5-Part Model: A Formal Approach to Designing Mechanics

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Abstract

A formal language for game design is an endeavor many academics and industry personalities have been tackling since the mid-nineties. One of the most renowned formal models for game design, the MDA Framework, includes steps to delimit and conceptualize the experience with a top-down approach. There is, however, a significant lack of high detail models for many low level tasks, like difficulty balancing or mechanic construction.
In this paper, we propose a formal model for novice designers. The 5-Part Model (5PM) for building and diagnosing game mechanics. This model is conceived as a natural complement for other high-level existing theories, like the MDA Framework or the Gameplay Design Patterns Collection.

Keywords: mda, game design, game mechanics, gameplay design patterns

1 Introduction

There is evidence of games in humanity's history from several thousands of years before Christ. For instance, *Senet*, one of the oldest games known to mankind, has been dated near 1500 B.C. [1]. However, the theory that supports what is a game and how is it made is a lot more recent. Some of the most relevant works of study in this field were published during the 2000s.

Since 1994 Greg Costikyan has been discussing the issue of defining a formal language for game design. Costikyan published an article in '94 that poses an early definition of game [2]. In this definition, Costikyan approached the issue from a very technical point of view that is not wide enough to comfortably include certain types of games like sports or some older board games. However, Costikyan himself revisited his work and in 2002 published a different article with more or less the same title: "I have no words and I must design" only this time he added the subtitle "Toward a Critical Vocabulary for Games"[3]. This paper presents a much broader and refined definition that can easily classify what IS a game and what is not and why.

Staffan Björk published a methodology in 2003 to classify and systematize common mechanics[4]. Björk took from the strategy of the Gang of Four and adapted the concept of Gameplay Design Patterns which are generic mechanic definitions for common *problems* (or design scenarios).

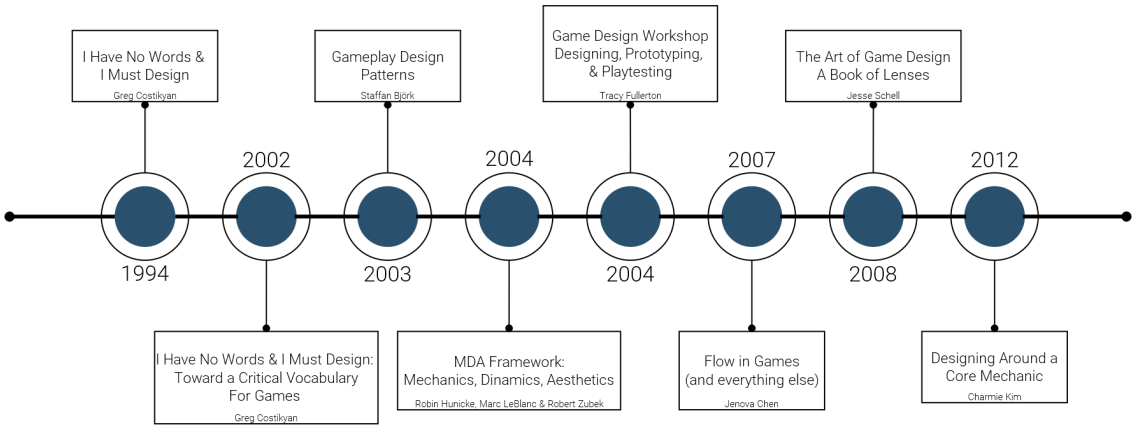

Figure 1: Timeline of some relevant publications on Game Design

In 2004 Robin Hunicke, Marc LeBlanc, and Robert Zubek published what became the go-to formal model for game design: The MDA Framework[5] (MDA stands for Mechanics, Dynamics Aesthetics). This paper encompasses the whole design process in three layers, providing an abstract, adaptive, and easy to understand framework. So far the MDA framework has been used, mostly in academia, to teach game design to new generations, and has proven a useful tool to systematize the intricate process of the game designer.

Jenova Chen published an article in 2007 on a different topic: balancing difficulty[6]. Chen borrowed the theory of Flow from psychology, specifically the definition of "The Zone" proposed by Mihaly Csikszentmihalyi from the mid-70s. In his work, Chen proposed a simple yet elegant way to understand the frame of mind of a player while they are engaged in a game related to difficulty.

Charmie Kim published a tool called the Core Mechanic Diagram[7] taught to him by his mentor William M. Mozell. The diagram is formed by four circles, one inside the other, that classify the mechanics of a game in categories (see figure 2). The *Core* mechanic is in the innermost circle, and it is the mechanic that governs the whole gameplay experience. The Secondary Mechanics are on the second level, which helps diversify the experience. The third level is for Progression Mechanics, the ones in charge of taking the player closer to the end of the game. The outer circle is the Narrative or Metaphor, this layer works like a coat of paint that transforms an interactive product into a narrative device, the same game (same core, secondary and progression) can be an epic adventure in a fantastic land with dragons and magic or a redemption story in the wastelands of a post-apocalyptic landscape.

There are of course many other important works on how to design and develop games. Like Tracy Fullerton's Playcentric Approach that tackles the design process from a data-analysis standpoint[8]. Jesse Schell's Book of Lenses explores more than 100 different design tools and strategies from technical aspects to business side considerations and many others[9]. For the context of this study, however, we will focus on the works of Costikyan, Björk, LeBlanc-Hunicke-and-Zubek, and Kim.

