustainable “checkers game” using plastic waste and focusing on eco-friendly materials and production methods. The goal is to achieve a balance between sustainability and affordable manufacturing. At the same time, there is an endeavor to create an engaging experience that raises awareness about plastic waste and encourages responsible behavior.

Research Methodology

The sustainable checkers board game was developed using the Double Diamond design process methodology, as shown in Figure 2. The four phases of the process include discover, define, develop, and deliver. The discovery phase thoroughly examines and grasps the problem area, acquiring comprehensive knowledge and insight to direct the problem-solving strategy. Following that, the define stage amalgamates the data to accurately articulate the problem statement, structure the challenge, and understand user requirements. The development phase investigates several alternatives, followed by ideation and prototyping techniques to produce potential solutions. The final stage of the delivery process transforms ideas into functional implementations, refining and revising prototypes to prepare them for commerce. To efficiently tackle design challenges and generate substantial solutions, the double diamond model successfully balances differential and converging cognitive processes (Yenimazman, 2011).

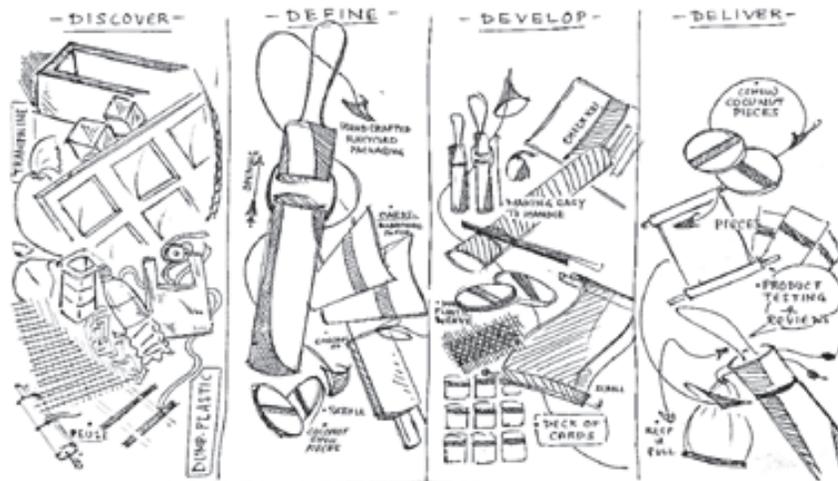


Figure 2: Double Diamond design process

Source: Shivang Chauhan

Discover

During the Discover phase, there was extensive research to understand the viability of plastic sourced from landfills and other sustainable resources for the development of a distinctive checkers game. The process commenced with the analysis of the environmental ramifications of plastic waste and the investigation of alternative materials, such as coconut shells, for game pieces, focusing on sustainable design principles. This phase entailed analyzing player behavior, market demand for sustainable products, and the technical obstacles associated with utilizing waste-derived materials. Doing secondary research and understanding the qualities of recycled materials facilitated the identification of critical concerns and opportunities for enhancing environmental awareness through an interactive educational game.

Define

In the Define phase, insights obtained from the Discover phase were combined to formulate clear design objectives. The project concentrated on developing a checkers game utilizing a woven plastic scroll for the board, coconut shell pieces, and recycled cardboard for packaging (Figure 3). The primary difficulty was reconciling sustainability with cost-efficient production while guaranteeing the game is both informative and enjoyable. This phase delineated the criteria for material procurement, production methodologies, and design elements, while concurrently establishing the overarching objective of enhancing awareness regarding plastic waste and advocating for responsible consumer practices.

