

PLANTS VS ZOMBIES AS AN EMPOWERING LEARNING MACHINE

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ABSTRACT

What makes the computer game Plants vs. Zombies engaging and a successful learning machine? In the game, vegetables and flowers defeat zombies by shooting peas, coconuts, and watermelons, and delaying the zombies by feeding them walnuts. The game is a classic strategic tower defence game in a vegetarian game universe. The game provides a unique example of seamlessly blending the tutorial into the gameplay.

This article analyses the game in order to identify engaging elements that can be used in the design of serious games. Empowerment and well-ordered problems were key elements found in the analysis of the gameplay in Plants vs. Zombies. Empowerment can be split into *active participation, meaningful feedback, co-design, identity, and identification*. The second key element, i.e. well-ordered problems, can be divided into *pleasantly frustrating, cycles of expertise, strategies to achieve goals, and stripped-down version*. Meaningful and engaging gameplay makes the player invests a lot of time in playing, and can trigger deep learning.

A first-hand experience of playing computer games gives valuable input for designing serious games. The first-hand experiences are also valuable in the classroom when relating game design theory to real-life experiences.

KEYWORDS

Serious games, game design, learning, computer games, empowerment, and teaching.

1. INTRODUCTION

What makes a game or serious game engaging and a successful learning machine? – How are new challenging elements introduced without reading tutorials? And how can the player exercise new evolving skills without getting bored or frustrated? The computer game Plants vs. Zombies provides a unique example of seamlessly blending the tutorial into the gameplay. Blending tutorials into the user activities can also be used in the design of serious games. The article is based on a first-hand experience of playing the Plants vs. Zombies. The target group for this article is designers of serious games, game designers and design students.

Good computer games are engaging and motivating (Gee, 2003; Fullerton, 2008; Juul, 2005; Salen & Zimmerman 2004; Kafai, 2006; Kili, 2005; Majgaard, 2014). Matching challenges to skills is fundamental in engaging games and optimal experiences (Kili, 2005; Csikszentmihalyi, 2005).

In serious games such as Number Blocks, Fraction Battle, and Trigonometry Apps embedding the tutorials haven't been articulated in the design processes (Majgaard, 2009; Majgaard, 2012; Petersen, 2012). In these design processes the development teams have been focusing on how the interplay between the academic subject matter and the gameplay could improve the engaging learning processes (Habgood, 2007). And these serious games haven't been as engaging as for example Plants vs. Zombies, and the question is, therefore whether there are specific engaging elements in Plants vs. Zombies which can be used in future serious games or used as design elements in regular games.

Gee (2005) wrote an inspiring article on games as learning machines, in which he highlighted empowered users, and understanding and problem solving as key areas for engaging the learner. In this article Plants vs. Zombies will be discussed in relation to Gee's principles and Schön's (1983) ideas on learning.

The research question is: What makes Plants vs. Zombies engaging and a successful learning machine - and how can this be used in designing serious games and teaching?

First, the game *Plants vs. Zombies* is introduced. This will be followed by a discussion of the game in relation to Gee’s and Schön’s ideas. Finally, the most engaging design elements in *Plant vs. Zombies* will be summarised.

2. PLANTS VS. ZOMBIES

The storyline in *Plants vs. Zombies* is thoughtful and encouraging. *Zombies* in computer games are usually fought with heavy weapons. In this game zombies are fought with vegetables. The game takes place in a kind of vegetarian universe. *Zombies* are all the time trying to destroy the ecosystem of suns and plants created by the player. The game makes the player think that planting vegetables and flowers can defeat the evil in the world (at least in the world of games). The storyline appeals to a broader target group than traditional strategy tower defence games. The game was created by PopCap Games in 2009 and sold more than 300,000 copies over the first nine days (Wikipedia *Plants vs. Zombies*). A sequel, called *Plants vs. Zombies 2: It's About Time*, was released in 2013. According to PopCap’s webpage, 65% of their customers are female and 29% of the customers are over 29 (PopCap, 2014). In addition, PopCap Games has created games such as *Bejeweled*, *Peggle* and *Solitaire Blitz*.

Players place different types of plants, e.g. sunflowers (producing sunmoney), peas (shooters) and walnuts (wall), in the garden. Each one has their own unique offensive or defensive capabilities. The playing field in front of the house is divided into five horizontal lanes, and the zombies move towards the player's house along one lane. The economy in game is based on sunmoney, which can be gathered for free, and by planting e.g. sunflowers. The player starts with a limited number of seed types and at each level a new plant is introduced. The zombies also come in a number of types. They have different attributes, in particular, speed, damage tolerance, and abilities.

In the last part of the game an optional Zen garden for relaxation and contemplation is introduced. In the sequel a kitchen garden for growing extra powerful plants is introduced.

The creator George Fan intended on balancing the game between cute plants and zombies (Wikipedia *Plants vs. Zombies*, 2014). Strong strategic elements were included to appeal to more experienced gamers, while keeping it simple to appeal to casual gamers. Simplicity and accessibility were obtained by blending tutorials into the game (Fan, 2012). New zombies were introduced at every other level. At the first level the new zombie was presented in a safe environment where it was relatively easy to shoot, and at the next level the new type of zombie was used in a more demanding setting. This is an example of mixing tutorial and gameplay. Fan (2012) describes the peashooter as a tower with personality who nobody would expect to move. The affordance of the peashooter is intuitively understandable and defines what actions are possible (Norman, 2013).

