Controlled Chaos: A Literature Study on Randomness in Game Design

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Contents

Abstract

Randomness plays a central role in modern video game design, shaping everything from level layout to combat outcomes. This literature study explores how randomness can be used as a meaningful design tool as one that adds variety and strategic depth without undermining fairness or player agency. We distinguish between input randomness, which influences the scenario before a player makes a decision, and output randomness, which affects outcomes afterward. Drawing on research, developer insights, and case studies from games like: *Into the Breach (Subset Games, 2018), XCOM (Firaxis Games, 1994)*, and *Slay the Spire (Mega Crit, 2017)*, we examine how these mechanics impact player experience and engagement.

Our findings suggest that input randomness generally supports more satisfying gameplay by preserving decision-making power, while output randomness must be handled with caution to avoid frustration. We also explore systems like random stat-based upgrades and vertically layered level design as ways to increase depth and replayability.

Based on these insights, we developed a game prototype that reflects these principles: a 3D roguelike with deterministic combat, random room sequencing, and randomized upgrade options. Procedural generation is intentionally avoided in favor of handcrafted rooms that are assembled randomly and containing unpredictability while still ensuring quality. If this proof of concept puts theory into practice it could offer a fun and dynamic gameplay experience built on well-researched design choices. We look forward to developing our PoC.

1 Introduction

In modern game design, randomness has become an essential tool for shaping dynamic, engaging, and oftentimes unpredictable player experiences. From procedural level generation in roguelike titles to probabilistic loot systems in online multiplayer games, chance-based mechanics are present in nearly every genre. The relevance of randomness in video games lies not only in enhancing variety and replayability, but also in affecting fairness, difficulty balancing since the game should not just be blatantly spamming some random elements out of context, moreover, psychological reward mechanisms are also of high importance in games with randomness. As gaming becomes an increasingly important field of study within computer science and psychology, understanding the role and effects of randomness is both timely and of high importance which also one of the reasons why we chose to focus on this aspect.

This literature review explores the principle of randomness in video games in a broad manner, looking into game design theory, cognitive science, and case studies from both indie and AAA game development. The aim is to analyze how randomness is applied in digital games, what purposes it serves, and how it influences player behavior, fairness, and strategic decision-making. Additionally special attention is paid to the distinction between *input randomness* where random events shape the scenario before the player's decision and *output randomness*, where the randomness affects the outcome of the player's action.

Our research were initially guided by the following research questions to give the research some sort of structure:

1. How is randomness used as a design tool in video games, and for what purposes?

2. What is the difference between input and output randomness, and how do these affect player perception and engagement?

3. How do developers manage or limit randomness to maintain fairness, enjoyment, and strategic depth?

To address these questions, we reviewed a diverse set of academic sources, industry reports, developer interviews, and case studies. Key examples include games like *Into the Breach*, *Slay the Spire*, *Shadow of Mordor (Monolith productions, 2014)*, and *XCOM*, which demonstrate various implementations and consequences of randomness. This review also includes a closer look at psychological phenomena (e.g. reward cycles, illusion of control, etc.), regulatory discussions surrounding loot boxes, and strategies for managing randomness to optimize game balance. **The ultimate goal of this study is to apply the gathered insights to the development of a proof-of-concept video game that incorporates these findings into its core design.**

2 Terminology

To avoid confusion throughout this literature review, we have compiled and explained the key technical terms and concepts that are frequently used when discussing randomness in video games. This section shows relevant terminology that come in context of randomness in video games. Most of the terms are present in this literature review. Therefore, the reader may use it as a dictionary :).

Randomness: The occurrence of unpredictable outcomes in a system. In games, randomness is often introduced through random number generators to produce uncertainty in gameplay events, such as item drops or enemy behavior.

Input Randomness: A form of randomness where the random event occurs *before* the player makes a decision. Examples include drawing a hand of cards or procedurally generating a level before the player interacts with it. Input randomness shapes the conditions under which a player must act.

Output Randomness: A form of randomness that takes place *after* the player has made a decision. It determines whether the intended action succeeds or fails. For example, shooting at an enemy in *XCOM* may or may not hit, even if the player chose the target carefully.

Procedural Generation: The use of algorithms to automatically create content (such as maps, levels, or characters) instead of manually designing each element. This method is often used to ensure replayability and variety.

Information Horizon: A term from game design that refers to how far into the future a player can predict the outcome of their actions based on available information. Randomness reduces the information horizon by making future events less predictable.