2 What is a game?

To establish how to build a game we have to define first what is a game. Costikyan's **universal definition of game** transcends media and delimits some fundamental elements that work as a very solid foundation for what we want to achieve[3]:

> *An interactive structure of endogenous meaning in which the player has to struggle to reach a goal.*

In his definition Costikyan defines four properties every game should meet:

- **Interaction**: The game state must be affected by the decisions the player takes. A game should have multiple terminal conditions of either victory or defeat, reachable by the player through their actions and decisions.

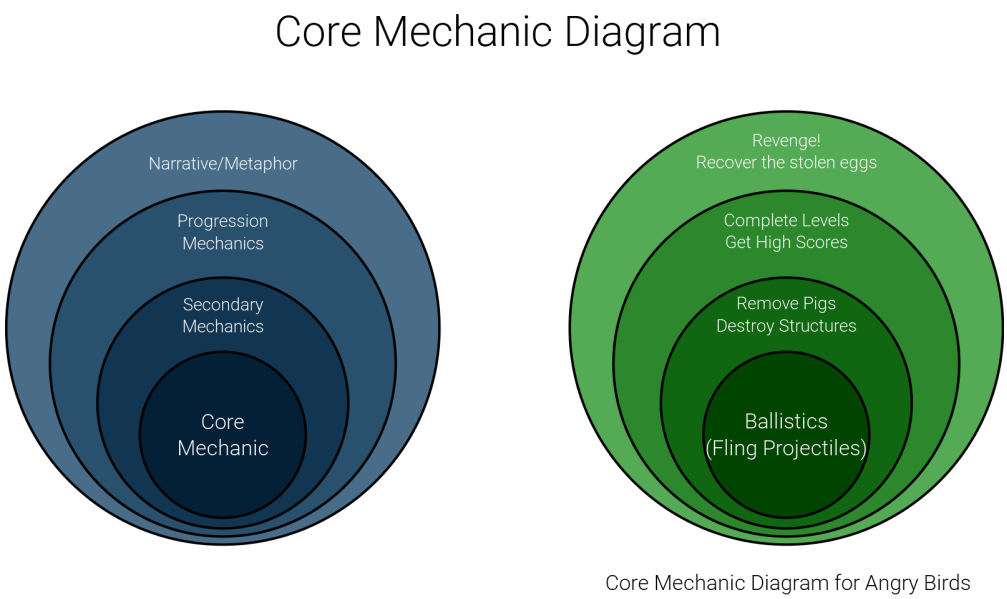

Figure 2: Charmie Kim's Core Mechanic Diagram with an example using it with Angry Birds.

- **Endogenous meaning**: Every element relevant inside the game, is relevant because the rules of the game dictate so. Monopoly money has value because of the rules of Monopoly state so and it is only valuable inside a game of Monopoly.
- **Struggle**: It is required for a game to be challenging to engage a player. There is literature that helps model how to graduate the difficulty of an experience to retain the user's attention, for instance, the concept of Flow [6] illustrates the tolerance thresholds of a user according to the difficulty of a game. Other works reinforce the need of a game to be challenging, but not frustrating, in order to keep player's engagement[10, 11].
- **Goals**: At every moment the player has to be aware of which is the objective they are pursuing. Goals are typically defined within the same endogenous meaning structure. It is not required that the goals are explicitly stated within the game, although it is advisable to do so. It is also possible to change the goals mid-game, as long as the player is properly informed of the new goals required by the system.

According to Costikyan's definition, and only for the sake of formality, a product that lacks any of the four properties is not a "game". That does not mean the product lacks quality or is somehow invalid, that only means the rules and methods used to design a game might not neatly apply to that given product.

For example, a Rubik's Cube is not a game because it lacks interactivity. The decisions the player take have no real impact on the outcome of the system and there is only one terminal state for a Rubik's Cube, you can *solve the cube*, or just abandon the task (which is more like quit playing than finishing the game). Since you can not lose at Rubik's Cube, it is not a game. A Rubik's Cube is a **Puzzle**.

From this universal definition of a game, we can progress towards a method that helps define how to make one, for this we will go to Hunicke, LeBlanc, and Zubek.

3 How to make a game?

The MDA Framework published in 2004[5] defines a game as a three-layer structure with the player and the designer standing in opposite sides:

- **Mechanics**: Closest to the designer, the mechanics layer includes every individual element that constitutes the game, from data representation to algorithms. In other words, every multimedia resource, rule, and material that make the product. In a way, the *game designer*'s work is to create game mechanics.
- **Dynamics**: During gameplay, the game mechanics respond to the player's inputs and other mechanics inside the system. The behaviors the game presents while in gameplay are the dynamics of the game.

- **Aesthetics**[1]: Closest to the player, an aesthetic is a complex emotional response the player experiences during gameplay. For instance, according to the authors, the *Fantasy aesthetic* is the one players experience while they assume the role of an adventuring character. These *aesthetics* result from the player's exposition to the game's dynamics.

According to the MDA Framework, the design task should begin with the designer assuming the role of a player, planning which aesthetic they wish the player to experience, and from there selecting the appropriate mechanics that better provide the desired effect. To guide this process the authors propose eight aesthetics, we decided to split one of them to a total of 9:

- **Sensation:** Refers to games where the experience conveys information for multiple senses. Sensation games tend to feature minimal verbal information and rely heavily on other means to communicate with the player. These games use light, color, and sound in strong and unconventional ways, but also rely on tactile information and body movement. Games like Just Dance, Guitar Hero, and Beat Saber are clear examples of this aesthetic.