3. DESIGN FOR LEARNING

How is learning designed into *Plants vs. Zombies*? Fan outlined 10 tips for making game tutorials more effective and more fun (Fan, 2012; Curtis, 2012), see the table below. In the game there is no tutorial page, the tutorial is seamlessly blended into the game. The player doesn’t read about specific actions. The player is lured into doing a specific action just once. "Once they see the results of their action, that's often all it takes for them to understand that action," Fan said (Curtis, 2012). Furthermore, he minimises the use of text messages. The messaging is adaptive and if the player understands the mechanics no messages or arrows are displayed. Fan prefers to use visuals to teach, e.g. an arrow, or just showing how the peashooter works. Fan believes information creates noise, e.g. messaging on things the player already knows. Additionally, he relies on what the player already knows, e.g. that plants don’t move.

Table 1. Fan’s ten tips for making tutorials more effective and fun.

1. Blend the tutorial into the game	6. Use unobtrusive messaging if possible
2. Better to have the player <i>do</i> than <i>read</i>	7. Use adaptive messaging
3. Spread out the teaching of game mechanics	8. Don’t create noise
4. Just get the player to do it once	9. Use visuals to teach
5. Use fewer words (max. 8)	10. Leverage what people already know

3.1 Active Participation and Empowerment

Fan's view on learning processes is based on the learner being active, e.g. "Just get the player to do it once" or "better to have the player *do* than *read*". The learning philosophy can be related to Donald Schön's ideas on learning being anchored to *active participation* and *reflecting-in-action* (Schön, 1983). According to Schön, the learning improves when the learner is being active and "doing" things. While the active interaction is going on, the learner reflects on the activity and how to reach the goal effectively. The player learns while interacting and the game is making *meaningful feedback*. For example, when the player for the first time plants a watermelon, he experiences how quickly a simple zombie is being defeated.

Meaningful interactivity makes the learning process more motivating and exciting. The player has influence on the gameplay and experiences the consequences of his own choices (*empowerment*).

When the player plants sunflowers, peashooters, and walnuts in front of his house, he immediately sees the consequences in terms of how successful the zombies are being kept down. While the player is observing the battle, he actively collects sunmoney for the purchase of new peashooters that immediately can be inserted in the game.

According to Gee, empowerment of learners are done by making the player a *co-designer* of the game, e.g. by planting vegetables and flowers. The player designs the garden and by that the strategy for defeating the zombies. The player chooses between a variety of plants with different abilities and characteristics, such as Jalapeno, Torchwood, Snow Pea, Power Lily, and Squash. Successful and empowered learning requires that learners feel like active agents not just passive recipients (Gee, 2003). Deep learning requires an extended commitment and such a commitment is related to *identity or identification*. In *Plants vs. Zombies* the player can relate to the sustainable, vegetarian, strategic and cute approach to fighting zombies.

3.2 Design of Well-Ordered Problems

According to Gee (2003), problems in good games are *well-ordered*, they shouldn't be too complex and confusing. As mentioned earlier new zombies were introduced at every other level; at the first level the new zombies were presented in a safe environment where they were relatively easy to shoot, and at the next level the new type of zombie was used in a more demanding setting. This design leads the player to form good guesses about how to proceed when he faces tougher problems later on in the game. In this sense, earlier parts of a good game are always referring to later parts (Gee, 2003).

Learning works best when new challenges are *pleasantly frustrating*. The new challenges should feel hard but doable. And even if the player fails, he should feel that he is making progress. Csikszentmihalyi (1990) describes this pleasantly frustrating relation between challenges and skills as flow. It is characterized by play and self-forgetfulness (Csikszentmihalyi, 1990). Good games adjust challenges to skills. The feedback is given in such a way that the player feels challenged and his effort is paying off. In *Plants vs. Zombies* the challenges progress so slowly that the player's skills adjust to the growing challenges most of the time.

Expertise is formed in any area by repeated cycles of learners practicing skills until they are nearly done automatically and can be named *cycles of expertise* (Gee, 2003). In *Plants vs. Zombies* each level can be described as a cycle and at each level the player can optimise his skills in collecting sunmoney, exploring new plants, and killing zombies. Good games create and support the cycle of expertise. Cycles of expertise are, in fact, the core of the gameplay in *Plants vs. Zombies*. Players don't like practicing skills out of context, over and over again. In good games, players learn by implementing *strategies to achieve goals* and practicing the new skills. Fan's (2012) first and second tips support this by putting focus on blending tutorials into the gameplay and learning by doing in a realistic game context. In *Plants vs. Zombies* the player implements strategies to achieve new goals at each level of the game while practicing new and old skills. The first levels of *Plants vs. Zombies* are a *stripped-down version* of the game. Only peashooters, sunflowers and walnuts are introduced. New plants and zombies are gradually introduced.

4. CONCLUSION

What makes *Plants vs. Zombies* engaging and a successful learning machine, and how can this be used in designing serious games and teaching? The game universe in *Plants vs. Zombies* makes the player think that planting vegetables and flowers can defeat the evil in the (game) world. This gives an overall meaning when playing the game. The affordance of the zombies is intuitively understandable and defines what actions are possible, e.g. a zombie with no helmet is easier to defeat than a zombie with a plastic helmet, and a zombie wearing a metal bucket is even harder to defeat. Coconut cannons hit harder than peashooters and so on.

The tutorial is seamlessly blended into the gameplay and this works remarkably well. The player is lured into doing a specific new action just once without reading any tutorial. The player might even not be aware of the seamlessly embedded learning objects. This idea has great potential in future productions.

Empowerment and well-ordered problems were key elements for deep learning and engagement of the player. They can be easily used in the designs of serious games. Design elements for empowerment are divided into the learner's *active participation, meaningful feedback, co-design, identity, and identification*. The design elements for well-ordered problems are divided into *pleasantly frustrating, cycles of expertise, strategies to achieve goals, and stripped-down versions*.

A first-hand experience of playing computer games gives valuable input for designing serious games. The first-hand experiences are valuable in the classroom when relating theory to real-life experiences.

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