



# Balancing Act: Leveraging 'PARAMETERS' Serious Game as a Tool for Mastering Game Design in Higher Education

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## MOTIVATION

Game balancing, a **critical aspect of game design**, involves fine-tuning a game's rules, difficulty levels, and algorithms to ensure fairness, challenge, and replayability (Schreiber/ Romero 2021). However, a universally accepted definition of game balancing remains elusive, with diverse interpretations complicating its study and application. The process includes mechanics, narration, and player experience. Sigman (2009) defines game mechanics as a function: "Mathematically, a game mechanic is usually just a function. A function is a mathematical 'black box'. Given a certain input, the black box (game mechanic) creates an output."

Balancing therefore involves adjusting the mathematical relationships between game inputs and outputs, either by altering the inputs or modifying the function itself (Fig. 1).

Teaching **game balancing** in a university curriculum is a particular **didactical challenge** (Refai et al. 2020). Although competencies can be formulated as learning objectives and translated into teaching units, an understanding of the game balancing principles requires working on a specific project. The basic principle of situated learning also applies here: **Balancing is only learned by balancing a project.**

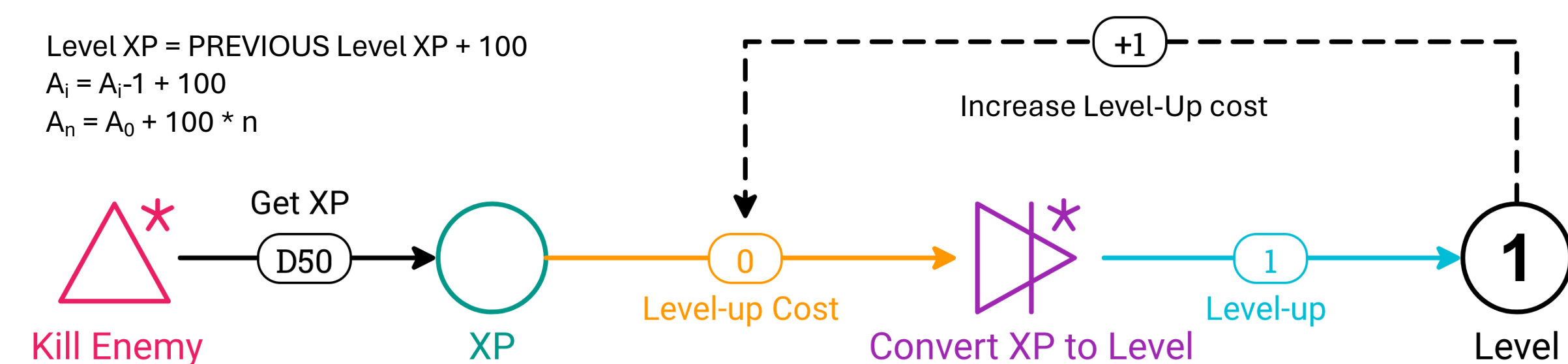


Figure 1: Arithmetic (linear) progression mechanic stated as recursive and iterative formula and visualized as a machinations diagram. Killing enemies yields experience points converting to level progression with increasing level-up costs.

## METHODOLOGY

To **bridge the gap** between theoretical knowledge and practical application in game design, we redeveloped the simple RPG PARAMETERS using the Unity game engine and C#. Originally a minimalist game focusing on numerical interactions by Japanese developer Yoshio Ishii, our version is designed to serve as an effective teaching tool in game design courses.

### PARAMETERS Gameplay Mechanics Overview

PARAMETERS uses a grid of interactive bars representing quests and enemies, emphasizing strategic play through resource management and progress tracking. Players interact via mouse clicks to complete quests or defeat enemies, balancing attack efforts with health recovery. This interface, akin to an Excel spreadsheet, simplifies complex RPG elements to focus on core statistical management, making it ideal for educational use. See Figure 2.

### Development and Educational Implementation

The redevelopment in Unity was aimed at utilizing PARAMETERS' intuitive gameplay to **teach game mechanics** and **balancing**. We encapsulated game functionality into objects, facilitating learning through best practice patterns in object-oriented programming. Game logic was modularized using design patterns like decorator and inheritance, enhancing the flexibility and educational value of the game.

A key component was the **separation of game data** (like stats and levels) into CSV files, allowing for easy adjustments and rapid testing of balance changes. We also developed a Unity Editor plugin to streamline the testing and iteration process, enabling real-time updates and immediate feedback on balance adjustments. By using the **strategy pattern** (Figure 3) we were able to switch between different implementations of game mechanics.