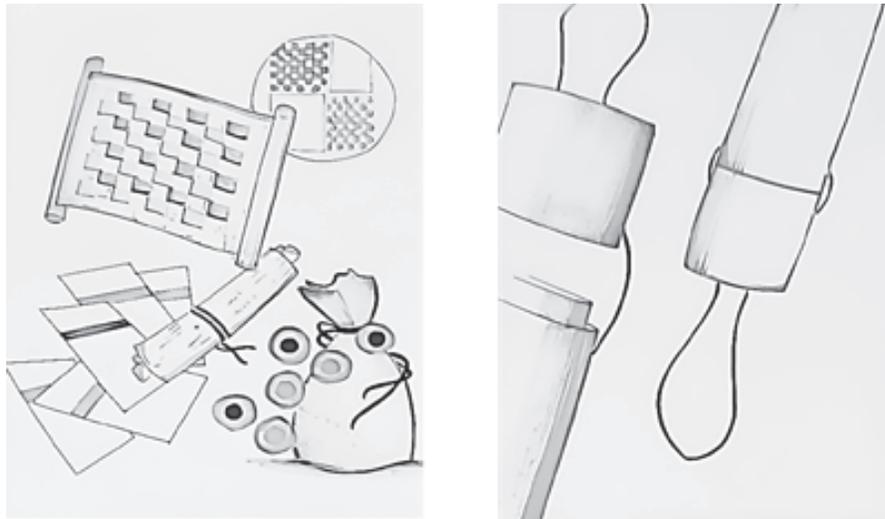


Figure 3: Product ideation

Source: Shivang Chauhan

Develop

During the Develop phase, the design concept was prototyped and enhanced according to the established objectives. Prototypes of the woven plastic scroll, coconut shell game pieces, and recycled cardboard packaging were developed and evaluated for durability, aesthetic quality, and practicality. User feedback was collected to implement modifications, guaranteeing the game is both captivating and strategically oriented, for which the strategic deck was designed as shown in Figure 4. The development phase also laid emphasis on the optimization of industrial processes to reduce environmental impact while achieving cost-efficiency objectives. Iterative design enhancements tackled potential obstacles, such as material procurement, guaranteeing the end product's feasibility and sustainability.

The materials used in developing the board game include the following:

Game board

Material: Strips of plastic wastefrom rice and grain sacks

Description: The game board's scroll format was created by weaving discarded plastic strips together.

Card deck

Material: Handmade paper

Description: 250–350 gsm handmade paper, which is the GSM range that most cards use. The deck was made out of handmade paper, which made it flexible, strong, and sustainable.

Pieces of game

Material: Shell of a coconut

Description: The game pieces were made from coconut shells, which are a natural and sustainable alternative to regular game pieces.

Packaging

Material: Repurposed cardboard

Description: The tubular packaging was made from recycled cardboard, weighing between 300 and 500 gsm. The tube was strong enough to protect the game's contents.

Thick rope

Composition: Repurposed plastic

Description: The game used plastic rope to secure the cap on the packaging.



Figure 4: Strategic deck

Source: Shivang Chauhan

Deliver

During the Deliver phase, the completed checkers game was manufactured, packed, and prepared for users with the proper specification as shown in Figure 5. The emphasis was on executing the production methods established in prior phases, which encompassed weaving plastic strips for the board, sculpting coconut shells for game components, and utilizing recycled cardboard tubes for packaging.

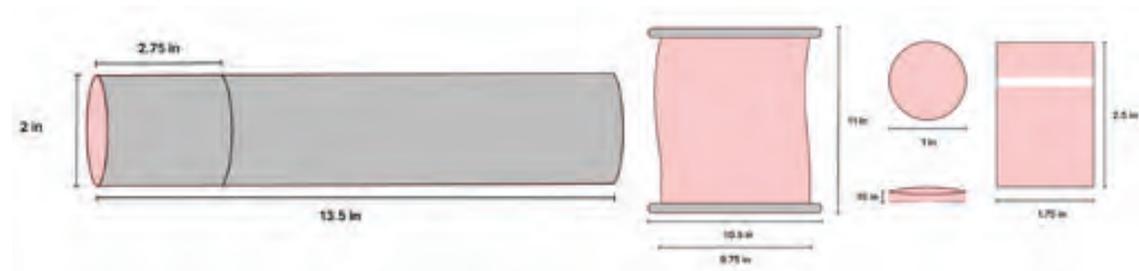


Figure 5: Prototype specification

Source: Shivang Chauhan

How to play updated checkers board game

Draughts, or checkers, is a strategic board game that traces its roots back to the ancient Egyptian game of Alquerque, which dates to around 1400 BC. Over the course of thousands of years, this game evolved and formed differently in different cultures. It is said that the board game mainly played in English-speaking countries originated in the 12th century. The game of draughts gained a lot of popularity in Europe during the 16th and 17th centuries. While it is impossible to determine when the game specifically started, it continues to thrive even today, largely due to its simple rules and complex strategies.

To enhance enjoyment of the game, additional cards were introduced. The purpose of integrating cards is to provide players with additional options beyond the standard moves available. This increases the game's versatility and encourages players to adopt a more thoughtful approach. It also demonstrates the ability to execute intelligent plays as the game progresses. The additional cards promote the concepts of planning and risk within the game, while also teaching players the idea of environmental trade-offs with phrases such as "recycle" or "skip turn." Whenever a player captures a piece from the opponent's side, a card must be played. This change promotes foresight and a more detailed approach to the game. The card deck contains a variety of cards with different values as well as some that will be valuable for future plays. This version of checkers, on average, takes longer to play compared to the standard version. The objective is to remove or obstruct all your opponent's pieces. The new version of the checkers board game is explained in more detail in Figure 6.



