Hollow Knight as a Learning Machine: Applying Gee’s Principles in Game Design

The integration of educational principles into video game design offers profound insights into effective learning methodologies. This paper will analyze Hollow Knight (Team Cherry, 2017), a critically acclaimed action-adventure game, through the article of James Paul Gee, called Learning by Design: good video games as learning machines. By examining how Hollow Knight uses principles such as problem-solving cycles, identity formation, and system thinking, this study will demonstrate how the game serves as a dynamic tool for experiential learning, which is related with topic of our class topics "How Games Teach us to Play".

# **Game Selection**

Hollow Knight (Team Cherry, 2017) is a Metroidvania-style game set in the decaying insect kingdom of Hallownest. Players assume the role of a nameless knight navigating a labyrinthine world filled with challenging combat, platforming obstacles, and environmental storytelling. The game emphasizes nonlinear exploration: players unlock abilities like wall-jumping and dashing to access new areas, while the map system requires manual updates at checkpoints. The game stresses exploration, requiring players to uncover maps, abilities, and narrative fragments organically. With an average playtime of 20–30 hours(from HowLongToBeat website) to complete, Hollow Knight provides enough content for a 20-hour analysis, ensuring sustained engagement without repetitive mechanics. Its nonlinear progression and emphasis on skill mastery align with Gee’s principles, making it an ideal candidate for studying learning-through-design.

**Lesson**

The topic of **"How Games Teach Us to Play"** is deeply embedded in the design of Hollow Knight (Team Cherry, 2017). Unlike traditional instructional methods, Hollow Knight does not rely on explicit tutorials or step-by-step guidance; instead, it teaches players **organically through exploration, trial and error, and environmental cues**. This aligns with James Paul Gee’s (2005) framework for **learning through design**, which emphasizes **well-ordered problem-solving, identity formation, and system thinking** as key components of effective learning in video games.

Boss battles in Hollow Knight further demonstrate **how games teach players to play**. Instead of providing detailed instructions, the game requires players to **observe enemy attack patterns, recognize visual and audio cues, and refine their strategies** through repeated attempts. This process mirrors Gee’s (2005) Cycle of Expertise, in which **failure serves as a learning opportunity** rather than a setback (p. 11). Each battle becomes a **test of patience, adaptation, and problem-solving**, reinforcing the idea that games function as **interactive learning systems**.

# **Justification**

### ****Well-Ordered Problems: Scaffolding Mastery Through Incremental Challenges****

Gee (2005) argues that effective learning environments structure challenges to build progressively on prior knowledge, avoiding overwhelming complexity(p.9). Hollow Knight exemplifies this through its incremental introduction of mechanics. Early gameplay focuses on foundational skills: basic movement, combat, and navigation. Weak enemies like the Crawlid serve as low-stakes practice for timing attacks and dodging. As players progress, abilities such as the Mothwing Cloak (dash) and Mantis Claw (wall-jump) are unlocked, each requiring mastery before advancing. For example, the dash ability not only enhances mobility but also enables access to previously unreachable areas, reinforcing spatial reasoning and problem-solving (Team Cherry, 2017). This gradual progression ensures that players develop a **strong foundation of skills** before encountering more complex challenges. By requiring players to **apply newly learned mechanics in meaningful ways**, the game reinforces **deep learning and retention** rather than rote memorization. This approach aligns with Gee’s assertion that **well-ordered problems create a learning experience where failure is productive** rather than discouraging. As a result, players are not only **entertained but also engaged in an interactive learning process** that mirrors real-world skill acquisition, making Hollow Knight an effective model of **experiential learning through game design**.

