

Getting to the <3 of Things: How Game Feedback Enables Failure for Learning

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Failure in serious games and its implications for scaffolding learning towards exploration remain understudied. We hypothesize providing more opportunities for safe failure leads to higher retention of concepts. Our case study examines the difference between including extra lives into a prototype serious game for geography through a quasi-experimental design that captured learning outcomes and failure rates. Participants reported more frustration when given fewer chances, and when having less familiarity with games in general. Our findings align with studies suggesting low-stakes environments allow comfortable experimentation and create opportunities for player persistence.

Introduction

Serious games are increasing in popularity as a learning technology and their effectiveness is well-documented. Nearly 80% of adults and over 90% of children in the United States regularly play video games by choice for fun (NPD Group, 2020). Research has demonstrated video games facilitate learning in a variety of ways (Gee, 2003, 2007; Squire, 2011). Video games have been described as powerful learning tools which require players to respond to simulated environments, progressively developing new knowledge and skills within game worlds (Gee, 2003) and support learning related to a variety of cognitive processes such as inductive reasoning (Greenfeld, 2014) and decision-making (Gros, 2007).

Background

Students prefer collaborative, active learning which is technology-rich, making a good case for digital games adding value in education (Bekebrede et al., 2011). Prince (2004) defined active learning as an instructional approach which involves engaging students in the learning process through meaningful activities, thereby promoting reflection on their actions, active inquiry, critical thinking, and problem-solving skills. Serious games take advantage of active learning through a balance of challenge and skill. This balance exists through "Flow" where learning occurs when a person is interested, focused, and controlled during a task (Egbert, 2004).

Gee (2003) emphasizes the importance of failing as part of the learning process and argues video games play a particular role in encouraging that attitude. Video games offer players a low-stakes environment for experimenting and making mistakes, which builds resilience and persistence when players fail. Furthermore, Gee emphasizes successful game design often incorporates failure as a necessary step towards success and encourages players to keep trying until they succeed. Various scholars view failure not as a setback, but as a necessary and valuable component of the learning process (Gee 2003; Kapp, 2012; Salen & Zimmerman, 2005).

Problem Statement

Research exists on many topics related to digital game-based learning, but there are not many results for applying serious games in higher education (Liberona et al., 2021). This study takes a look at a serious game currently used in higher education in an introductory geography course. Feedback is something digital games have mastered (Gee, 2007; Kapp, 2012). The feedback we receive when playing video games is timely and well-scaffolded. For example, in a game like the classic Nintendo Entertainment System (NES) Super Mario Brothers, Mario blinks and shrinks or falls when he encounters an enemy that he does not squish, and an additional sound plays. This indicates to the player that the non-playable character (NPC) on screen has the ability to harm Mario.

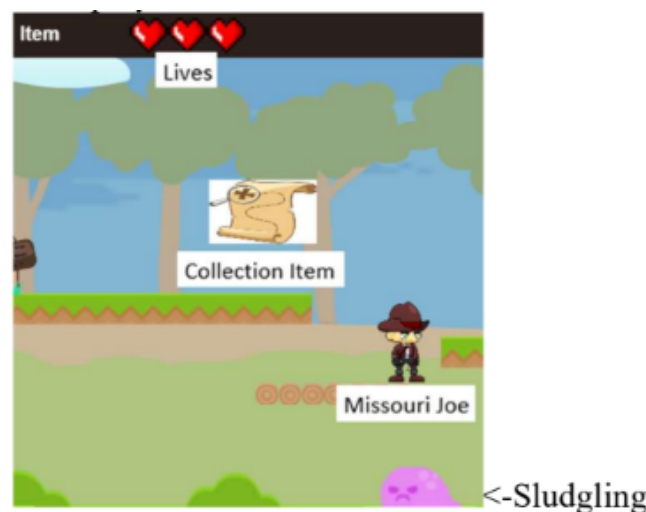
Methods

In the serious game selected for this study, Biomes Rescue, the player receives feedback in the form of a “deathscreen” when encountering a harmful NPC, which in this game are called “Sludglings.” For this study, we redesigned the game to give the player more chances, or “lives,” so the player does not need to break flow in order to continue gameplay and proceed with learning.

The feedback in the second iteration of the game is in the form of hearts at the top of the screen. When the player begins, they have three “lives,” or chances, rather than being forced to restart gameplay every time the player encounters a Sludgling. When the player encounters this harmful NPC, the player will flash briefly and a “life” will disappear from the user interface at the top of the screen. The third time a player takes damage, the deathscreen appears.

Figure 1

Gameplay UI with Hearts


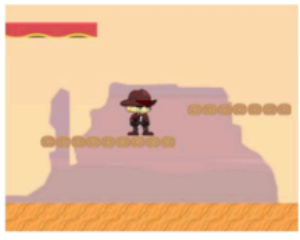
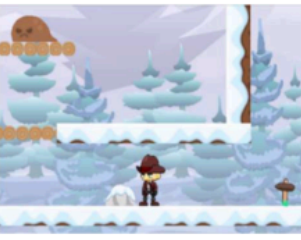



A collection and matching dynamic enables players to associate different characteristics with biomes. Driven by a simple narrative, to restore the biomes from anthropomorphized NPCs representing pollution, the player explores this puzzle-platformer.