Loot Box: A virtual item that players can open to receive random rewards, often used in monetization systems. Loot boxes may contain cosmetic items or powerful equipment, and are sometimes compared to gambling mechanisms.

Dungeon Crawl: Dungeon crawl is a type of gameplay or genre where the player explores a labyrinthine-like environment, facing: enemies, loot and traps

Output Bias and Probability Manipulation: A practice in game design where probabilities are subtly altered to match player expectations. For example, a game may make a 90% hit chance function more like 99% to avoid perceived unfairness.

Spiky Information Flow: A design approach where most of the game progresses with manageable complexity, but sudden, disruptive events introduce large amounts of new information at once. This keeps gameplay both strategic and dramatic.

Variable-Ratio Reward Schedule: A reinforcement system where rewards are given after an unpredictable number of actions. This type of reward structure, common in both slot machines and loot boxes, tends to be highly addictive.

Skill Tree Systems: This is a way the game allows players to visually choose the characters features. Often present in role-playing games such as the AAA game *GTA V (Rockstar Games, 2013)*.

2.1 What are roguelikes?

One of the key terms used in this study is the genre classification roguelike. The name stems from the orginal game, *Rogue*, developed by Michael Toy and Glenn Whichmann. If features of *Rogue* are present in other games you call it roguelike becuase it is **like** the game **Rogue**. Now, what are features of *Rogue*, or what are roguelikes? A roguelike game is traditionally defined as one that incorporates procedural generation, dungeon crawl and last but not least a roguelike contains a permanent death system, often referred to as "permadeath." These design principles originated from the 1980 game *Rogue*, from which the genre takes its name. In roguelikes, each game session is unique due to the use of randomized environments and item placements, forcing players to adapt strategically to unfamiliar conditions. Additionally, when a player's character dies, they typically lose all progress and must start from the beginning, emphasizing high stakes and replayability. The randomized structure of room progression and stat-based item variations, in roguelikes, provide a fitting context to explore input randomness in practice.

Over time, the term roguelike has evolved, and many modern games incorporate only some of these features. Such titles are often referred to as roguelites but they still preserve the core concept of randomness and high replay value. Examples of popular modern roguelikes or roguelites include *Slay the Spire, Hades (Supergiant Games, 2020)*, and *Dead Cells (Motion Twin, 2018)*.

2.2 Procedural Generation in Rogueikes

Procedural generation is a method in game design where content, such as levels, maps, items, or events, is created algorithmically rather than manually. Instead of a developer hand-crafting each individual element, a set of rules or algorithms generates new combinations of content during gameplay or each time the game is loaded. This technique allows for vast amounts of variability, increased replayability, and

reduced production time for content-heavy games. Classic examples of procedural generation include the terrain in *Minecraft (Mojang Studios, 2011)*, the dungeon layouts in *The Binding of Isaac (2011)*, or the randomized weapons creation in *Borderlands (Gearbox Software, 2009)*.

Roguelike games frequently use procedural generation as a core mechanic to achieve their defining characteristic: unpredictability. Since each playthrough in a roguelike is meant to feel different, procedural generation offers a practical solution for generating fresh challenges without requiring developers to design hundreds of levels manually. In this sense, the two concepts: roguelike and procedural generation—are often tightly linked, especially in popular discourse and game marketing.

However, it is important to highlight that while procedural generation is common in roguelike games, it is not a requirement. A roguelike can still function effectively without full procedural generation, as long as it maintains core genre features such as permadeath, random elements (input randomness), and high replayability. The replacement of traditional procedural generation can be achieved by using predesigned content segments that are shuffled or rearranged differently in each run. For example, a set of manually created rooms can be randomly ordered to create a new game structure each time, mimicking the effects of procedural randomness while preserving design control. Such form of procedural generation is reffered to as modular procedural generation because it uses premade modules and shuffles them randomly into a dungeon-crawl map.

3 Methodology

To investigate the role of randomness in video games, we used a variety of sources available to us, using a combination of general-purpose and academic sources. Our research began with explanatory content from YouTube and Wikipedia, which provided an accessible introduction to key terms and concepts. This initial phase helped us build a terminology list that served as a foundation for identifying academic keywords (see chapter 2).