- **Narrative:** Games that have a written story that the game transmits to the player. These kinds of games are the ones closer to traditional media, most likely movies. Some common elements of a Narrative game are well-defined characters with clear personality traits, linear progression, and story arc. In stark contrast with sensation games, narrative games are the ones that rely more on verbal information, text is usually very prominent in this kind of games. Life is Strange, Detroit Become Human, and The Walking Dead are good examples of this aesthetic. One remarkable example of this aesthetic is Black Mirror Bandersnatch, which was published by the movie streaming service Netflix instead of a game distribution platform.

- **Fantasy:** These games usually feature a digital avatar for the player. It is in this aesthetic that the concept of Silent Protagonist[12][2] was conceived. Usually, a Fantasy Game has a story and some form of linear progression, like the narrative aesthetic, but the main difference is that in a fantasy game the story does not usually follow a formal structure, and there is little to no character development since the purpose of the game is to allow the player to "write their own story". Dungeons and Dragons, and The Legend of Zelda are maybe the best examples of this aesthetic.

- **Challenge:** A game that requires the player to develop specific motor skills to play. These games reward fast reflexes and good muscle memory and are extremely punishing to new players. Sensation and Challenge are similar, but sensation games are usually more forgiving, a player has a good time in a sensation game even if they lose a match; while losing in a challenge game is usually framed as a negative experience and can lead to frustration for players that have not mastered its mechanics. Dark Souls, Cuphead, Mortal Kombat, Need for Speed (basically any fully-featured racing game) enter this category.

- **Puzzle:**[3] Refers to a game that demands a very complex cognitive process to play. Strategy, resource planning, problem-solving, pattern recognition, good memory, and lateral thinking are usually skills required or promoted by games in this aesthetic. The Room, World of Goo, Spacechem, Magic the Gathering, Chess, Machinarium are good examples of this aesthetic.

- **Fellowship:** The game itself is a social framework. These games work only as an interface between two or more players and they are usually impossible to play alone. The game system provides several tools for interaction with other players, usually through avatars (like the ones in the Fantasy aesthetic) but also with in-game communication tools like chat or voice. Interaction between players is moderated by the game system itself and is determined by the tools the designer gives a player to play with. For instance, a game can be designed to require players to cooperate to achieve a goal (Overcooked, Left 4 Dead), the game can provide tools for players to antagonize each other (Fortnite), or both (League of Legends, Team Fortress 2).

- **Discovery:** A game that requires the player to explore the game system and find pieces of information the designer intentionally hid throughout the whole game. This exploration can be spatial, but also in

[1]For Hunicke, LeBlanc, and Zubek the word Aesthetics does not correspond to the modern definition of *study of essence and perception of beauty.* For the context of this work the word *aesthetic* is understood as an *emotional response experienced by the player.*

[2]Silent Protagonist is a player-controlled character that has no voice of their own, it is meant to help the player immerse into the story imbuing their personality into the game character.

[3]In the original article by LeBlanc, Hunicke and Zubek the Challenge aesthetic groups both physical and intellectual challenge, but since both are handled in a very distinct manner we decided to split the aesthetic in two: Challenge and Puzzle.

other dimensions of gameplay. For instance, in Minecraft, the player can combine several materials to build tools, but the game provides no log or manual on what can be built, the player has to figure out almost every aspect of the game. Myst, Gone Home are also good examples of this aesthetic.

- **Expression:** Games that are usually creative spaces where the player can use several tools and resources to express themselves. These are usually more toys than games since expression games tend to lack clear goals for the player to pursue. The game acts as a sandbox where the player can safely do whatever they want with the tools provided with little to no consequence. This kind of game needs to have some tool that allows the player to share their creations. The Sims, Goat Simulator, and Mario Maker are good examples of the expression aesthetic.
- **Submission:** Games found in the hyper-casual section of a digital store. A submission game should be extremely easy to pick up, simple to play and master, yet fun for long periods. A submission game is characterized by short gameplay cycles with high replayability, usually through procedural generation and repetitive gameplay. It should be a game that can be played for 5 minutes or 5 hours with the same level of engagement, and should not demand any dedication from the player. Candy Crush, Bejeweled, Cookie Clicker (any idle game really) fit in this category.

Once a **main aesthetic** has been selected, the designer has to pick a *Core Mechanic* that better fit that aesthetic, which implies a process of prototyping and testing to ensure the desired effect. Later in the process, *Secondary* and *Progression* mechanics can introduce new aesthetics to diversify the experience and improve the depth of the product. These **subordinate aesthetics** can compete among them as long as they do not overshadow the main aesthetic. It is important to stress that every aesthetic is supported by one or several mechanics, whenever a new mechanic is introduced a corresponding aesthetic is reinforced.

Sporadic instances of a secondary mechanic, like puzzles within a horror/survival game (Silent Hill), or quick time events in a narrative game (The Walking Dead), incorporate subordinate aesthetics with a very weak presence. If the frequency of like-mechanics is increased, the strength of the associated aesthetic rises as well. A good example of this is the game Dark Souls (main aesthetic Challenge) that does not include a goal list or a map, most of the lore in the game is hidden inside item descriptions the player has to seek and read to piece it all together. All these elements support a very strong subordinate Discovery aesthetic that deepens the experience but does not rival the core mechanics (a deliberate combat system, rhythmic enemy patterns, and a very frail main character, all elements of a main Challenge aesthetic).

