

Ecopolis: Merging Competition and Sustainability Education in a Resource Management Game

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Abstract. *This article introduces Ecopolis, a resource management game that imparts knowledge about sustainability and ESG+P pillars through engaging gameplay mechanics. Players learn about these concepts via interactive decision-making tasks, using game components like cards, a game board, and tokens. The game is available in Print 'n' Play and digital versions. Following playtest sessions with four players, enhancements were made, particularly to the resource management aspects. The game received positive feedback for its effectiveness in teaching sustainability concepts. Future versions aim to improve game balance and introduce new dynamics.*

Keywords. *Educational Games, ESG+P, Sustainability*

1. Introduction

Sustainability, once solely linked to the environment, now embraces Environmental, Social, Governance, and People (ESG+P) pillars as delineated by [Magalhães 2022]. This article introduces Ecopolis, a board game blending competition with ESG+P-focused education. Inspired by Kolb's Theory of Experiential Learning [Kolb 2014], Ecopolis combines elements from popular resource management games like Catan and Terraforming Mars with sustainable decision-making.

In our current business paradigm, where corporate actions have vast implications [Taliento et al. 2019], the game highlights the importance of sustainable practices for risk mitigation and benefits like improved reputation. Ecopolis not only emphasizes a holistic stakeholder perspective but also offers a captivating medium to delve into sustainability concepts.

2. Game Development

In this section, we will discuss the development of the game Ecopolis, aimed at raising interest in sustainability through an approach that considers environmental responsibility, social impact, and effective governance [Damoah and Adu 2023]. The game is designed to engage players in collaborative decision-making and present an immersive narrative.

2.1. Development Method

As part of the development process, we followed the MEDIEVAL (Method of Designing Educational Virtual Instruments with Ludic Approach) [Parreiras et al. 2022] methodology. The MEDIEVAL method provides a framework for creating educational games that

address specific problems and learning objectives. It emphasizes a ludic approach, similar to a board game, to ensure an engaging and interactive experience for players and it is composed of 10 steps: (I) Identify the problem and motivation. (II) Infer the objectives for the solution. (III) Plan the game that addresses the problem. (IV) Apply the Endo-GDC for a holistic view of the game. (V) Create the GDD to detail the planned features. (VI) Choose the most suitable game engine. (VII) Develop the software and assets. (VIII) Play the game and gather feedback. (IX) Apply the MEEGA+ for game testing. (X) Publish the game and the results. While we didn't utilize the method in its entirety, we drew inspiration from its structure and steps to guide our development process.

2.2. Game Mechanics

During the development process, in accordance with MEDIEVAL Step IV (Planning the game that solves the problem), we carefully selected game mechanics appropriate for the scope of our project. These mechanics were chosen to align with the learning objectives of the game and provide an engaging gameplay experience. The following are the main mechanics we incorporated:

- **Income:** Allows players to obtain resources periodically based on their choices.
- **Negotiation:** Encourages players to make agreements and coordinate actions to ensure the success of all.
- **Race:** Motivates players to make informed decisions throughout the game to achieve the final goal before other players.

These mechanics were identified and implemented during the appropriate step of the MEDIEVAL, ensuring that they align with the educational goals and provide an enriching experience for players.

2.3. Endo-GDC

During the Game Canva phase, we utilized the Endo-GDC framework [Taucei 2019], recommended by MEDIEVAL Step V (Apply Endo-GDC for a holistic view of the game). The focus of this phase was to deepen our understanding of the challenge of teaching sustainability through an educational game. The Endo-GDC framework emphasizes the design of educational games and provided valuable insights into addressing the misconceptions surrounding sustainability among the general population. Our specific learning objectives were to help players understand sustainability from an environmental, social, and governance perspective, and empower them to use these principles to improve their operating environment.

