

Designing Serious Games with the Game of Games

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Abstract: Education of serious gaming and gamification is often done in a traditional classroom setting. This paper discusses three cases in which we practice what we preach. In the classroom of the future students create a game while playing a game. The main question addressed in this paper is how we can design a meta serious game for educational purposes that is fun but also has educational value? In the development of the meta game (the Game of Games) we take a design science approach. The Game of Games was used to develop three games in an educational setting. The Game of Games was able to deliver the desired structure to guide students to develop serious games. The game of games consists of four islands: the land of ideas; the land of desire, the land of creation and the land of plenty. We found out that all three tests (feedback, flow and fun) initially were not timed correctly. Serious game development is in need of early prototype development. Secondly, The difference between dynamics and mechanics is not clearly defined in the literature and therefore not easily applicable for the novice game developer. Finally, in contrary to game dynamics and mechanics behavioral change is well described in literature. Testing and measuring the effectiveness in educational settings however is proven difficult. Despite promising results in structuring the serious game development process, future research has to show the effect of the game of games for serious game development purposes.

Keywords: Serious Gaming, value proposition, prototyping, MDA, behavior

1. Introduction

Serious games represent games that effect the behavior of its players (Thompson, 2008) with the intention of serving learning goals, behavioural goals, organisational goals and or intervention goals set by its developers. Serious games are applied in a broad spectrum of domains (Göbel, 2010). Serious Games need to manifest an explicit and carefully thought-out purpose (De Wit, 2011). Transposed to an educational setting Greek Philosophers early on recognized the value of play in relation to learning. "You can discover more about a person in an hour of play than in a year of conversation" (Plato). Addressing its role in the transfer of cultural explicit and implicit knowledge Huizinga (1944) stated that "Play is older than culture" (Huizinga, 1944). Huizinga (1944) posed the idea that games provide a magic circle where knowledge can be gained that can be transferred to actual reality, providing a safe learning environment fostering knowledge transfer; an aspect later addressed by Hays and Singer (1989) regarding training systems design. The application of game elements in education is furthermore associated with enhanced student motivation (Dominguez et al., 2013) and engagement (Dijk et al., 2015). Games and its educational function is omnipresent in both history and present.

The Game of Games –aimed at guiding novice serious game development- as shown in Figure 1 is developed with a playful mind (Fullerton, 2014) grounded with aspects from game development, business modelling, iterative design and intervention development.

The Gamification loop (Liu et al, 2011) and the widely used Mechanics Dynamics and Aesthetics (MDA) Framework (Hunicke, LeBlanc, & Zubek, 2004) have been used to create the flow in the Game of Games. In addition the original Business Model Canvas (Osterwalder & Pigneur, 2010) as the Gamification Model Canvas (Jiménez, 2014) have been used to model the Game of Games. The combination of these models and theories provide the foundation setting the stage and intervention/change goals for the serious game. First we introduce the research method in section 2, in section 3 the flow of the game of games is followed in the background as shown in figure 3. The background shows mostly theory that is used in the Game of Games. Section 4 shows four cases in which the game of games is used to create three different games. Finally we discuss and conclude in section 6.



Figure 1: The Game of Games



Figure 2: Gamification Loop (Liu, Alexandrova, & Nakajima, 2011)

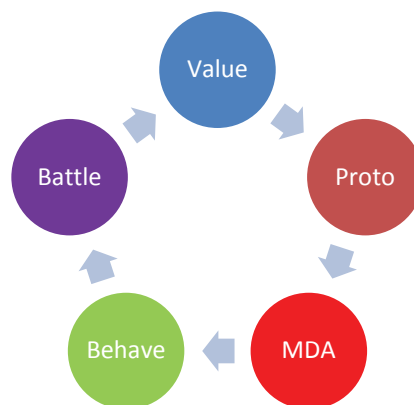


Figure 3: Game flow of Game of Games

2. Research Method

The Game of Games is designed with the Design Science Research Method (Pfeffer et al. 2007).