The majority of academic literature was sourced from the open-access database *arXiv*, which offered a wide range of research papers in computer science and game studies. Search terms such as "input randomness," "procedural generation," and other were derived directly from our terminology list and entered into the arXiv search tool to locate relevant sources. Additional searches were conducted using Google Scholar and ResearchGate. Although ResearchGate provided a promising insightful papers, we were unable to access them due to paywalls or permission restrictions, and therefore focused primarily on sources available via arXiv and other smaller but trustworthy databases.

Throughout the process, we documented all useful findings in a shared Word document to maintain a clear overview and manage the large volume of information. As recommended by our supervisor, Michael Schneider, we included only research papers published by reputable or verifiably academic institutions. This increased the credibility and reliability of our source base and ensured that the reviewed material met academic standards.

While the inability to access certain ResearchGate papers represents a limitation of our study, the broad selection of high-quality sources from arXiv still allowed us to gather solid information on the topic.

4 Literature review

Randomness is a powerful tool in video game design, influencing everything from level generation to player psychology. This literature review looks at a variety of sources such as existing research, case studies, mentioned before, and expert input on the use of randomness in games of game designers and with that we will later try to connect them to get a logical conclusion. It is structured around key themes: the purpose of randomness in games, types of randomness, randomness and strategy, psychological and behavioral effects, and additionally on ethical concerns such based around gambling and loot boxes.

4.1 Purpose of Randomness in Games

Randomness is commonly used to introduce variety, replayability, and unpredictability into games. Procedural generation, for example, allows games like *Minecraft* and roguelikes to produce infinitely many levels and challenges, ensuring that each playthrough feels fresh. *Shadow of Mordor*'s "Nemesis system" adapts based on player actions, using randomness to dynamically alter storylines and characters.

In multiplayer games, randomness can be a tool for fairness. Games such as *Mario Kart (Nintendo, 1992)* use random item distribution to give weaker players stronger boosts, balancing out differences in skill. This ensures that newer or less experienced players can still enjoy the game, making it accessible and fun for all participants.

4.2 Types of Randomness: Input vs. Output

A key distinction in game design is between input and output randomness. Input randomness refers to situations where a random event happens before the player makes a decision. This includes shuffled cards in *Slay the Spire*, rolled dice in *Dicey Dungeons (Distractionware, 2019)*, or procedurally generated maps. Players adapt their strategies to the conditions set by these random factors.

Output randomness, on the other hand, occurs after a player has made a decision. For instance, in *XCOM*, a player chooses to shoot an alien, but whether the shot hits is determined by chance a.k.a. randomness. Similarly, in *Apex Legends (Respawn Entertainment, 2019)*, the contents of a loot box are only revealed after the purchase. Output randomness is often criticized because it introduces uncertainty after a player has made a decision, meaning that even well-thought-out strategies can fail due to chance alone. This can lead to a loss of perceived control, where players feel that their success or failure is not determined by their skill or planning but by luck. As a result, repeated negative outcomes, especially in high-stakes moments can generate frustration, reduce motivation, and ultimately worsen the overall gameplay experience.

The Ludology Podcast (Ep. 183) and online interviews with other game developers suggest that while output randomness can create tension, it can also cause players to feel a lack of control. Games like *FTL (Subset Games, 2012)* were noted for generating player frustration due to excessive output randomness, leading the developers to shift toward more input-based randomness in subsequent titles like *Into the Breach*.

4.3 Strategic Impact and the Information Horizon

Game designer Keith Burgun introduces the concept of the "information horizon" which is the gap between a player's current turn and when new information is revealed. Random-

ness affects how far into the future a player can plan. If randomness occurs too frequently or without limits, it shrinks the information horizon, making planning difficult.

Well-balanced randomness, especially input randomness with good information horizon, can significantly enhance strategic depth by forcing players to adapt their plans to new and unpredictable conditions. The sudden random input randomness may be reffered to as spiky information flow. This type of randomness encourages thoughtful decision-making and makes players feel that their success or failure is a direct result of their own choices. Because the randomness occurs before the player takes action, it frames the challenge rather than interfering with the outcome. Players are given time and space to analyze the situation and select a response based on the available information. As a result, failure tends to be interpreted as a consequence of one's own strategy rather than bad luck, which strengthens the sense of fairness and personal responsibility. The game thereby supports improvisational gameplay and creative problem-solving, while avoiding the feeling of making progress feel arbitrary and not well programmed.