The MDA is widely used as a reference in the academic environment, however, it is not impervious to criticism. One of the core aspects the MDA is criticized for is the redefinition of the terms “mechanic” and “aesthetic”. Frank Lantz[13] emphasizes the term’s divergent meanings when compared with the more colloquial industry definition. For Lantz, the word *mechanic* is commonly referred to as the combination of interactive elements that emerge consistently and are frequently reused by game designers. This concept was defined as Ludic Devices by Lana Polansky[14], whom Lantz cites; but maybe more appropriately by Staffan Björk as Gameplay Design Patterns in his 2003 publication [4]. In the article *From MDA to DDE*[15] the author describes an extended model with a narrower definition for “mechanic” and switches the term “aesthetic” for “experience” while maintaining its essence.

While most of the criticism can be summarized as reinterpretations of the framework, or very similar alternatives (DDE is basically MDA with another name), we, the authors of this work, agree with some of them in one aspect: MDA establishes the concept of Mechanic as the building blocks of a game but fails to describe what a mechanic is or how to make one. Most game designers and developers solve this problem empirically, using trial and error, experience, and rapid prototyping. This works, there have been many good games published to date, but this approach might not be the most efficient for a novice designer without previous experience, besides this approach is not repeatable, and might not yield enough information to understand why a mechanic works well in one game but performs poorly in a different scenario.

4 The 5-Part Model: Formalizing the construction of mechanics

In the first version of the article *I have no words and I must design*[2], Greg Costikyan reveals a different definition for a game:

> *A game is an art form in which the participants, called players, make decisions to manage resources through game tokens in order to achieve a goal.*

This early definition is not as clear and attractive as the 2002 counterpart but yields a few details of what Costikyan believed constituted a mechanic. Taking this definition as a starting point we devised a formal model of a mechanic, mostly derived from Costikyan’s words in his article of 1994, but with some tweaks

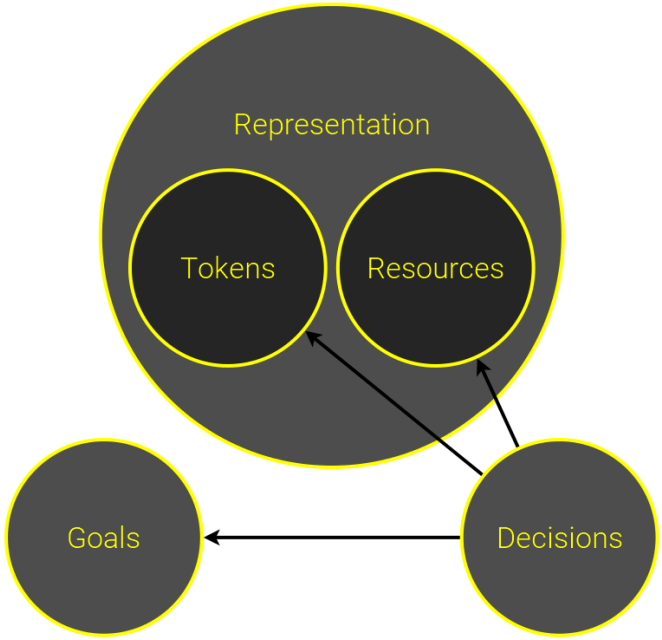

Figure 3: The 5-Part Model represented by the relations between each of the five parts. Tokens and Resources are both subsets of the Representation. Decisions are taken with Tokens over Resources to pursue Goals.

and adjustments to provide a robust generic model to build and diagnose mechanics at a lower level with higher detail.

- **Representation:** Every concrete element (graphical resources, text, audio, programmed routines) the player perceives directly, one way or the other. Every parameter that determines the behavior of the system during run-time is also part of the mechanic. For instance, in a platform game, how high and far a character can jump are both parts of the representation of the **jump mechanic**.
- **Tokens:** A subset of the representation a player can control directly. The influence of the player over the system is limited, while every element within the game should be interactive to some degree, not all elements respond directly to player input. Some elements react only to the avatar of the player. Only the components the player can control directly are tokens.
- **Resources:** A subset of the representation the player can "spend" or "gain". Some are evident, like victory points, extra lives, in-game currency, others not so much, like the physical space in a platform game, time in a racing game. Every mechanic should consume or risk at least one resource and reward the player with at least another resource. It is not necessary that the cost and the gain sum zero, a mechanic could attract the player by offering a higher gain for a reasonable cost/risk. This is especially true for optional mechanics.
- **Goals:** Every mechanic should enunciate three different goals:
  - Immediate: What benefit will the player get right the moment they use this mechanic? Typically in the form of a resource (reward).
  - Local: How does this mechanic help the progression in the game? The concept of "level" could be associated with this idea (passing the level). Some resources could also be associated (extra lives, better equipment, etc...).
  - Global: How does this mechanic help in winning the game? This goal should be aligned to the main goal of the game, the "save the princess". In the best-case scenario, the global goal should be the same goal of the game.
- **Decisions:** Finally, the game has to be inherently interactive. Every mechanic should require the player to act. The player must have the power to use or not a given mechanic (whenever a mechanic is presented as a binary option) or to graduate some aspect of the resources spent while using the

mechanic (fuzzy or continuous input mechanics). To jump or not to jump, to capture a piece or not, to move a piece or another, to accelerate more or less, or take a closer turn in a racing game, to bet more in a poker game, etc...

4.1 5PM as a diagnostics tool

Our first hypothesis is that the model will help identify errors in a mechanic. When a player feels a mechanic is unfair, unbalanced, or useless, it usually means it has an error with some of its components. Let us work a few examples.

4.1.1 The jumping mechanic in Prince of Persia

The original Prince of Persia game had a big issue with its animation. When the player starts a jump the animation for jumping begins, but the character takes two steps before leaving the ground. If the player hits the jump button too close to an edge, the character will miss the jump and fall.