We conducted a quasi-experimental case study to investigate the usefulness of immediate feedback in the form of additional “lives” to player learning. The goal of Biomes Rescue is to teach the player basic concepts about the characteristics of various biomes. The player collects clues about the biomes and goes between them through the Hub World. Matching clues to the correct biome unlocks more of the level and allows the player to collect additional clues. The win condition for the game is to fully unlock all biomes and battle the “SludgeKing,” who wants to eat the world’s biomes. The player’s role is to stop him. We hypothesized the differences in feedback would impact the learner’s knowledge retention when playing this serious game, in that if they had more chances they would retain more information.

Table 1

Biomes and the Hub World

			
Hub World	Desert	Taiga	Rainforest

Data was collected with eight participants from a purposeful convenience sample - three expert gamers and five novice gamers. Some of the participants had the condition of extra chances in the form of three “lives” while others were given the no-lives condition. The participants virtually attended a one-hour session of recorded gameplay. The post-test asked players to match facts to the correct biome and was scored for accuracy.

Results

Players died frequently in this game. Those with multiple “lives” were allowed to continue playing without immediately reaching the deathscreen, and could be hurt by enemies up to 3 times without starting over. All novice players without multiple lives quit before completing the game - one stopped on the first level after matching only two clues. The post-test did not reflect this, as many simply guessed, and some had more prior knowledge than others. Expert players finished the game relatively quickly, with the quickest time by an expert player without multiple lives.

Figure 2

Results

#	Gamer Level	Age	Condition	Times Started Over	Time on Death Screen	Complete Play Run	Post-test Score	Experience with Games
1	Novice	30	-	20	1:20	N/A	4/12	Boring
2	Novice	48	♥♥♥	14	0:56	11:01	7/12	Nostalgic
3	Novice	63	-	16	1:04	N/A	6/12	Relaxing, entertaining
4	Expert	21	♥♥♥	4	0:16	13:52	8/12	Co-op, fun
5	Novice	32	♥♥♥	3	0:12	6:45	8/12	Aggressive
6	Expert	19	-	1	0:04	9:35	5/12	Fun, skill-building
7	Expert	33	-	5	0:20	5:51	9/12	Relax, chill & detach
8	Novice	52	-	5	0:20	N/A	12/12	Doesn't play much, frustrating, "bad" at it

When asked their favorite part of the game, participants who completed the game said they liked the animals, who appeared once the biome was complete, and squishing the Sludglings. Participants who did not complete the game had similar answers, although they tended to express higher levels of frustration with the game, as well as animosity towards the Sludglings. When asked their least favorite part, participants with the multiple lives condition who completed the game disliked the desert level, whereas no-lives participants expressed exasperation with having to restart the game. Participants who did not complete the game expressed greater frustration with dying, there being no checkpoint within the game, and other minor frustrating game mechanics or bugs.

The willingness of “lives” participants to provide more in-depth feedback probably reflected their relatively lower degree of frustration with the game than those who had to start over constantly. When asked what they would change to make the game more successful as an educational tool, participants all responded with notes about either making the biomes more clearly delineated or improving the inventory to make clues more readily accessible.

Discussion

The frustration our participants described feeling when playing the game made them less inclined to learn, less likely to achieve a state of flow, and less likely to complete the game. We found participants with experience playing games (“expert” gamers) were more likely to persevere, even though they expressed a similar state of frustration as novice gamers. Tolerance for frustration had a limit for all participants, but expert gamers understood the broader scope of trial-and error as a game mechanic from their own past experience, and saw that as part of gameplay, while novice gamers were simply discouraged by the difficulty of the game. We also found that those who had multiple chances (lives) when playing the game were more likely to complete the game. Players who enjoy a challenge are more likely to find competence and enjoyment within failure (Frommel, 2021), so it makes sense our expert gamers (or those who enjoy ultra-difficult games) were not hindered by the absence of additional chances.

Our participants with lives all completed the game, whereas our participants without multiple lives had only a 40% completion rate. All participants who completed the no-lives condition game were expert gamers. The no-lives condition was so frustrating for novice gamers that they were unable to complete the game. The number of correct results in the post-test assessment seemed to have little connection to what the players were doing in the game. Their two major points of frustration were novice status and restarting. This implies serious games aimed at novice gamers should gravitate toward less difficult gameplay if they wish to induce states of flow, learning, and enjoyment in the player, while serious games aimed at expert gamers may have more latitude to include extreme difficulty as part of play.

Conclusion

Frustration is an important tool in game design, but “pleasant frustration” is difficult to achieve when the audience is at different levels of expertise. When the player, despite multiple attempts, is unable to make satisfactory progress, learning dissipates because the challenge is too high. Our “lives” participants seemed less frustrated when starting the game over, even in the case where they were novice players who had started over several times. The no-lives condition did not provide ample opportunity for safe failure, because when challenges and skills are not balanced, it results in frustration (Egbert, 2004). Immediate feedback allows players to both remain in a state of flow and see direct progress as they play (Cheng et al., 2015). Doing as little as possible to interrupt flow during play allows the tasks of learning and playing to occur sequentially, or in an alternating fashion, rather than simultaneously (Nadolski & Hummel, 2017). A low-stakes environment for experimenting and making mistakes builds resilience and persistence when players fail (Gee, 2007). Our findings show that making the stakes lower, or giving more opportunities for safe failure, does result in a better outcome for the learners.

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