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DIFFICULTY BALANCING METHODS IN SIMULATORS WITH LEVELING SYSTEMS

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Анотація
У тезах розглядаються методи балансування складності у відеоіграх та симуляторах із системою рівнів гравця. Описано ключові підходи: статичне та динамічне балансування, системи адаптивної складності, криві навчання та прогресії. Проаналізовано їх переваги та недоліки, а також можливості застосування у симуляторах творчої діяльності.
Ключові слова: балансування складності, симулятор, система рівнів, динамічна складність, адаптивні ігрові механіки, геймдизайн.

Abstract
The paper examines difficulty balancing methods in video games and simulators with player leveling systems. Key approaches are described: static and dynamic balancing, adaptive difficulty systems, learning curves and progression design. Their advantages, disadvantages, and applicability to creative activity simulators are analyzed.
Keywords: difficulty balancing, simulator, leveling system, dynamic difficulty, adaptive game mechanics, game design.

Introduction

The development of simulators with player leveling systems requires careful design of difficulty progression to maintain engagement and motivation. Balancing difficulty – the process of matching challenge to player skill – is a fundamental problem in game design that directly impacts player experience, retention, and the educational or creative value of the simulation. This topic is particularly relevant in the context of creative activity simulators, where the diversity of player styles and the subjectivity of success criteria add significant complexity to the balancing task [1].

The concept of flow, introduced by Csikszentmihalyi [2], describes an optimal state of engagement achieved when challenge and skill are in balance. Game designers have long drawn upon this model to structure difficulty curves, recognizing that both excessive difficulty and insufficient challenge lead to disengagement. As simulators grow more complex and player bases more diverse, robust and adaptive balancing methods have become a research priority in game development and human-computer interaction.

Core Difficulty Balancing Approaches

Static difficulty balancing is the most traditional approach, in which designers manually tune parameters – enemy health, resource costs, time limits – based on playtesting and heuristic evaluation. Difficulty levels (Easy, Normal, Hard) exemplify this method. While simple to implement, static balancing cannot respond to individual player differences or learning rates, often leading to mismatches for players outside the assumed target profile [3].

Dynamic Difficulty Adjustment (DDA), also known as adaptive difficulty, addresses this limitation by monitoring player performance metrics in real time and modifying game parameters accordingly. Systems such as the one employed in Resident Evil 4 dynamically altered enemy behavior and item drop rates based on player success [4]. Research by Hunicke and Chapman [5] formalized the DDA concept and demonstrated its positive effect on player retention and satisfaction. Key metrics used in DDA include success rate per level, average time-to-completion, and frequency of player deaths or errors.

Progression system design is closely related to balancing: the structure of a leveling system defines the trajectory of player growth and the pace at which new challenges are introduced. Experience point (XP) curves, skill trees, and unlockable mechanics serve as instruments for pacing [6]. A well-designed progression system ensures that each new level introduces meaningful skill requirements without overwhelming the player. In creative simulators, progression may be tied not only to performance metrics but also to creative output diversity, encouraging exploration rather than pure optimization.

Adaptive Systems and Machine Learning

Recent advances in machine learning have opened new avenues for difficulty balancing. Reinforcement learning agents can be trained to model player behavior and predict frustration or boredom, enabling proactive difficulty adjustments [7]. Procedural content generation (PCG) techniques allow the automatic creation of challenges calibrated to estimated player skill, as demonstrated in systems like the Infinite Algebra platform in educational contexts. In creative simulators, PCG can generate tasks that scale with the player's demonstrated creative capabilities, maintaining the balance between challenge and freedom.

Player modeling – constructing representations of individual player characteristics, preferences, and skill levels – is the foundation of modern adaptive systems. Models may be explicit (derived from direct measurement) or implicit (inferred from behavioral data). Combining both approaches yields robust profiles that support accurate difficulty calibration [1; 3].

Conclusions

Difficulty balancing in leveling simulators is a multifaceted engineering and design challenge that spans static configuration, dynamic adaptation, and intelligent player modeling. The most effective modern approaches combine progression system design with real-time adaptive mechanisms informed by behavioral data. For creative activity simulators in particular, balancing must account for subjective success criteria and the value of player exploration, suggesting that hybrid DDA-PCG systems represent a promising direction. Further research into player modeling for creative domains and the application of machine learning to difficulty calibration will be essential for advancing the field.

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