This is clearly an error in **Representation**, but why? The problem stems from the way the game understands a long jump. In real life when a person wants to jump a long distance, they may take some steps back, run and then jump, the physical act of jumping is performed the exact the moment the person wants to leave from the ground. But in Prince of Persia the player can run with a button, and jump with other button, the physical act of jumping is tied in the representation of the game to that button, but when pressed the character does something else, first he takes two steps running, and then jumps. The game's representation is ambiguous, because the player associates one action to each button, one button for running and other for jumping, but the button for jumping also makes the character run.

Nowadays game designers use the term "responsive" to refer to the quality of a game of performing an action as soon as the player issues a command. In a game like Super Meat Boy, the character jumps exactly the moment the player hits the button, any previous velocity the character had before jumping is added to the movement vector, resulting in a jump with directional momentum. For the player this feels right, since it matches their perception on how a jump should behave.

A designer should ask themselves if their mechanic is represented in a way that matches what the player expects it to happen.

4.1.2 The Dinosaur vs Shelter in Ark Survival Evolved

In Ark Survival Evolved the Core Mechanic is to fight dinosaurs, either to kill them or train them. The main **resource** of this mechanic is the amount of dinosaurs in the play field, which spawn with certain regularity across the whole island. The player also has the ability to build shelters to survive, this is a very prominent secondary mechanic which main **resource** is the available space to build. Once a player builds a shelter the game locks the area surrounding the shelter to prevent any dinosaurs to spawn inside or too close to it, giving the player room to move around safely as long as they remain near a shelter.

There lies the conflict, Ark is a massive multiplayer game, the game is designed to host many players inside the same small island; every player can build a shelter for themselves, limiting the available space required to spawn new dinosaurs. If enough players build shelters, the game becomes unable to spawn new dinosaurs in large areas of the play field. The shelter mechanic eats up the resource of the dinosaur mechanic, making the game shift from a "train and fight dinosaurs" adventure to a "fight each other" adventure.

The designer should ask themselves, does this new mechanic share resources with another mechanic? If so, how can I ensure one mechanic does not cannibalize the other?

The other issue with these two mechanics is they contradict each other. The **immediate goal** of the dinosaur mechanic is to tame dinosaurs, while the immediate goal of the shelter mechanic is to reduce hazards from the neighborhood. Since dinosaurs are hazards, the shelter mechanic pushes them away preventing the player from getting near one to tame. The goal of the shelter mechanic directly opposes the goal of the dinosaur mechanic.

4.2 5PM as a complement to MDA

Our second hypothesis is that the 5PM can help a designer understand how a mechanic supports a specific aesthetic. By studying the properties of a mechanics and relating them with its resulting effects, a designer should be able to grasp why some mechanics support some aesthetics and how to change them in order to shift the aesthetic.

4.2.1 Plague Inc.: Evolved

Plague Inc. is a **Puzzle** game, its core mechanic is Evolve the Virus, which allows the player to change the behavior of their virus along time by adding or modifying traits. In Mark Brown's video essay about designing puzzles [16], he classifies player interaction with Puzzle games within two broad types: Puzzle Solving is the task of finding the only solution of a "puzzle box", a closed environment carefully designed to be solved by a specific sequence of steps, while Problem Solving is the task of managing resources to optimize results of an open environment that can have different degrees of success or failure. Plague Inc. falls in the latter category, the game presents an open environment with a win condition that can be attained at different points with different efficiency rate.

A Puzzle game, specifically a Problem Solving game, wants the player to feel smart, to feel like a strategist or a decision-maker, in charge of great stakes at a safe distance.

- **Representation:**

  The virus has several parameters like lethality, severity, and infectivity bars.

  Also, the game displays a world with the spread of the disease. This map also features port and airport icons that act as possible infection routes.

  The player collects DNA points that later can be spent to induce new behaviors.

  There are controls for activating new transmission vectors, symptoms, and abilities.

  The game's representation focuses on presenting information to the player in the most efficient way possible. The game looks and feels like a station in a control tower of an airport, the player is fed with information carefully represented to be easy to read, to facilitate decision making.

- **Tokens:**

  The tokens in the evolve the virus mechanic appear grouped in three categories named transmission, symptoms, and abilities. The activation or deactivation of these tokens is the only input given to the player to interact with the evolve mechanic.

  Each interaction with a token has to be confirmed, this reassures the feeling of control. Whenever the player is interacting with a token the game changes the context to provide sensitive information and the game pauses, allowing the player to decide carefully and with confidence.

- **Resources:**

  The most immediate resource to the mechanic are the DNA points which are used as a currency to activate the tokens, furthermore, there is the time available before a cure is found to the disease, the balance of infected vs deceased, the travel routes available for the infection and the infectivity itself are part of the resources available to the mechanic.

  Every resource in the game is displayed as a number, allowing the player to predict the outcome of a particular decision and clearly stating what is the cost and the reward of every available action.

- **Decisions:** The player must decide to spend or save the DNA points acquired, and if the decision has been made to spend them whether to increase the resistance, the infectivity or the lethality of the disease and in each of these fields if the desire is to go for a new option or to increase the potency of an already selected one.

  The amount of information available to the player allows them to design a game-wide strategy. A mindful player with experience can easily layout the steps required to achieve an expected result, even plan for contingencies.

- **Goals:**

  - **Immediate:** Once the virus has been evolved the immediate goal is to increase either the lethality or the infectivity of the disease.
  - **Local:** The spread of the disease throughout the map and the acquisition of more DNA points.
  - **Global:** The infection and death of every human on the planet.