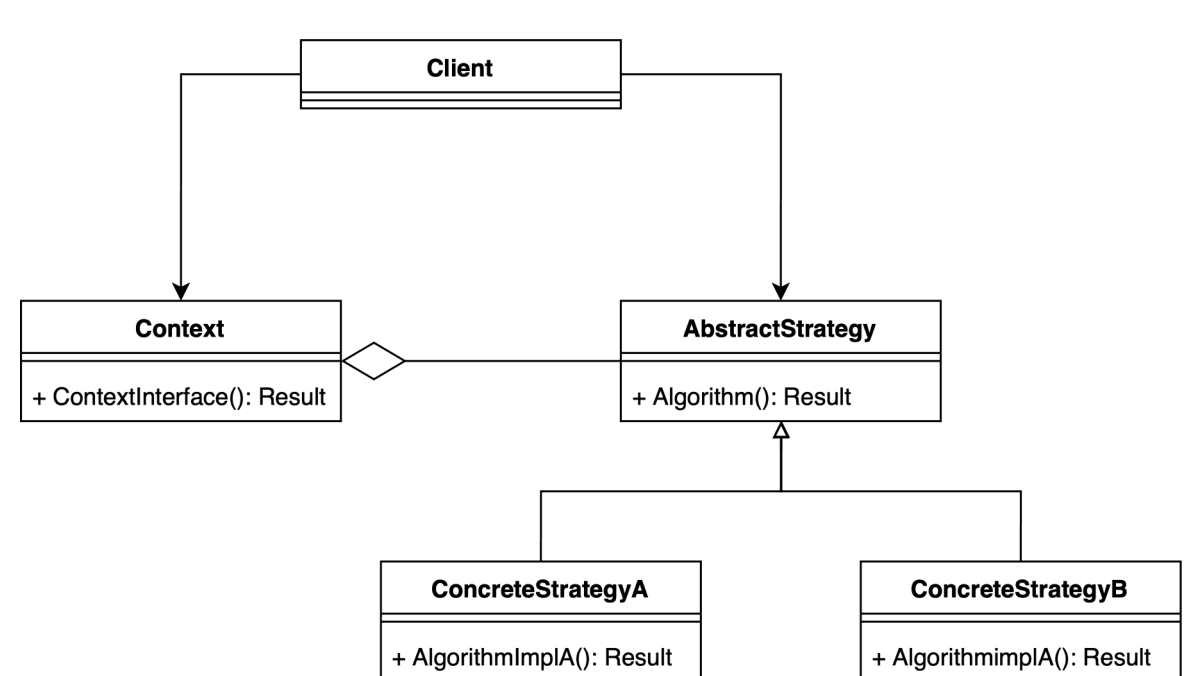


Figure 3: Strategy pattern as defined by (Gamma et al. 1995)

These methods ensure that PARAMETERS not only enables teaching game balancing effectively but also mirrors current industry practices, providing students with a hands-on learning experience that directly applies to professional game development scenarios.

## CASE STUDY AND RESULTS

**Integration into Curriculum:** In the Game Design II course of the M.A. program in Computer Game Studies at the University of Bayreuth, Germany, the serious game PARAMETERS was integrated as a key educational tool. The course is designed to merge theoretical instruction with practical exercises, enabling students to explore game design from sociocultural, aesthetic, and technical perspectives.