Some games mitigate chaotic randomness through design tricks. *Pandemic (Z-Man Games, 2008* controls card randomness by shuffling epidemic cards into separate piles to avoid too many or too few appearing in a row thus optimizing the information horizon. Modern *Tetris (1985)* uses a 'bag system' to control randomness in the distribution of pieces. Instead of selecting each new piece completely at random, the game first creates a 'bag' containing one of each of the seven unique Tetris block shapes. These pieces are then randomly shuffled and drawn one by one until the bag is empty. Once all seven blocks have been used, a new bag is filled and the process repeats. This method ensures that players receive every block type within a short span of time, eliminating frustrating situations where, for example, the crucial line piece (the 'I' block) fails to appear for many turns. The bag system preserves randomness while providing a fair and predictable distribution, allowing players to plan better and reducing the chances of losing due to bad luck alone.

4.4 Psychological and Behavioral Effects

Random reward systems often tap into psychological effects similar to gambling. Loot boxes, for example, use variable-ratio reward schedules (like slot machines) to stimulate dopamine release, reinforcing the desire to keep playing or spending.

Players often misinterpret probabilities of such slot machines. A 90% hit chance might feel like a certainty, and a string of failed 33% outcomes may cause players to believe the next one "has to" succeed. Developers sometimes adjust probabilities to match player expectations. For example, *Fire Emblem (Nintendo 1990)* improves hit chances behind the scenes, and *Civilization VI (Firaxis, 2016)* may guarantee a success after repeated failures.

Tharsis (Choice provisions 2016) developer Zach Gage and others suggest using intuitive systems like physical dice or cards to help players better understand randomness. Games like *Slay the Spire* benefit from this clarity, as players can predict and adapt to outcomes more easily based on known card effects. Similarly, *Armello (League of Geeks, 2015)* uses card-based actions and visible dice rolls in combat, which allow players to assess risks and make informed decisions. The game also includes stat-based effects, such as increased Fight or Body stats, earned through quests and gear, which influence how randomness affects outcomes. Because these systems are transparent and familiar and morevover an input-randomness, players feel more in control even when luck plays a role.

By presenting randomness in ways that are easy to visualize and calculate, such games reduce the perception of unfairness and support engagement even in uncertain situations. It is to be considered that such addition may eliminate some surprise factor which randomness-based game try to achieve since you tell the player their chances and it will not come to them as a surprise.

4.5 Ethical and Design Considerations: Loot Boxes

Surpisingly, loot boxes raise ethical questions due to their similarity to gambling. The ToDiGRA journal article explores this topic in depth, showing how loot boxes operate under the same psychological principles as gambling machines, including near misses, surprise rewards, and dopamine triggers.

Legal frameworks vary: Belgium and the Netherlands classify some loot boxes as gambling and have banned them, while other countries have taken softer stances. Some companies attempt to increase transparency by disclosing item drop odds, which means they publicly state the exact probability of receiving different item types when opening loot boxes. For example, a game might indicate that a legendary item has a 5% chance of appearing, while common items have a 75% chance. This helps players make more informed decisions and reduces the sense of manipulation.

Academic studies also suggest that younger players are especially vulnerable, as they lack the cognitive control to resist these psychological tricks. Financial harm, lack of transparency, and addictive mechanics make loot boxes one of the most controversial uses of randomness in games today.

In addition, some games implement what's called a pity system—a mechanic designed to guarantee a rare or valuable reward after a certain number of unsuccessful attempts. For instance, *Hearthstone (Blizzard Entertainment, 2014)* uses a pity timer that ensures players receive at least one legendary card if they have opened 40 packs without getting one. This system prevents extremely unlucky streaks and reduces player frustration, while still maintaining the element of randomness.

These mechanisms help reduce the resemblance to gambling by minimizing the sense of total unpredictability. In traditional gambling, outcomes are fully random and players have no assurance that persistence will lead to success. By contrast, pity systems provide a form of safety net, ensuring that effort (or spending) is eventually rewarded. Disclosing drop odds also discourages the illusion of 'beating the system,' which is common in gambling psychology. Together, these features make loot systems feel more controlled, transparent, and less exploitative—although debates remain about whether they go far enough to fully separate games from gambling-like mechanics.