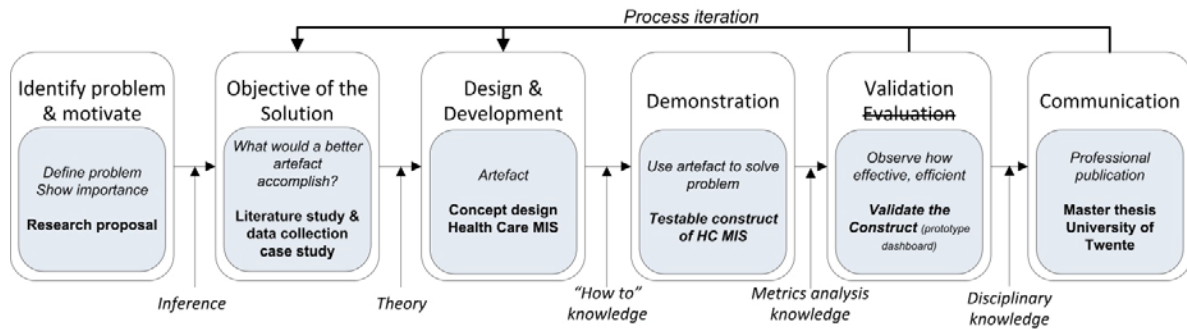


Figure 4: DSRM based on Pfeffer et al. (2007)

The DSRM Process Model is based on the model from Pfeffer et al.(2007) this model has one alteration. According to Wieringa (2010) the DSRM empirical research can be used to validate or evaluate the artefact. In the validation step the artefact will be verified with the user and the evaluation controls after implementation if the user is satisfied. This study will validate the artefact in the final stage instead of the evaluation process. To find the right literature the approach of Wolfswinkel, Furtmueller, and Wilderom (2013) is used. The steps in his method are define, search, select, analyse and present.

3. Background

This section creates a foundation for the Game of Games and follows the flow of figure 3. The game starts on the island of ideas and to move from one island to the other we use nine ferries. The order of these ferries can be decided along the way but the sections below show the best flow so far from three experiences. The game designers move first to the land of desire in 3.1, then they create a prototype in the land of creation. The land of plenty should be visited constantly with three test ferries (Feedback, Fun and Flow) as done in 3.2, 3.3 and 3.4. First the prototype is evaluated with feedback, then the game designers use MDA in 3.3 and finally determine what behavior they want to change for the player of the game in 3.4. The business battle is not described in this paper.

3.1 Value Proposition and Player characteristics

The game of games starts out with a value proposition (Osterwalder & Pigneur, 2010) addressed in a VP game. Before we can do that we have to identify and classify the players. Many authors refer to Bartle (1996) who identified players with the types of cards but later renamed them as socializers, achievers, explorers and killers. Kallio (2010) adds the casual player who mainly plays to pass time. Yee (2005) introduces immersion as a source of motivation for the players meaning discovery, role-playing, customization and escapism (Dixon, 2011).

Table 1: Identification of player characteristics

Author	Social	Casual	Commitment Achievement	Immersion
Dixon (2011)	+	+	+	+
Kallio (2010)	+	+	+	
Yee (2005)	+		+	+
Bartle (1996)	+		+	+

3.2 Prototyping and Feedback

The second phase in the Game of Games triggers the game creators to come up with a prototype as soon as possible and with the feedback on the prototype they learn that feedback is one of the most important mechanisms within serious gaming. Prototyping is a well know practice which is commonly used in product development, however when looking for prototyping in relation to games we found out this is still relatively untouched ground. There are some scholars who give a better understanding of prototyping in game design, often by applying software development practices (Ollila, 2008, Eladhari, 2012). Fullerton (2014) underlines the importance of prototyping in her book about game design. She argues that prototyping is the creation of a working model of the idea that allows testing of the feasibility and improvement of the game. The focus of a prototype is to get the fundamental mechanics right, not perfecting the aesthetics or optimizing technology (Fullerton, 2014). The whole Game of Games is developed according to the playful design principles of Fullerton.

Feedback is one of the key components of a game. According to Reeves and Read (2009) it is one of the “Ten ingredients of great games”, giving a good indication of its importance. But what is exactly feedback? And how can we use it to increase engagement? Feedback is generally conceptualized as the information the player receives from the game by performing certain actions. Feedback allows the player to monitor his progress towards a desired goal (Garris 2002). In most games feedback is present in the form of a continuous feedback loop. When designing serious game we can use these feedback loops to our advantage. Butler (1995) argued the positive effect of feedback on learning. In his research a distinction between immediate feedback and cognitive feedback is made. Immediate feedback ensures the player to keep focused. “If the player has to wait long before he can realize what effect his actions cause, he will become distracted and lose the focus on the task” (Kiili, 2012). Cognitive feedback has the goal of stimulation the player to reflect on his choices and actions in order to improve his own models and strategies (Butler, 1995). In other words, cognitive feedback increases the player's motivation for learning objectives. Dunwell (et al, 2011) starts with describing the type of feedback from Carl Roger's (1961) point of view from evaluative to evolutionary.

Feedback can have multiple variables, however some scholars differ on the amount of variables and their content. In table 2 we compare different articles and the variables they mention.