  As every bit of information in the game is presented in an orderly fashion with a quantitative approach, the player can design a strategy that tackles each level of objectives in a logical sequence, building up to the end game in a very premeditated course of action.

4.2.2 Mortal Kombat 11

Challenge games like MK11 demand the player to act quickly and with precision. Muscle memory and good reflexes are required to achieve victory and every tiny mistake is heavily penalized. A Challenge Game wants the player to feel in control of an intense and chaotic situation, to hold their breath and feel an adrenaline rush for a short but extreme moment.

MK11's Kombat mechanic can be summarized as the direct physical confrontation of two individuals in the most spectacular and ridiculous display of violence since the beginning of the video games industry.

- **Representation:**

  The game features a varied set of playable characters.

  Each character has a health bar, a different set of movements and commands, an offensive and a defensive gauge.

  The fights take place in a one-dimensional battlefield that spans from left to right.

  During gameplay, there are exactly two characters always facing each other and more or less centered in the screen. The battlefield moves while the game frames both characters on display at all times.

  The game presents its critical information in a very simple fashion. It takes a fraction of a second to read a bar, the reading might be inaccurate, but clear enough for the player to understand if they are in a good or a bad state. Bars are also very easy to compare, which allows a player to assess quickly if they are winning or losing. Non-random visual effects and precise short animations provide enough feedback to predict the state of the game for the next second or two, but no further than that.

- **Tokens:**

  A summary description of the token would be the game character, however, in an effort to provide a fuller understanding, the game character refers to the controllable parts as are the available movement, the regular and special commands, the defensive and offensive gauge activation (meter).

  The character is controlled by digital inputs, buttons[4], that are always in contact with the player's fingers and available at a split second.

  In interaction design, there is a principle called Fitts Law[17] that determines the amount of time it takes a user to select a choice with an analog device (like a mouse cursor). Limiting the action of the player to digital inputs only, and making them available at all times reduces the time of choice to effectively nothing.

  The decision of having only one token to play also affects time, in a game of chess a player has to choose which piece to move and then how to move it. In MK11 every decision is channeled through only one token, removing the time required to choose.

- **Resources:**

  The resources available to the player are the health of the character, the offensive and defensive gauges, the time remaining on the match, the position on the screen, and space available to move.

  All resources are readable in a split second and update constantly with strong feedback that helps the player notice once an important event has taken place. For instance whenever a character is damaged, an animation is played to inform the player reinforced with visual and sound effects, but also the health bar flashes and for a few seconds shows in different color the amount of health lost in the immediate past.

- **Decisions:**

  MK11 features a lot of split-second decisions, many performed by muscle memory instead of a conscious way. These include moving forward or backward, attack, or defend, whether to use a regular or special command. Follow-up a move (to perform a combo) or stop. And the option to spend meter and enhance a move.

  Every character has a very limited move-set with certain thematic unity. Each move is effective only in certain situations which further limits the range of choice a player has in every given moment. there is another principle of interaction design called Hick's Law[18] that directly relates the amount of time required to make a choice to the number of options available. The design strategy of MK11 of limiting options available to the player to a handful at a time coincide with the intention of having the player make a lot of decisions in a fraction of time.

[4]Even an analog stick in a fighting game is reduced to a digital output, the player rarely uses the gradient of the stick, only its extreme positions.

- **Goals:**
  - **Immediate:** Increase the available space, improve the current position, open the defense to a follow-up attack.
  - **Local:** Reduce the opponent's health bar or force a disadvantageous position for the opponent.
  - **Global:** Completely deplete the opponent's health bar twice.

  A typical match in MK11 resolves in under a minute. Notice how even the global objective is scaled to this time frame, the game is designed to perform in very short and intense sessions.

4.2.3 The Walking Dead

Telltale's The Walking Dead (TWD) is a very strong **Narrative** game. The game tells the story of Lee and Clementine, a convict and an orphan child who find themselves in the middle of a zombie apocalypse in the south-east of United States.

In a Narrative game the player is a witness of the story, not the protagonist. The game invites the player to accompany the characters in their journey and, through the game mechanics, lend a hand to them when they need it. TWD's core mechanic is the decision mechanic, often the player is given limited control over Lee, they can decide what they want Lee to say or do, to certain degree, in almost every situation.

- **Representation:**

  In the middle of a dialog, in a moment when someone asks or says something to Lee, the game pauses for a brief moment and shows some dialog options and a countdown timer. The given choices depend entirely on the context, for instance when a character asks Lee "Can I give you a piece of advice?" the options presented are "Sure", "What is it?", and "Mind your own business". Whatever the player picks, Lee will say something slightly different, this reflects the fact that the player is not talking for Lee, but merely "suggesting" what to say.

  In a Narrative game, text is king. The choices given to the player are things that Lee might say or do, the text is limited to what makes sense for the story.

- **Tokens:**

  Tokens are elements of the representation that the player can control directly, given that in TWD's decision mechanic the only thing the player can control directly are the dialog choices.

  The player is a witness, not the protagonist, so the agency to the player is limited to dialog suggestions for Lee. There are sections of gameplay when the player is given control over Lee's actions, to a certain degree, but this a secondary mechanic that appears sporadically.

- **Resources:**

  TWD's decision mechanic has some hidden resources that the player cannot query directly. Often an alert appears on the top left corner that claims that the choice will have some impact in the future. Under the hood the game has several flags that drive the alternative paths of the story, whenever the player makes a choice, there is a chance it is an important choice tied to one of those flags, changing it is value permanently.