Lee’s (2023) analysis of Hollow Knight’s boss fights highlights the role of “sub-rewards”—small achievements tied to exploration—in sustaining motivation (p.20). For instance, discovering Cornifer, the cartographer, in each zone rewards players with map fragments, symbolizing incremental progress. This scaffolding ensures players to learn to see the game as a system of interrelated parts (Gee, 2005, p. 12), a principle evident in my journal reflections. After acquiring the Mantis Claw in the City of Tears, I revisited earlier zones like Greenpath, uncovering hidden pathways and practicing vertical movement. This nonlinear design encourages organic skill application, preventing the “garden path” pitfalls Gee (2005) warns against, where early missteps derail later learning(p. 12).

The game’s ability upgrades, such as the Monarch Wings (double jump) and Isma’s Tear (acid resistance), further illustrate well-ordered progression. Each ability is introduced in a context that necessitates its use. For example, the Monarch Wings are found in the Ancient Basin, a zone filled with bottomless pits that require precise aerial control. By the time players reach this area, they have already mastered basic platforming and combat, allowing them to focus on integrating the double jump into their existing skill set. This aligns that learning should be a process of gradually increasing complexity, where new challenges build on mastered ones.

The Crystal Heart (super dash) exemplifies this principle. Found in the Crystal Peak, this ability requires players to charge a dash that propels them across large gaps. The zone’s design—narrow platforms and laser-emitting crystals—forces players to practice timing and precision. My initial failures here taught me to anticipate environmental hazards, a skill later critical in the White Palace’s sawblade-filled corridors. Gee (2005) emphasizes that tools and abilities should feel like extensions of the player’s agency (p. 8), a concept embodied in how Hollow Knight ties upgrades to environmental mastery.

### ****Pleasantly Frustrating Difficulty: Boss Battles and the Cycle of Expertise****

Central to Gee’s (2005) framework is the concept of “pleasantly frustrating” challenges—tasks that balance difficulty with achievability to foster perseverance. Hollow Knight’s boss battles epitomize this principle. The False Knight, an early boss, teaches players to recognize telegraphed attacks through repetition. After multiple failures, I noticed his overhead slam created shockwaves avoidable by dashing, a skill acquired earlier. Lee (2023) identifies this as “reward shaping,” where incremental feedback (e.g., surviving longer) sustains motivation(p.1). Her reinforcement learning model reveals that bosses like the Mantis Lords are designed to “train” players through iterative failure, aligning with Gee’s (2005) “cycle of expertise” (p. 11). This means that each repeated attempt at a boss fight is not merely a test of endurance but an opportunity for **incremental skill-building**, where players **gradually refine their combat strategies, reaction times, and pattern recognition**. As a result, Hollow Knight fosters a **learning environment that transforms initial failure into long-term mastery**, reinforcing the idea that **challenges, when properly structured, serve as powerful learning tools** rather than discouraging obstacles.

The Mantis Lords battle further illustrates this. Initially overwhelming, their boomerang-like nail throws and synchronized attacks demanded adaptive strategies. My shift from aggression to patient baiting and counterattacking mirrors Gee’s (2008) assertion that failure is a source of feedback, not judgment (p. 34). Victory felt earned, not handed, reinforcing the player’s identity as a skilled warrior. This balance between challenge and reward ensures players remain engaged without succumbing to frustration, a hallmark of effective game-based learning.

Late-game bosses like the Radiance push this principle to its limits. As the final boss, the Radiance combines every skill players have learned: dodging, timing, and pattern recognition. My 15 failed attempts were punctuated by incremental progress—surviving longer each time, recognizing attack sequences, and refining my charm loadout. This aligns with Lee’s (2023) finding that bosses function as summative assessments of player skill (p. 23). The eventual victory was not just a triumph but a validation of cumulative learning, embodying Gee’s (2005) concept of “performance before competence” (p. 13).