Figure 6: Infographic of updated checkers

Source: Shivang Chauhan

User Testing Results and Analysis

The game underwent evaluation for quality, durability, and user involvement. Packaging and branding strategies emphasize the game's ecological advantages, informing consumers about plastic waste and encouraging responsible behavior through an engaging, interactive product, as shown in Figures 7 to 10. The game is intended for both adults and children, incorporating sustainability through recycled cardboard packaging and an innovative characteristic: a portable checkers game scroll mat crafted from discarded plastic.



Figure 7: Packaging
Source: Shivang Chauhan



Figure 8: Scroll
Source: Shivang Chauhan



Figure 9: Deck
Source: Shivang Chauhan



Figure 10: Newly designed checkers
Source: Shivang Chauhan

User testing was conducted with a diverse group of ten participants, including three participants in the age group of 19–25 years and seven in the age bracket of 26 years and above (Figure 11). There were a total of five females, four males, and one as “other” to assess the game’s appeal and educational impact. The overall reception was highly positive, with 80 percent of users rating the game as either ‘good’ (50 percent) or ‘excellent’ (30 percent), and 70 percent finding the rules ‘easy’ or ‘very easy’ to understand. The testing confirmed the game’s significant educational value and its positive influence on players’ attitudes towards sustainability. A compelling 80 percent of participants reported that playing the game increased their awareness of plastic waste, with 40 percent noting a ‘very significant’ impact and another 40 percent citing an ‘important’ one.

The enhanced awareness of the participants was directly linked to player attitudes, as demonstrated by their appreciation for the game’s physical design. The most praised features were the tangible sustainable components, including the coconut shell pieces that were rated excellent by 70 percent of the respondents. This inclination was followed by appreciation for the plastic scroll mat by 60 percent of the users, and eco-friendly packaging got the maximum rating by 50 percent of the respondents. The preference for eco-conscious materials indicates that the game’s core values resonate deeply with the players’ own attitudes toward sustainability.

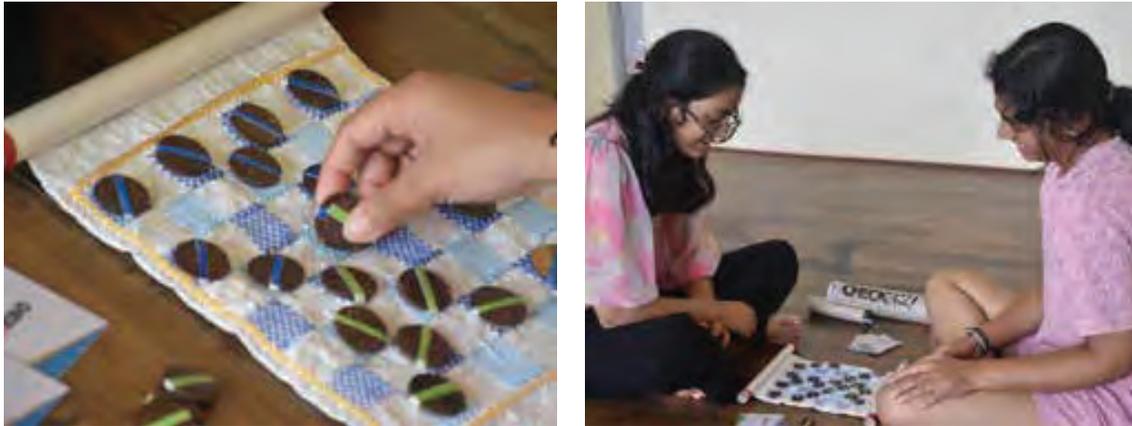


Figure 11: User testing

Source: Shivang Chauhan

In conclusion, the findings from the user testing show a successful integration of an engaging game with impactful environmental messaging. The game not only functions as an enjoyable product but also serves as an effective educational tool. Its ability to positively shift player awareness and align with pro-environmental attitudes confirms its strength in promoting sustainability.