2.4. Elementary Tetrad

During the Game Design Document (GDD) phase, we utilized the Endo-GDC framework, recommended by MEDIEVAL Step VI (Creating the GDD to detail the planned features), we proceed utilized the Elementary Tetrad methodology. This methodology, recommended by the MEDIEVAL framework, identifies four essential elements for game development: mechanics, narrative, aesthetics, and technology. By incorporating these elements into the design of Ecopolis, we aimed to create an immersive and engaging gaming experience.

¹Print 'n' Play version available at https://drive.google.com/drive/folders/1S2DdvKURgqRc4ys4x1sl9qlFYAjK7_Rm

Aspect	Description
Story	An unexplored territory, containing rare minerals and a rich ecosystem, was discovered in Brazil. The Brazilian government called upon the country's leading entrepreneurs to help establish a city in this territory, named Ecopolis. The city of Ecopolis is named based on pillars related to environmental, social, governance, and people aspects. The main challenge for entrepreneurs is to create maximum value for this emerging society while considering these pillars.
Mechanics	The game requires players to manage resources representing the various aspects related to the city's development. Public resources, such as the environment and society, need to be carefully managed to avoid collective loss. Additionally, individual resources, such as governance and people, must be maintained to prevent individual defeat. At the end of the game, players receive awards based on the amount of resources they have generated. For example, the player who generates more environmental resources receives the "Environmental Award".
Aesthetics	The game features simple aesthetics, utilizing colored cards with real images and symbols that represent the resources affected by acquiring the card. The cards also contain additional information on their backside, which remains hidden during gameplay.
Technology	The game utilizes a limited set of cards, a game board, and pins as components ¹ . Additionally, a digital version of the game has been implemented for the Tabletop Simulator platform ² .

2.5. 6-11 Framework

To finish Step VI, we applied the 6-11 Framework [Dillon 2011], which allows the identification and exploration of different emotions and instincts associated with each game dynamic and mechanic. Through this analysis, we identified emotions such as pride, excitement, and fear, which relate to players' instincts such as greed, protection and care, identification, collection, survival, and curiosity. This framework provided valuable insights into the emotional and instinctual aspects of Ecopolis, enhancing the overall gameplay experience.

The 6-11 Framework diagram, as depicted in Figure 1, showcases the emotional and instinctual aspects associated with the game mechanics implemented in Ecopolis.

3. The game Ecopolis

Ecopolis, guides players through the exploration of sustainability, highlighting the Environmental, Social, Governance and People (ESG+P) pillars. While entertaining, it educates on the significance of sustainability.

- **Initial Setup:** Players prepare the game by shuffling the cards and placing three face up. Scoring markers for shared (environment and society) and individual

²Available at <https://steamcommunity.com/sharedfiles/filedetails/?id=2861702409>

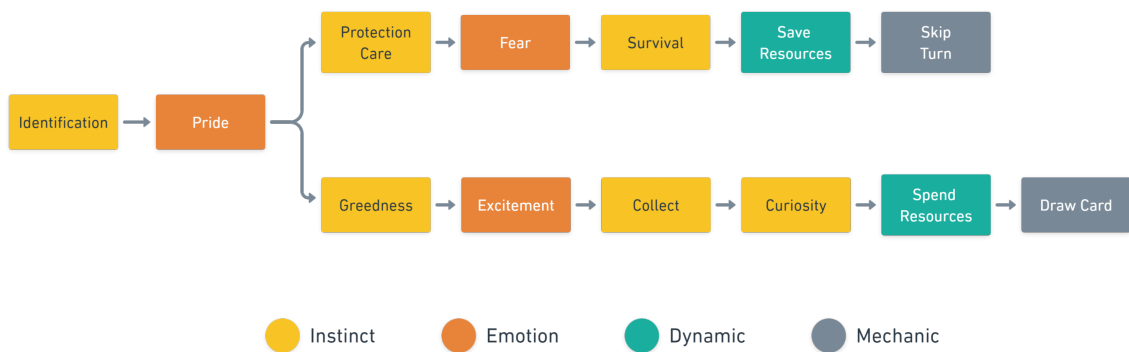
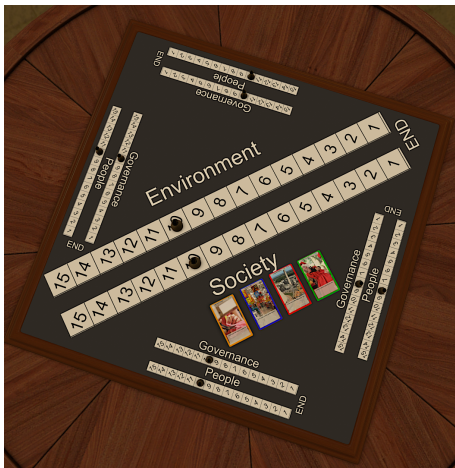