### ****Identity and Agency: The Silent Knight as a Vessel for Empowerment****

Gee (2005) posits that deep learning occurs when players adopt identities tied to in-game goals, fostering emotional investment(p.7). Hollow Knight’s silent protagonist facilitates this by minimizing narrative constraints, allowing players to project their strategies onto the knight. Environmental storytelling—crumbling statues, cryptic NPC dialogues—encourages personal interpretation. For example, the Mantis Lords’ post-victory bow transformed my perception from intruder to respected challenger, deepening my connection to the game’s world.This approach enhances player immersion by making progression feel personally meaningful rather than dictated by the game. By allowing players to **craft their own narrative interpretations**, Hollow Knight reinforces Gee’s (2005) argument that **learning is most effective when tied to personal agency and investment**. The absence of a predefined protagonist personality further enables players to **develop a sense of ownership over their journey**, strengthening their **engagement and problem-solving skills** as they navigate Hallownest. This player-driven learning process not only deepens emotional attachment but also mirrors real-world learning experiences, where individuals learn best when they feel **personally connected to their challenges and goals**.

The game’s charm system further personalizes identity. Charms like Quick Slash (faster attacks) and Grubsong (soul gain on damage) allow players to tailor their playstyle. For example, I gravitated toward defensive charms like Stalwart Shell (invincibility extension) during boss fights, reflecting my cautious approach. Gee (2005) argues that such customization “validates diverse learning styles” (p. 12), ensuring players feel ownership over their strategies.

The game’s minimalistic narrative—delivered through cryptic tablets and NPCs like the mournful Elderbug—invites players to construct their own understanding of Hallownest’s fall. This ambiguity fosters a sense of discovery, as piecing together lore fragments becomes a self-driven quest. Gee (2008) praises such design for treating players as co-authors of the narrative (p. 35), a principle that deepens engagement.

### ****System Thinking and Distributed Knowledge: Navigating Hallownest’s Ecosystem****

Hollow Knight’s interconnected world demands “system thinking,” where players understand mechanics as part of a larger ecosystem (Gee, 2005, p.14). The map system, discovered organically through Cornifer’s humming, teaches navigation without tutorials. Updating maps at benches became a ritual, symbolizing progress and safety. This mirrors Gee’s (2008) information on demand principle, where knowledge is contextual and immediately applicable (p.26). Instead of overwhelming players with information upfront, Hollow Knight ensures that **navigation and spatial learning emerge naturally from experience**, making the process of exploration both engaging and educational.

The Infected Crossroads—a zone later corrupted by orange pustules—teaches players to associate visual changes with gameplay shifts. The sudden appearance of explosive enemies forced me to adapt my combat strategy, linking aesthetics to mechanics. Such design shows teaching through the environment rather than text, and this deepens immersion.

Community-driven resources, such as fan-made guides and forums, act as “smart tools” (Gee, 2005, p. 9), distributing knowledge beyond the game. When stuck in Crystal Peak’s laser-filled tunnels, online tips revealed using the Desolate Dive to bypass obstacles—a strategy I later applied independently. Such external resources enhance reinforcement learning, bridging in-game challenges with collective expertise.

Effective learning environments balance challenge and assistance, principles that are evident in *Hollow Knight*. The game’s lack of explicit instruction forces players to “co-design” their experience (Gee, 2005, p. 6), interpreting mechanics through experimentation rather than being guided by linear tutorials. This aligns with Gee’s (2005) argument that meaningful learning occurs when players actively construct knowledge instead of passively receiving information. *Hollow Knight* exemplifies this approach by requiring players to discover the game’s mechanics, navigation strategies, and combat techniques through trial and error.

The game’s boss battles illustrate Gee’s *Cycle of Expertise* (2005), where repeated failure leads to incremental mastery (p. 11). Each defeat provides feedback, allowing players to refine their approach by learning attack patterns, adjusting strategies, and improving reaction times. This process mirrors real-world learning, where perseverance and adaptation are key components of expertise development. Similarly, the game’s nonlinear progression and interconnected world encourage system thinking, as players must understand how different abilities interact within the larger game environment. For example, acquiring the Mothwing Cloak (dash ability) allows players to access previously unreachable areas, reinforcing the principle that skills are not isolated but interwoven into a broader system.