Table 2: Feedback characteristics from literature

Author	Type	Content	Format	Frequency/ Timing	Amount/ Complexity
Dunwell (2011)	+	+	+	+	
Shute (2008)	+			+	+
Kiili (2012)				+	
Fu (2009)		+		+	
Bellotti (2013)				+	
Erhel (2013)	+			+	+
Mory (2004)	+			+	+

Especially the Frequency or Timing of the feedback is often discussed, often characterized as immediate or delayed feedback. Modern theories of learning state that learning is most effective when it is “active, experiential, situated, problem-based and provides immediate feedback” (Connolly, 2012). Learning is only effective and really achieved, when learners review their learning outcomes and reflect upon them (Guillen-Nieto, 2012).

3.3 MDA and Fun

The third phase of the Game of Games starts out with an empty game of Go in which the mechanics have to be used. In the land of creation the difference between mechanics and dynamics has to be learned. Secondly, in the land of desire the aesthetics and the fun test ferry need full attention. The Game of Games uses the MDA Framework (Hunicke et al 2004). The model is also used for gamification (Deterding, Dixon, Khaled, & Nacke, 2011) (Zichermann & Cunningham, 2011).

Mechanics are functional components of a gamified application and provide various actions, behaviors and control mechanisms to enable user interaction (Hunicke et al., 2004). Some of the most common mechanics are, for example, point systems, leaderboards, levels and challenges (Zichermann and Cunningham, 2011). Dynamics, on the other hand, determine the individual's reactions as a response to using the implemented mechanics (Thiebes et al. 2014). Aesthetics are the emotional responses expected from the game. In the Game of Games we use the mechanics from Scavenger and let the students sort them in the five types of Adams and Dormans (2011): Physics, Internal economy, Progression mechanisms, Tactical maneuvering and Social Interaction.

Challenge (Fullerton, 2014) is the most commonly cited and addressed aspect of fun in game-based learning (Jabbar, 2015). A game should not be boring, rendering the player frustrated. An optimal game challenge level is neither too easy nor too difficult. The optimal level should match the player's skill abilities to reach a pre-defined goal. Then the right amount motivational tension is produced. Challenge is linked with intrinsic motivation and ‘effectance’- motivation. *Furthermore, “motivation is maintained by creating uncertainty about goal attainment. Uncertain outcomes are challenging because of the variability depending on the user's actions, multiple goals, hidden information, and randomness”* (Wilson, 2009, p.232).

Young (et al, 2012) asked this question, it is not just something amusing, nor is it simply the result of a leisure time activity. Next to challenge it has to have a playful component with a virtual character and environment (Jabbar, 2015). The third part of fun is considered the storyline (Fullerton, 2014) or narrative (Jabbar, 2015). In the Game of Games we build “a house of Fun” with a foundation (the basic idea is fun), a structure (storyline), formal details and refinement of challenge and play (Fullerton, 2014).

3.4 Behavior and Flow

The actual behavioral changes that are the result of serious health games are manifold, and often times show that game based interventions worked to achieve the behavioral change or not, even if sometimes to a lesser extent than hoped for. In line with the change objectives of the research papers, game-based interventions targeting fruit and vegetable intake in children have increased and kept fruit and vegetable intake in children (Thompson et al., 2015), the elderly showed improvements in physiological, psychological, sensory-motor and social levels (Wiemeyer & Kliem, 2012), and an intervention to increase the number in daily steps has been successful in doing so (Lin et al., 2006).

Crookall (2010) argued that debriefing can be added to serious games by means of creating online communities and discussion boards, since people debrief about issues in their daily lives anyway through means of communication (Lin et al., 2006)

An important aspect of behavioral changes is that rather than creating sudden changes, it is often the case that behavior changes incrementally in small steps. This has been found in the Transtheoretical Model of change, which argues that individuals gradually change their behavior through a series of steps (Grimley, Prochaska, Velicer, Blais, & DiClemente, 1994).

Within the Game of Games we owe to the authors above but follow a more practical line written by the learning company (Kessels et al, 1996) from unconscious incompetence to unconscious competence also referring to Maslow and Kolb but not in a direct way: Problem; Physical situation; Personality; Social relationship; Cognitive coping; Impact.

According to Csikszentmihalyi (2008), even assembly line workers can have fun on the job (he referred to it as “flow”) by establishing hourly goals and trying to beat their best time. If work can be fun, games can also be work (consider, e.g., professional sports)(Young et al 2012). According to Dunwell (et al, 2011) the main addition of flow to the challenges (making choices, exercising difficult skills, stretching personal limits, competing with peers and reaching and exceeding goals) are the skill levels of the player.