4.6 Random Stat-Based Upgrades

One specific and increasingly popular design approach is the use of random stat-based upgrades. A random stat-based upgrade is a game mechanic in which a player's character receives improvements to core abilities—such as health, strength, defense, or special attributes through randomized systems. These upgrades differ from traditional level-up or skill tree systems in that the enhancements are not chosen directly by the player, but rather are assigned or acquired through probabilistic means such as item drops, card draws, or quest outcomes. Unlike cosmetic or inventory-based randomness, stat-based

upgrades directly impact gameplay mechanics, often shaping how players approach challenges in subsequent stages of the game.

This mechanic plays an important role in improving input randomness by introducing variety early in the decision-making process. Players are often required to adapt their strategies to the upgrades they receive, while still feeling in control because they are responding to known changes rather than suffering from unpredictable outcomes (as you may find out while reading, we are not really fond of output randomness. TEAM INPUT-RANDOMESS!) . In this way, random stat-based upgrades maintain player engagement by providing new opportunities in each playthrough.

A prominent example is found in *Armello*, where players can increase their character's stats—such as Fight, Body, Wits, and Spirit through card-based equipment and successful quest completions. The quests present players with randomized risks and potential rewards, while gear cards are drawn from shuffled decks. Although the specific rewards are not guaranteed, the possible outcomes are visible, allowing players to make informed decisions. This clarity enhances the fairness of the system and preserves agency, as players feel they are strategically navigating through uncertainty rather than being passively affected by it.

Random stat-based upgrades are particularly well-suited to roguelike games, which emphasize replayability and emergent strategy. By introducing new stat combinations in each run, these systems encourage players to explore different playstyles and make dynamic choices that align with the resources available. At the same time, they avoid the potential frustration of output randomness by ensuring that player choices remain central to success.

Table 1: Comparison of Input and Output Randomness in Game Design

Type of Randomness	**When It Occurs**	**Impact on Player**	**Example Games**
Input Randomness	Before the player makes a decision	Shapes initial conditions; encourages adaptation and planning; perceived as fair	*Slay the Spire*, *Spelunky*, *Into the Breach*
Output Randomness	After the player makes a decision	Affects outcomes directly; can reduce perceived control; adds tension or frustration	*XCOM*, *Hearthstone*, *Apex Legends*
Stat-Based Randomness	During upgrade or reward phases	Influences future strategy; offers variety without compromising agency	*Armello*, *Dead Cells*, *Hades*
Reward System Randomness	Upon opening loot/reward boxes	Triggers dopamine response; often criticized as manipulative; ethically controversial	*Overwatch*, *FIFA Ultimate Team*, *CS:GO*

5 Adding Our Spice: Verticality and Player Experience

Vertical movement—the ability to move not just forward and backward, but also upward and downward—has become an increasingly valuable design element in modern game development. It transforms gameplay from a flat, linear experience into a fully three-dimensional one, giving players more ways to navigate, explore, and interact with the world. According to recent research on character movement design using Unreal Engine, adding vertical elements such as climbing, jumping, or ascending to higher floors significantly boosts player satisfaction and engagement (Moldstud, 2023).

The study points out that verticality enhances immersion and creates a more dynamic gameplay experience. When players can move freely in all directions, the game world feels more alive and responsive. It also invites exploration, as players are encouraged to look beyond the obvious path—not just ahead, but above and below. From a design standpoint, vertical movement allows developers to build layered environments with multiple paths, hidden areas, or elevation-based challenges—features that support replayability and strategic depth, which are core qualities of roguelike games.

Beyond exploration, verticality also influences how players experience control. Well-implemented vertical mechanics—like ladders, elevators, wall jumps, or teleporters—tend to increase the feeling of freedom and agency. However, this only works if the navigation feels natural. Poorly communicated or clunky vertical movement can easily lead to confusion or break immersion. That's why strong visual or spatial cues—such as lighting, level layout, or animation prompts—are essential to guide players intuitively through vertical spaces.

In our own proof-of-concept roguelike game, we want verticality to play a central role. Rooms could not only laid out side by side but are also stacked vertically, allowing players to move upward and downward through the dungeon. This opens up more diverse strategies and adds a stronger sense of spatial exploration. For example, by placing exits at unexpected heights or tying certain upgrades to higher or lower levels, we can surprise the player and encourage meaningful movement decisions.

Ultimately, verticality adds a new layer of complexity to our semi-procedural design and fits naturally into our goal of thoughtful, player-driven navigation. It increases freedom, deepens exploration, and complements the principles of modern, engaging level design—making it a core feature, not just an optional extra.