Figure 1. 6-11 Framework diagram for Ecopolis.

(governance and people) resources are set on ten. The first player is chosen through any desired method. See Figure 2a for an example of initial setup.

- **Turn Flow:** Each turn involves applying card costs from left to right in the player’s hand. Provided no defeat condition is met, the player may opt to buy an open card, determining its placement in their hand. A new card from the deck replaces any purchased card. See Figure 2b for a sample card.



(a) Initial setup



(b) Example card

Figure 2. Initial setup and card example.

- **End of Game:** The game concludes when the deck depletes, a player gathers four consecutive cards of one color or different colors. All players are then permitted one last action. The game is lost if any public (Environment and Society) or private (Governance and People) resources are exhausted. Awards based on resource generation determine the winner, with ties permitted.

Ecopolis offers an engaging experience, challenging players to make strategic decisions under the sustainability lens, thereby fostering understanding of ESG+P interconnectedness.

4. Application

Ecopolis can be utilized in diverse contexts, such as in educational settings or businesses, for promoting sustainability and enhancing collaboration.

4.1. Classroom Application

Teachers can utilize Ecopolis as a pedagogical tool for conveying sustainability principles interactively. After gameplay, a debriefing discussion can be held to explore students' experiences. Questions for discussion can encompass decisions made, impact of these decisions on gameplay and parallels to societal resource management, achievement of objectives, lessons on collaboration and conscious decision-making, and applicability of game-derived insights to personal life or career paths. These discussions can help reinforce course content, aiding in a deeper understanding of sustainability and responsible resource management.

4.2. Business Application

In corporate settings, Ecopolis can serve as a team-building exercise. Post-game, a facilitator can conduct a discussion session covering collaboration, resource management, and sustainable decision-making. Discussion points could include strategies for collaboration and negotiation, conflict between individual and group goals reflecting organizational contexts, relation of game mechanics to real-life business situations, sustainability lessons applicable to work, and potential ways to enhance corporate sustainability and social responsibility based on in-game decisions. This dialogue can strengthen understanding of sustainability, foster collaboration, and promote effective communication among employees.

5. Playtest

Playtest sessions were conducted, serving as a basis for identifying improvements in the game components and rules based on player feedback. Four players were invited and to participate in the playtest phase, without applying any preconditions or filters that required a specific player profile. Those volunteers were in the age group of 20 to 25 years old, some affiliated with a university and others not. Interaction took place through Google Meet, Discord, and Tabletop Simulator.

Each game session lasted approximately 30 minutes, during which feedback was collected regarding gameplay difficulties and positive or negative aspects. Overall, the feedback was positive and had a direct impact on the improvements and revisions of the game before the final version, particularly regarding resource management and the values of the improvements.

6. Conclusion

The article details Ecopolis, a resource management game that creatively imparts sustainability and ESG+P pillars. Positive feedback from game testing highlighted its engaging nature, though adjustments are needed for more immersive gameplay, including better balancing costs of improvements and streamlining resource management. It was observed in certain instances that matches could reach a stalemate, where any move risked losing the game. Future game versions plan to address these issues and introduce new mechanics for a more balanced play experience.

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