Beyond the game itself, *Hollow Knight* has a strong player-driven learning ecosystem, with extensive community-generated guides, wikis, and video tutorials. These resources act as “smart tools” (Gee, 2005, p. 9), supporting distributed knowledge by allowing players to learn from one another. The existence of a vast player community enhances the game’s role as a teaching tool, demonstrating how collaborative learning emerges in digital spaces.

### ****Shortcomings and Redesign Opportunities****

Despite its strengths, Hollow Knight occasionally strays from Gee’s ideals. Deepnest’s oppressive design—pitch-black tunnels, ambushing spiders—risks overwhelming players. While the zone taught caution, its difficulty curve could be softened with subtle visual cues, such as bioluminescent fungi highlighting safe paths, aligning with Gee’s information on demand principle (Gee, 2005, p.11).

The White Palace, a late-game platforming challenge, exemplifies another flaw. Its razor-sharp sawblades and infinite respawning enemies felt punitive rather than instructive. Gee (2005) warns that challenges should empower, not alienate (p. 10). A redesign introducing checkpoints or reducing environmental clutter could maintain difficulty while respecting player investment.

Late-game abilities like the Shade Cloak (phase-through attacks) are introduced abruptly, disrupting the well-ordered progression. A gradual tutorial, perhaps through mini-bosses requiring its use, would better scaffold mastery. For example, a Shade Cloak-gated puzzle in the Queen’s Gardens could teach players to phase through hazards incrementally.

**Conclusion**

Hollow Knight (Team Cherry, 2017) exemplifies how well-designed video games serve as powerful learning environments, naturally engaging players in **problem-solving, identity formation, and system thinking**. Through an analysis of the game’s **incremental challenge progression, adaptive difficulty, and immersive exploration**, this paper has demonstrated how Hollow Knight aligns with James Paul Gee’s (2005, 2008) principles of effective learning. The game’s nonlinear structure, **lack of explicit instruction**, and **demand for skill mastery** mirror real-world learning processes, where **trial and error, perseverance, and discovery** are essential components of expertise development.

By examining the **well-ordered problems** embedded in the game’s ability-based progression, we see how Hollow Knight scaffolds learning in a way that prevents overwhelming complexity while ensuring meaningful challenge. The **pleasantly frustrating difficulty** of its boss battles aligns with Gee’s Cycle of Expertise (2005), reinforcing the idea that **failure serves as feedback rather than punishment**. Furthermore, the game’s **open-ended identity projection**—allowing players to customize their approach through charms and strategic play—demonstrates how learning is most effective when tied to personal agency and engagement. Additionally, Hollow Knight fosters **system thinking**, teaching players to view its interconnected world as a **network of evolving challenges and solutions**, reinforcing Gee’s idea about **system thinking** (Gee, 2005, p. 14).

Beyond the in-game learning experience, Hollow Knight extends its educational value through **community-driven knowledge sharing**, with extensive player-created guides, wikis, and discussions forming a smart tool (Gee, 2005, p. 9). This external support system enhances the game’s ability to function as an educational tool, reinforcing the idea that learning is not only an **individual** process but also a **collaborative** one.

However, while the game excels in fostering **autonomy and mastery**, certain aspects—such as the **punishing design of Deepnest and the White Palace**—illustrate the delicate balance between frustration and engagement. These challenges highlight areas where minor **redesigns**—such as additional environmental cues or more structured ability introductions—could improve accessibility without compromising the **core learning experience**.

Ultimately, Hollow Knight serves as a compelling case study for **“How Games Teach Us to Play.”** Its **structured yet flexible learning environment**, emphasis on **experimentation and adaptation**, and reliance on **player-driven discovery** reinforce the idea that **games are not just entertainment but sophisticated learning platforms**. By applying Gee’s framework, this study underscores how game-based learning can cultivate **critical thinking, resilience, and problem-solving skills**, demonstrating that **play itself is a powerful educational tool**.

Reference

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