  Also the game features a timer (in the form of a depleting bar) that rushes the player to make a choice. If the player waits until the time runs out, the game will interpret that the player chose not to speak.

  Notice how the available resources are narrative ones: flags that change the course of the story.

- **Decisions:**

  Decisions in this mechanic are very obvious, the player is given a few dialog choices plus the choice of doing nothing.

- **Goals:** For a game so purely narrative, the goal is always to move forward, the player will want to know what happens next.
  - **Immediate:** Advance the plot to the next dialog.
  - **Local:** Advance the plot to the next episode.
  - **Global:** Reach the end of the story. Find out what becomes of Lee and Clementine at the end of the road.

4.2.4 Gone Home

In 2013 the independent studio Mostly Positive published Gone Home, a game about Katie, a college girl that needs to go to her parents' new house for a few days. When she arrives there is nobody home, and she finds herself trapped in the porch of an unfamiliar house in the middle of a raging storm, with no notice from her family except a troubling note from her sister. She has to find her way in by herself and, since there is nothing better to do, explore the house and maybe find out what happened to her sister.

Gone Home is a **Discovery** game, the player is given control of the protagonist with no instructions, and no clear goal. Just a big house full of closed doors waiting to be opened and secrets waiting to be revealed.

The core mechanic of Gone Home is to Move Around. The player can go wherever they want, within the inner walls of the house, and interact with different objects and notes they find.

- **Representation:** The game is a first person experience where the player can move and look around freely. In the middle of the screen there is a small white dot that helps as a cursor, when the cursor is on top of something important, the object will change color and a text will appear on screen indicating what action can the player do with the object. Some objects can be picked up and moved, some things can be opened, notes can be read, etc...

  In a Discovery game uncertainty is a vital part of the gameplay. The fact that there is no obvious difference between interactive and decorative elements forces the player to check every corner of the house in search of things to do.

- **Tokens:** The player controls Katie and can move her around the house, also there are many things around the house, like doors, switches, or items, that the player can interact with directly.

  In a discovery game, novelty is important, the player expects to find new things in their surroundings. In Gone Home, except maybe for a few light switches, every interactive element of the house is different. There are notes, doors, drawers, pantries, magazines, and many other elements, each one unique. The player can do only one thing with each token (open door, read note, turn on light), and every little thing is important to reach the end of the game.

- **Resources:** The house itself is a resource, as the player progresses the house opens and reveals itself, at first the player is confined to a small space, by the end of the game they can go freely to every room they want.

  This title has a peculiar trait: it is impossible to lose. The main reason for this is that there are no costs associated to the core mechanic (or any mechanic), since there are no costs, the game does not have a failure state.

  A hazard or threat in the game-space can act as a deterrent to explore, which directly contradicts the Discovery aesthetic. Gone Home solves this problem by completely removing any risk for the player, making Gone Home an archetypal example of a Discovery game.

- **Decisions:** The player can choose where to go and what to interact with. These decisions impact the order and speed at which the player explores the house.

- **Goals:** Discovery games usually hide their goals from the player, the designer leaves clues to lure the player deeper into the game-space. Gone Home gives two things to the player: A big house to explore and a note with a cryptic message from Sam (Katie's sister) claiming she left home.

  - **Immediate:** Unlock the next room (the next piece of the puzzle).
  - **Local:** Find new clues and notes about Sam and the family.
  - **Global:** Learn the truth about Sam and why she left home.

5 Discussion

Game design is a task most commonly performed through an empirical process and can yield outstanding results. However, a formal language with structured models will allow us to understand and diagnose different products and outcomes, especially when the empirical process fails to produce a quality result or to provide an explanation for the failure to achieve the intended result.

The main objective of this study is to provide new tools that might help novice game designers to approach their decision-making process with more information and give them a lens to examine their products from a critical standpoint. Furthering the discussion on critical vocabulary for game design is beneficial to

newcomers and veteran designers as well, since the capacity to replicate success is key for the endeavors of any game designer.

Regarding our first hypothesis, we believe the 5PM can certainly be used as a powerful diagnostic tool. Examples like the animation of Prince of Persia in section 4.1 help define with better words what a designer means by "game feel" and how to apply it to a better result in the game they are making. Other ambiguous terms like "juice" or "oil" can be explained with detail using the different parts of the **representation** and how the player perceives them. The case with Ark illustrates how the 5PM can help diagnose potential problems when introducing new mechanics to the game. The 5PM can help the designer understand when and how several mechanics interfere with each other, given they might share resources, or have opposite goals.

As for our second hypothesis, the 5-Part Model is intentionally designed to complement the MDA Framework and the Core Mechanic Diagram in what would be part of an integrated framework for game design. Through the 5PM a designer can study and replicate the characteristic elements that link a mechanic with its corresponding aesthetic. Understanding these elements allow the designer to modify the aesthetic by tweaking its individual components.

In section 4.2 we describe how different parts of a core mechanic provide the required building blocks of a particular aesthetic. Mortal Kombat's limited decision pool and simple representation are vital to the fast-paced gameplay that drives its Challenge aesthetic. If a designer takes a core mechanic like MK11's Kombat, and adds detailed information to its representation while making the decision pool larger and dynamic in time, the aesthetic of the resulting game would shift into Puzzle as elements of strategic planning emerge.

Adding an objective marker to the representation of the Move Around mechanic of Gone Home would totally ruin the Discovery quality of the game, shifting its aesthetic to Narrative since the game's story-driven puzzles would become a lot more relevant.