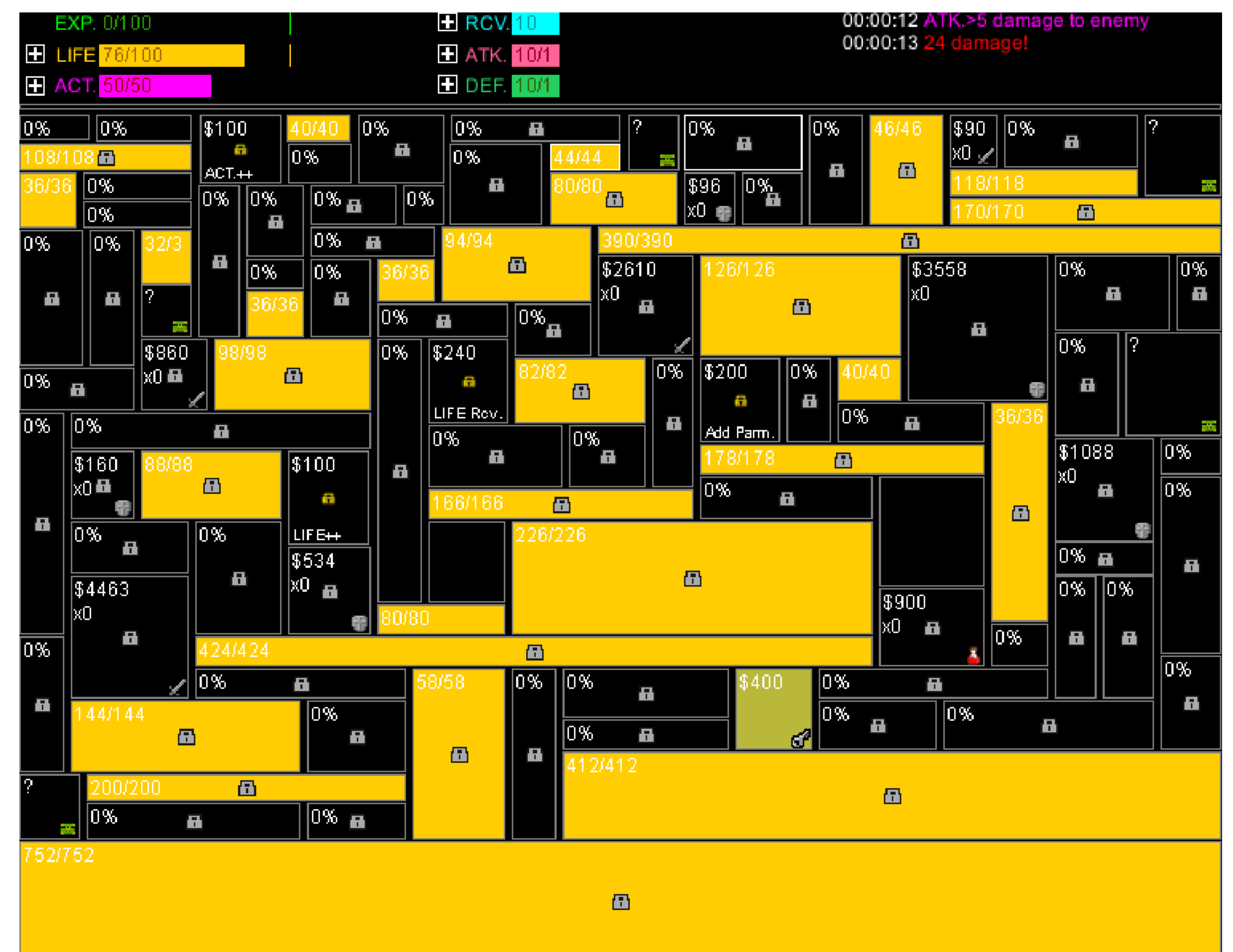


Figure 2: Interface and game space of PARAMETERS.

The curriculum alternated between **theoretical lectures** on game design patterns and mathematical game theory, and **practical exercises using PARAMETERS**. Students began with basic game balancing using pre-prepared CSV files — *regular.csv* for standard gameplay, *hard.csv* for a more challenging setting, and *cheat.csv* for an easier experience — allowing them to adjust game dynamics without coding experience, mimicking real industry practices.

### Hands-On Learning

Students engaged in hands-on activities, **modifying game behaviour** and balancing through Strategies and CSV files. They applied their theoretical knowledge by creating and testing their own game balance setups in group play sessions, gaining practical insights into game development.

### Feedback and Adjustments

The course's effectiveness was evaluated using standardized feedback forms, which indicated high student appreciation for the practical learning elements. However, some students found modifying game code challenging, highlighting the need for more guided exercises in coding and game mechanics.

Results and Pedagogical Impact: The reimplementation of PARAMETERS as an educational tool demonstrated **several benefits:**

- **Core Game Mechanics:** Simplified RPG elements allowed students to concentrate on core game balancing mechanics.
- **Game Balancing:** The game provided varied difficulty levels and challenges, encouraging students to think critically about game progression and player engagement.
- **Interactive Learning:** The engaging nature of the game and the immediate impact of adjustments on gameplay facilitated an effective learning experience.

## CONCLUSIONS AND FURTHER APPLICATIONS

The use of PARAMETERS highlighted its potential in teaching various aspects of game design, from basic parameter balancing to advanced game mechanics and cultural localization. The game's structure allowed for flexible and diverse instructional strategies, making it a valuable tool for broader educational purposes.

PARAMETERS proved to be a **versatile educational resource**, effectively bridging theoretical knowledge with practical application in game design. The project's **open-source** nature and the continuous improvement driven by community feedback further enhance its educational value and adaptability. Source code and instructions are available open source via GitHub.

### References

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