Vertical movement—the ability to move not only forward and backward but also upward and downward has been shown as a valuable design tool in game development. It expands the playable space from a flat, linear plane to a three-dimensional environment, offering players more ways to navigate, explore, and interact with the world. According to recent research into character movement design using Unreal Engine, adding vertical elements such as climbing, jumping, or ascending to higher floors significantly increases player satisfaction and engagement (Moldstud, 2023).

The study highlights that verticality contributes to a more immersive and dynamic gameplay experience. When players can traverse environments in multiple directions, the game world feels more alive and realistic. This also encourages exploration, as players are rewarded for looking up or down, not just forward. From a design perspective, vertical movement allows developers to create layered environments with multiple paths or secret areas, which enhances replayability and depth—both of which are core qualities in roguelike games.

In addition to exploration, verticality affects how players perceive control. Well-implemented movement mechanics that include vertical options (e.g., ladders, elevators, or teleporters) increase the feeling of freedom and agency. However, this benefit only holds if the vertical movement is intuitive. Poorly communicated or awkward vertical navigation can confuse players and break immersion. Therefore, designers are encouraged to use environmental cues—like lighting, layout, or animation prompts—to guide players naturally through vertical spaces.

In the context of our proof-of-concept roguelike game, vertical movement plays a central role. Rooms are not just connected in a horizontal sequence, but also stack vertically, allowing players to ascend or descend through the dungeon. This design choice supports both strategic variety and a richer sense of spatial exploration. Moreover, by placing vertical exits at unexpected angles or linking important upgrades to higher or lower levels, we create opportunities for surprise and meaningful decision-making.

Overall, the inclusion of verticality aligns with the principles of good level design and player-centered movement. It increases navigational freedom, deepens the complexity of exploration, and brings additional variety to procedural or semi-procedural systems, making it a strong and, fortunately, research-supported addition to our game design.

6 Discussion: Summary of our Findings

Based on the sources and case studies examined, several clear we have gathered improtant information that directly address main goals.

Firstly, randomness serves multiple purposes in game design: enhancing variety, increasing replayability, maintaining player engagement, and promoting fairness. Particularly in multiplayer or casual party games, randomness helps bridge skill gaps and ensure that less experienced players still have a fair and enjoyable experience. The literature shows a strong consensus that procedural content and unpredictable scenarios can make gameplay more dynamic and less repetitive.

Secondly, the difference between input and output randomness proved to be crucial. Input randomness, occurring before player decisions, is generally seen as enhancing strategy by forcing players to adapt. Output randomness, on the other hand, can undermine player agency if overused. Developers like those behind *Into the Breach* actively design around this, favoring systems that allow players to plan based on known variables. However, some well-tuned output randomness (as seen in *Hearthstone*) can still contribute to player excitement when expectations are clearly managed. Unfortunately, this is rarely the case.

Thirdly, developers often control randomness through balancing techniques and/or algorithmic limitations. Systems such as the "bag method" in *Tetris*, the epidemic card structuring in *Pandemic*, or smart loot systems in *Diablo 3 (Blizzard Entertainment 2012)* demonstrate how randomness can be controlled to ensure fairness without removing unpredictability. We found these systems to be strong examples of how randomness and fairness are not opposites, but complementary forces when used with intent.

The psychological effects of randomness, especially in reward systems—stood out as both powerful and problematic. Loot boxes exemplify the fine line between engaging mechanics and exploitative design. Studies and real-world regulation show that when randomness is monetized without transparency or ethical safeguards, it can result in manipulative and even harmful outcomes, especially for younger players.

From a critical perspective, while the literature was rich in examples and design theory, it was somewhat limited in empirical behavioral data, especially in measuring long-term player responses to randomness. Moreover, few sources addressed cultural differences in how randomness is perceived or regulated, which could be important for global game design. While much of the literature focuses on player psychology and fairness from a general perspective, it largely overlooks how these issues vary across different regions. For example, some countries like Belgium and the Netherlands classify loot boxes as a form of gambling and have implemented strict bans, whereas others like the United States or Japan are more permissive or regulate them less stringently. In addition to legal frameworks, cultural attitudes toward luck and fairness also differ: in some cultures, randomness is seen as an exciting and integral part of gameplay, while in others, players place greater value on skill and transparency. These differences can have a significant impact on how random mechanics are received and whether players perceive them as fair or manipulative. A better understanding of cultural perspectives could help developers design games that are both legally compliant and more appealing to diverse player bases. This represents a notable gap in the current literature and a valuable direction for future research.

