

Peer Review

Review of: "A Simple Board Game for Modeling the System Dynamics of Deforestation"

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Review of the manuscript titled *"A Simple Board Game for Modeling the System Dynamics of Deforestation"*:

Summary

The manuscript explores an innovative approach to raising awareness about deforestation and reforestation dynamics through a simplified board game based on modified Lotka-Volterra equations. It effectively integrates system dynamics with educational gamification, presenting two game variants that simulate realistic forest resource management scenarios. Initial findings indicate that the game can mirror ecological behaviors, such as overshoot-collapse dynamics and sustainable recovery, making it a promising tool for education and advocacy.

Strengths

1. Relevance and Innovation:

- The manuscript addresses an urgent environmental issue, effectively linking ecological modeling with gamification to enhance accessibility and understanding.
- The use of operational games as an alternative to complex mathematical models broadens the audience to include younger students and non-specialists.

2. Theoretical Foundation:

- The integration of system dynamics, Lotka-Volterra equations, and game theory provides a solid scientific basis for the game's mechanics.

- The connection to historical and contemporary examples of deforestation dynamics lends credibility to the approach.

3. Educational Value:

- By translating mathematical models into a tactile and interactive format, the board game has the potential to foster early engagement with sustainability issues.
- The design decisions, such as visual representation and strategic decision-making, enhance user experience and learning.

4. Two Variants:

- The inclusion of a "basic" and "sustainable forestry" variant allows for a comparative exploration of behaviors, emphasizing the impact of different strategies on forest health.

Weaknesses and Concerns

1. Methodology and Validation:

- The manuscript relies heavily on qualitative observations and limited test runs (N=3 per variant). This sample size is insufficient for robust statistical analysis or generalizable conclusions.
- Simulations and gameplay outcomes are presented descriptively. Still, there is a lack of rigorous evaluation metrics to assess the game's effectiveness as a learning tool or as a model of ecological dynamics.

2. Complexity vs. Accessibility:

- While the game simplifies the Lotka-Volterra equations, the rules and mechanics remain relatively complex for younger audiences or those unfamiliar with strategic board games.
- The reliance on a game master and detailed record-keeping may deter casual or novice players.

3. Educational Impact Assessment:

- There is no systematic evaluation of the game's educational impact on players, such as pre- and post-game knowledge assessments or behavioral changes.

4. Realism of the Model:

- The assumption that logging decisions (e.g., hiring/dismissing loggers) are entirely player-driven may oversimplify real-world dynamics, where external factors like government policies, market forces, and ecological constraints play significant roles.
- The use of dice to introduce variability might not accurately reflect the probabilistic nature of ecological processes.

5. Comparative Context:

- While the manuscript references similar games (e.g., the "Moby Dick Game"), it lacks a detailed comparison to existing tools in terms of educational outcomes and ecological fidelity.

Suggestions for Improvement

1. Expand Empirical Testing:

- Conduct more extensive gameplay trials with diverse participant groups (e.g., students, educators, policymakers) to generate statistically significant data.
- Incorporate surveys or interviews to evaluate user experiences and learning outcomes.

2. Refine Accessibility:

- Simplify the rules or provide a beginner's variant to make the game more approachable for younger audiences.
- Consider developing a digital version of the game to automate calculations and streamline gameplay.

3. Strengthen Educational Assessment:

- Introduce measurable outcomes to evaluate the game's educational effectiveness, such as quizzes, reflection prompts, or participant feedback.

4. Enhance Realism:

- Integrate additional variables or constraints to mimic real-world complexities, such as government regulations, climate effects, or societal pressures.

5. Broader Contextualization:

- Include a discussion of how this game compares to existing tools in terms of usability, engagement, and educational impact.

Suitability for Publication

The manuscript presents a novel and relevant contribution to the intersection of environmental science, education, and gamification. However, its current limitations in empirical validation and educational assessment must be addressed to strengthen its scientific and practical significance. With these improvements, the work could be a valuable addition to a journal focused on interdisciplinary or educational approaches to sustainability.

Declarations

Potential competing interests: No potential competing interests to declare.