4. Case studies of the Game of Games

During the Serious Gaming course the students came-up with three game-concepts, a board game called Kid-Ney’s Journey, an on-line game called Edutopia and a board game called the Start Up game.

4.1 Case 1: Kid-Ney’s Journey (Vis, 2016)

Value Proposition and Player Characteristics

The game is targeted at people in the age of 21-40 years old, who need to start treatment soon, and at their spouses or close relatives. The goal of the game is to give these people insight in the effects of a treatment on their daily life and to help them weighting the advantages and disadvantages of each treatment method. The intention of the game is to stimulate a dialogue between the people that will be living with the consequences of the treatment daily, e.g. both the patient and the close family. The game can be played by two to four players, is intended to last for 20-30 minutes and can be played at home, or in the waiting room of the hospital.

4.1.1 Prototyping and Feedback

It was decided to develop a board-game, partly for the practical reason that it takes less time to develop a prototype. Therefore, it was possible to have a playable, presentable prototype by the end of the cycle. Additionally, the team wanted to design a multi-player game that could be played by several players simultaneously to stimulate discussion among the players. A board-game gathers people around a table, and has therefore a low barrier for direct conversation. During the course, several ideas for games and game-concepts were developed by the participants. Each idea was abstracted or inspired by existing, well-known

and easy to play games, such as 'Game of goose' and 'Trivial Pursuit'. The game will probably be played once or at most a few times during the short period in which a decision on treatment method needs to be made.

4.1.2 MDA and Fun

The storyline of the games is that each player needs to collect armor to defend their Kid-Ney against the disease. The goal in the game is to collect a complete armor in one color for their Kid-Ney, in order to be able to be strongest when fighting the disease.

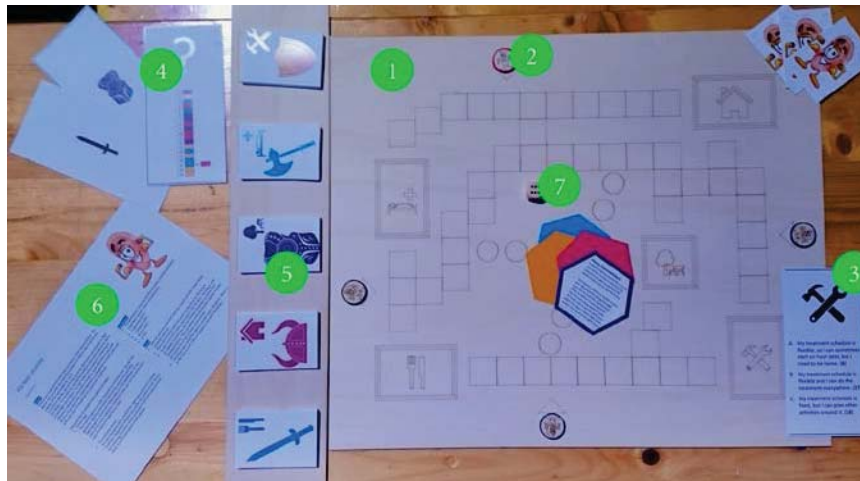


Figure 5: Kid Ney's journey (1) playingboard, (2) pions, (3) dilemma-cards, (4) answer-cards, (5) armor-cards, (6) manual and (7) dice).

The story-line of the game is a bit sarcastic, with Kid-Ney collecting a harness to defend himself for the disease. However, the group considered this to be a usable metaphor, as a treatment protects the patient against the detrimental particles that poison the body and keeps the patient alive. In this way treatment acts as a kind of harness. The group imagined further that sarcasm could be appreciated by the target-group, but were also aware that such sarcasm might not be appreciated by people outside the target-group, especially elderly might prefer a more serious storyline.

4.1.3 Behavior and Flow

The Behavior change in this game is a choice of treatment that is actively done in the game. The whole family plays your treatment too so a good decision can be made later together with them. The game only has to be played once or twice so the flow is on level one and also challenge one, making choices.

4.2 Case 2: Edutopia

Value Proposition and Player Characteristics

The game is for children in the age of 8-12 years old. The targeted group is the top layer of the class who want to do extra learning activities in a fun way. This is also the goal of the game. The value of the game is to create a stimulating learning environment for schoolkids governed by the class teachers but individually done by the kids.

4.2.1 Prototyping and feedback

In an early stage was decided to create an on-line game which meant the designers had to learn specific program languages like Blender and Unity. It took quite some time (6 weeks) to come up with a prototype that only had one island and was only for viewing, not for playing yet. At that time the feedback was right or wrong and the storyline was not yet clear.