In our view, randomness remains an essential but delicate part of game development. It enables surprise, drama, and creativity—but must be balanced with fairness and transparency. Our literature review found a wide range of perspectives, practical applications, and ethical considerations, fulfilling the goal of presenting a comprehensive and comprehensible overview of the topic.

In future research we also might explore randomness in emerging areas such as AI-generated content, adaptive learning games, or virtual economies. These domains offer newer and very interesting opportunities to understand how randomness functions in regards to a fully random generation done by AI.

In the context of AI-generated content, randomness is often used to help artificial intelligence systems create dynamic and unpredictable experiences, such as procedurally generated narratives, levels, or character interactions. Studying how randomness interacts with generative AI could reveal how to balance unpredictability with coherence, and how players respond to content that is both unique and computationally authored.

Lastly looking into adaptive learning games, which personalize content based on a player's performance could be interesting as well, as they also rely on controlled randomness to keep challenges engaging and varied. Investigating how randomization affects learning outcomes could have educational implications—for example, whether introducing unexpected challenges helps or hinders cognitive development, and how players form strategies in evolving environments. But the last mentioned point could be a bit too scientific, nevertheless, still interesting!

7 Conclusion and Hypothesis

When we started working on this project, we had a general idea that randomness played a big role in game design—but honestly, we didn't expect it to be this deep. Through the literature review, we came across a surprising number of perspectives, not just on how randomness works mechanically, but also how it *feels* to players: sometimes exciting, sometimes frustrating, sometimes unfair. What really stuck with us was the distinction between input and output randomness. That simple concept—randomness before vs. after the player acts—turned out to shape almost everything in our design thinking.

The more we read, the clearer it became: randomness can add fun and variety, but only when it respects the player's sense of control. So, we made a clear call **no output randomness** in our game. No dice rolls to determine whether a hit lands. If you aim and shoot, the shot hits. Instead, all the uncertainty comes before the decision: in the way rooms are ordered, which upgrades you get, or what kind of challenge appears next.

One of the most interesting directions this took us was into **random stat-based upgrades**—basically, giving the player new stats or abilities. We're using that idea to offer unpredictable but fair variety in every run, this allows every run to be very unique.

Another piece that shaped our design more than we first expected was **verticality**. We hadn't originally planned to focus on upward/downward movement, but a study we read made us realize how important vertical spaces are for exploration and immersion. That got us thinking differently about our room layouts. Now, our game doesn't just move forward—it moves up and down, too. It sounds small, but it changes how players think, where they look, and what they feel when navigating the space.

We also found the idea of the **Information Horizon**—the timing of surprise—super useful. It gave us a framework for things like enemy ambushes and room effects that don't feel random for the sake of being random, but instead disrupt patterns in meaningful ways, forcing players to adapt to sudden changes. Importantly, we decided to intentionally **avoid loot boxes or monetized randomness** in our prototype. Our research highlighted concerns about ethical design and player manipulation in such systems, especially when rewards are tied to payment. By excluding these mechanics, we aim to create a game that is both engaging respectful of the player's experience.

Furthermore, we have decided to include a **pity system**, meaning should the player receive weaker randomly generated loot multiple times back to back, the game will ensure that the probability of them receiving better loot will increase. This is important so that the randomness will not be the sole cause of the player failing repeatedly, which could lead to frustration.

One practical constraint we faced was the complexity of full procedural generation. Given our limited time and resources, we decided not to implement it. Instead, we're designing a set of handcrafted rooms that will be randomly compiled into different level configurations each run. This approach still supports unpredictability and input randomness—key pillars of roguelike design but ensures that each room is carefully constructed for balance and playability. As mentioned before we call this **modular procedural generation**.

Looking back, this project wasn't just about making a game. It was about figuring out how randomness can be used thoughtfully to make players feel challenged, surprised, and still in control through elements of randomness. We've come out of the research phase with a game concept that reflects that: a roguelike with deterministic combat, random stat-based progression, vertical navigation, and a world that changes each time you play.

Now, we're moving into the part we've been waiting for: actually building it and seeing if it plays the way we hope it will.

8 AI Prompts

ChatGPT (4.0): "Read this literature review and tell me if there are any technical terms that could be difficult for readers to understand so that I can add them to my list of terminology", 09. Mai 2025, the technical terms were added and later also explained in the terminology list.

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