SWOT Analysis

Based on user feedback, this game design initiative exhibits several significant strengths, primarily its environmental and educational value. Participants appreciated how the game creatively utilized innovative and natural resources. One user noted, “It’s nice to see a game that’s not only fun to play but is also good for the environment.” This appreciation also applies to the game. The introduction of a tactical card deck truly set this game apart from other tabletop games. “The card deck adds a whole new level to checkers,” exclaimed another user, adding, “It’s not just a game; it’s a strategic challenge.” This kind of feedback demonstrates that the core concept that drives the new version of the board game is quite appealing to players, merging enjoyment seamlessly with interactive play and playful environmental stewardship.

Concerns surrounding the game’s appeal and duration were highlighted in the user reports. Among the respondents, several expressed concern over the longevity of the natural elements. One user expressed the concern plainly, stating, “The coconut shell pieces are beautiful, but they look fragile, and I’m worried that my kids won’t be able to use them repeatedly.” Furthermore, the feedback suggested that the niche nature of the game may lead to a reduced audience reach. One parent commented, “While I love

the eco-concept, my kids are still more drawn to their digital games.” This suggests that those accustomed to online games may be reluctant to engage with the eco-friendly game concept.

User feedback provided a clear, concise overview of the opportunities and threats. The enthusiasm surrounding the board game’s sustainable design indicates that the opportunity to capitalize on the growing eco-friendliness trend is significant, particularly within the educational sector. As one user remarked, “This would be a fantastic and useful tool for educators to discuss reuse and repurposing in the classroom.” Conversely, the feedback on durability conveys a potential threat in the supply chain, as sourcing high-quality, resilient natural materials could be challenging and an expensive investment requiring R&D. The selection of digital alternatives exemplifies the risk of dealing with a market where sustainability does not overshadow convenience. It demonstrates the need for strategic marketing to thrive in a competitive landscape.

Conclusion

Research on developing board games sustainably identifies one of the most significant opportunities to promote eco-consciousness on everyday consumer items. The latest eco-friendly checkerboard game made of recycled plastic and natural materials, like miniature coconut shells, promotes reuse, reduces waste, and provides players with biodegradable alternatives to the traditional game pieces. The fusion of strategy and eco-sustainable gameplay enhances the entertainment value of the game and prompts players to engage with environmental challenges critically. The focus on biodegradability and eco-sustainable design commendably moves game designers and players away from the extractive, non-sustainable synthetic materials toward natural biodegradable materials. These games promote an interdisciplinary approach to design teaching through environmental problem-solving. The environmental focus of this game positively impacts the fun component and educates the players about sustainability in their everyday lives. In particular, the games promote waste reduction and the many innovative ways to achieve it, especially to younger players. The incorporation of sustainable materials aids in teaching the principles of product life cycle thinking, a core aspect of sustainable design. This is the period when some individuals contemplate the impact of their disposable items on the ecosystem. Nonetheless, issues like increasing economic costs of production, the quality and durability of materials, and limited market appeal are recognized. This research shows that designing sustainable products can be interesting and meaningful, highlighting the growing importance of sustainability in product development.

Limitations of Study

Although the research presented here effectively demonstrates that sustainability can (and should) be a part of game design, it is by no means easy. One of the limitations is the lack of comparative analysis with other sustainable products to assess the environmental impact of reusing discarded plastics and natural materials, like coconut shells, when designing games. The project leans heavily on recycling waste and natural materials. But there's not enough research on how long these materials will last and how well they'll work over time, especially in terms of how well they can stand up to repeated games. The work does not explore the technical challenges of repentance that would be required for developing sustainable games. The challenge of balancing material quality against cost-effectiveness is recognized; nonetheless, there is limited discussion on potential remedies or innovations in manufacturing methods that could improve the accessibility and economic viability of the overall product.

Recommendations

There is scope to conduct further studies to examine the production of sustainable board games, with a focus on material sourcing, quality, and production methods to achieve desirable scalability. There should be concerted efforts to conduct R&D to augment material durability and refine production processes to integrate sustainability with cost-effectiveness, guaranteeing that environmentally friendly games can compete in a wider market. Additionally, consumer research may be undertaken to comprehend market perceptions of sustainable games, thereby pinpointing measures to improve attractiveness and market share. Research comparing the environmental advantages of different sustainable materials utilized in the game, such as repurposed plastic options or biodegradable elements, may yield insights and the way forward to devise optimal methods for eco-conscious game creation.

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The authors used QuillBot solely for paraphrasing purposes to enhance language clarity and readability. The tool was not used for generating ideas, analyzing data, or interpreting findings. The authors take full responsibility for the content of this article.

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