4.2.2 MDA and Fun

A lot of time was spend on modeling issues, mainly on the aesthetics of the game but also the mechanics and dynamics of the puppets took a great effort. The fun part was put in the learning element itself, solving puzzles and act under time pressure. When tested in the last week the kids were found playing far beyond school time. Obviously parents allowed them to do an educational game.



Figure 6: Edutopia

4.2.3 Behavior and Flow

The behavioral component is all about explicit learning in a relatively fun way. The kids were motivated to do more than they would usually have done in normal class. In the future plan also lower level schoolkids are involved to avoid that the gap of knowledge would grow. The higher level kids have to help the lower level kids to get a level higher themselves. The flow did not get very much attention but implicitly was brought into the game because the children kept on playing as proof of the pudding.

4.3 Case 3: Start up game

4.3.1 Value Proposition and Player Characteristics

The Target group of the third game are entrepreneurial students that are thinking about starting their own company. The value for them is that they learn what subjects are important when starting a company based on the lean start up book of Riis. Another value for municipalities is to motivate people to start new companies and create more employment.

4.3.2 Prototyping and Feedback

The first step was to make it a board game, in the future there are plans for making it on-line or available as app.

The prototype was created from second hand game material cut and pasted toward a playable prototype. It was difficult to find test groups that would spend an hour on a not yet finished game. At first the designers wanted to put too much feedback in the game with a lot to read on the card. Later they solved that with a QR code that referred to more information only when the player was interested.

4.3.3 MDA and Fun

During the design process the emphasis on fun became more important. First it seemed an informative game only but in the final version the fun factor was bigger than the serious factor in a good balance. The mechanics of the game were well investigated and used mainly by looking at successful other games using leaderboards, different color cards and different phases of company development. Also the Aesthetics improved by using pictures of modern company buildings and by professional printing of their material.

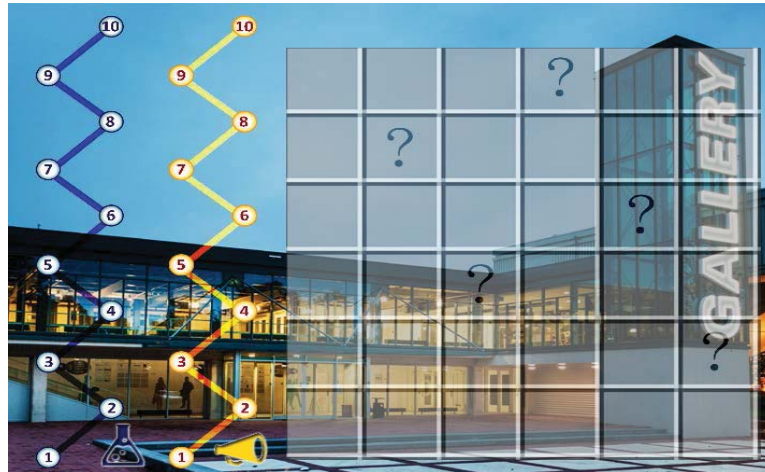


Figure 7: Start up game

4.3.4 Behavior and Flow

The flow test came late but there were no real problems in challenge and ability. Still, after the last test the question remained if people would play this game more often just for fun. One of the testers said: “what am I learning from this game”. The behaviour component was most of the time hidden but implicitly it seems to work.

5. Discussion, conclusions and future research

Our main question was: “is the game of games fun and effective”? The answer is yes but the limitation is that it cannot be proven in three cases. We did validate with an evaluation and one of the students cannot prove our point but implicitly did so by stating: “I have never spend so much time for a course voluntarily”.

In the two last cases it took quite some time to leave the land of ideas and find value for the new ideas. We discovered that a pressure cooker led to a quick prototype in the first case. This leads us to the conclusion that time pressure helps in reaching a first prototype which increases the value of the game.

The MDA model was very useful in the land of creation. We used an empty game of goose together with the Scvngr flash cards to develop the designers MDA. In conclusion it was difficult to practice the difference between mechanics and dynamics.

Finally Flow came too late in our meta game. We did a flow session based upon the Kongregate game “Swords and Souls” but it came too late to really improve the flow of the three games. The third conclusion is that behavior and flow are the most difficult practical part of the Game of Games, well theorized but difficult to perform.

Future research will bring the Game of Games in the business domain where we conduct an action study into youth health and in the future we want to create an examination with a Game of Games Trivial Pursuit. We hope other researchers and practitioners are going to use the Game of Games and find some more proof of its effectiveness.

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