Another remarkable quality of the model is its diagnostic capabilities. Gone Home is a very intriguing game, but does not feel particularly challenging. After a detailed analysis with the 5PM we found that Gone Home's relaxed nature can be traced back to the way its resources are designed. Most commonly a mechanic builds conflict through its resources, the player has to evaluate the cost/benefit ratio before performing an action. A mechanic with rewards but no cost creates no conflict, thus the player does not feel the pressure of failure and the gameplay acquires this relaxed, effortless feeling. In Gone Home the core mechanic rewards the player with new space to explore, but this mechanic is free, the player is not required to sacrifice any resource in order to use it. Because of that the player can keep exploring freely, at their own pace, without worrying about losing the game.

By contrast, consider Dark Souls, which has a very strong Discovery aesthetic, rewards the player for exploring in the same way as Gone Home, but in Dark Souls the field is dangerous, there are hazards and enemies that can kill the character, the player is risking several resources: Health, Souls (a form of currency), and Humanity (a resource that unlocks certain mechanics). This creates conflict, if the player dies they have to go back to the place where they fell and recover their resources. Since losing Humanity hinders the player in many ways, returning to the place where they died is even more dangerous now than before.

The fact that exploring has a cost ramps up the challenge for the mechanic, while in Gone Home the lack of cost makes the mechanic feel safe and easy (devoid of challenge).

We believe this model can be applied to understand and predict the response of a given game, allowing the designer to tune the finer aspects of their experience by tweaking and experimenting with each individual property of a core mechanic. Maybe even shed some light on the secrets of successful games or highlighting the critical elements of a particular genre.

We intend to inspire a working ideology focused on improving development techniques aided with the tools here described. This work is also expected to become the cornerstone of future research in the field of game design.

6 Future Work

The next step in this research line is to try and test the model in real environments. For this purpose, we are applying the model as a research tool in an optional course of Game Design as well as a building tool in a few independent games.

We are also developing a detailed model for balancing difficulty called the Risk and Reward that will complement with the 5PM and Jenova Chen's Flow Zone.

References

[1] D. Zwang, "Senet and twenty squares: Two board games played by ancient egyptians," p. 19, 07 2017. [Online]. Available: https://www.metmuseum.org/blogs/metkids/2017/ancient-egypt-board-games

[2] G. Costikyan, "I have no words and i must design," *Interactive Dramas*, 1 1994. [Online]. Available: https://www.academia.edu/1270811/I_have_no_words_and_I_must_design

[3] ——, "I have no words and i must design: Toward a critical vocabulary for games," *Computer Games and Digital Cultures Conference Proceedings*, vol. 1, 6 2002. [Online]. Available: http://www.costik.com/nowords2002.pdf

[4] S. Björk, S. Lundgren, and J. Holopainen, "Game design patterns," *Digital Games Research Conference 2003*, 1 2003. [Online]. Available: https://www.researchgate.net/publication/221217599_Game_Design_Patterns

[5] R. Hunicke, M. Leblanc, and R. Zubek, "Mda: A formal approach to game design and game research," *AAAI Workshop - Technical Report*, vol. 1, 1 2004. [Online]. Available: https://www.cs.northwestern.edu/~hunicke/MDA.pdf

[6] J. Chen, "Flow in games (and everything else)," *Communications of the ACM*, 4 2007. [Online]. Available: http://jenovachen.com/flowingames/p31-chen.pdf

[7] C. Kim, "Designing around a core mechanic," *Gamasutra*, 6 2012. [Online]. Available: https://www.gamasutra.com/blogs/CharmieKim/20120612/172238/Designing_around_a_core_mechanic.php

[8] T. Fullerton, *Game design workshop: a playcentric approach to creating innovative games*, 4th ed. CRC Press/Taylor & Francis, 2019.

[9] J. Schell, *The Art of Game Design A Book of Lenses*. A K Peters Ltd, 2018.

[10] T. Constant and G. Levieux, "Dynamic difficulty adjustment impact on players' confidence," *CHI '19: Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, 5 2019.

[11] J. T. Alexander, J. Sear, and A. Oikonomou, "An investigation of the effects of game difficulty on player enjoyment," *Entertainment Computing*, vol. 4, no. 1, pp. 56–62, 2 2013.

[12] A. Vanden Bossche, "Opinion: Shut up and save the world: The silent protagonist," 2008. [Online]. Available: https://www.gamasutra.com/php-bin/news_index.php?story=17652#.UE-1-LJlQYB

[13] F. Lantz, "Mda," *Game Design Advance*, 9 2015. [Online]. Available: http://gamedesignadvance.com/?p=2995

[14] L. Polanski, "On genre and the ludic device," *Sufficiently Human*, 8 2015. [Online]. Available: http://sufficientlyhuman.com/archives/1008

[15] W. Walks, "From mda to dde," *Gamasutra*, 11 2015. [Online]. Available: https://www.gamasutra.com/blogs/WolfgangWalk/20151111/259078/From_MDA_to_DDE.php

[16] M. Brown, "Problem solving... or puzzle solving?, how to design puzzles," 2015. [Online]. Available: https://www.youtube.com/watch?v=w1_zmx-wU0U

[17] J. Newcombe, "Fitts law - the secret to an intuitive ux?" 2018. [Online]. Available: https://medium.com/nyc-design/fitts-law-the-secret-to-an-intuitive-ux-a8a985811d23

[18] M. Soegaard, "Hicks law: Making the choice easier for users," 6 2020. [Online]. Available: https://www.interaction-design.org/literature/article/hick-s-law-making-the-choice-easier-for-users