

**THE REPUBLIC OF TURKEY
BAHCESEHIR UNIVERSITY**

**DESIGNING XCUBE AND ANALYSING FUN
FACTORS**

MASTER'S THESIS

ATAKAN CANKORUR

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**THE REPUBLIC OF TURKEY
BAHCESEHIR UNIVERSITY**

**GRADUATE SCHOOL OF SOCIAL SCIENCES
GAME DESIGN MASTER'S PROGRAM**

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Supervisor: ASSOC. PROF. BARBAROS BOSTAN

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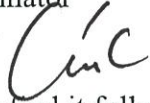
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ABSTRACT

DESIGNING XCUBE AND ANALYSING FUN FACTORS

ATAKAN CANKORUR

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The theory of "Creating order out of chaos" which became prominent in the field of psychology, has also been utilized in many games that were developed for different platforms. Similarly, as a game design element, the "Controlled Randomization" concept had been preferred in a remarkable number of games due to its procurement of "iterativeness" and "luck factor" to the games. Within this thesis study, the usage of the said notions within the games by the means of pattern, style, methods, amount; and the UX on the players as per the basics of the game design discipline shall be explained via the Xcube game, which was developed for the mobile platforms in a commercial manner, as a case study. Within the scope of this study, comparisons of Xcube with similar featured games shall be made in the words of game design, gameplay and game mechanics, where series of analyses will be added accordingly within such regard. Additionally, the results of the survey made among the selected players that will play Xcube for these research purposes and give responsive feedback on the gameplay experience shall contribute to the analysis duly. As a conclusion, the claim on whether the "Creating order out of chaos" and "Controlled Randomization" does generate an element of fun in the game and inject it to the players shall be discussed accordingly.

Keywords: Creating order out of chaos, Randomization, Mechanic, Puzzle, Mobile game

ÖZET

Xcube'ün tasarlanması ve eğlence faktörlerinin analiz edilmesi

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Psikoloji biliminde isminden söz ettirmiş olan "Kaostan düzen yaratma" teorisi, yıllar içerisinde farklı platformlar için geliştirilmiş pek çok oyunda kendisine yer bulmuştur. Yine benzer şekilde, bir oyun tasarımı unsuru olan "Kontrollü Rastlantısallık" kavramı da, özellikle "tekrar oynanabilirlik" etkisi ve şans/sürpriz faktörü sağlaması bakımından hatırı sayılır sayıdaki oyunda tercih edilmiştir. Sözü edilen bu iki kavramın oyun tasarımı temellerine göre oyunlarda ne şekilde, hangi yöntemlerle ve miktar yönünden nasıl kullanıldığı ve oyuncular üzerinde oyun tecrübesi (User Experience/UX) açısından ne yönde etkiler bıraktığı, Ağustos 2017'de ticari olarak mobil platformlar için geliştirilmiş olan Xcube isimli oyun üzerinden bir örnek çalışma metoduyla anlatılacaktır. Bu çalışma kapsamında, Xcube ve yine bu yönleriyle ön plana çıkmış diğer bazı oyunlarla oyun tasarımı, mekanikler ve oynanış yönünden karşılaştırmalar ve buna bağlı analizler yapılacaktır. Buna ek olarak, Xcube isimli oyunu oynamış olan katılımcılarla yapılacak bir anketin sonuçlarından da faydalanılacaktır. Netice olarak "Kaostan düzen yaratma" ve "kontrollü rastlantısallık" unsurlarının, bir oyunu oyuncular için kullanıcı deneyimi yönünden daha eğlenceli hale getirip getirmediği tartışılacaktır.

Anahtar Kelimeler: Kaostan Düzen Yaratma, Kontrollü Rastlantısallık, Mekanik, Puzzle, Mobil Oyun

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ABBREVIATIONS

COOC.	:	Creating order out of Chaos
CR.	:	Controlled Randomization
ETC.	:	Etcetera
GDC	:	Game Determined Chaos
PDC	:	Player Determined Chaos
BBZ	:	Bejeweled Blitz
RD1	:	Retention Day 1
RD7	:	Retention Day 7
RD30	:	Retention Day 30
DAU	:	Daily Active User
MAU	:	Monthly Active User
DAUE	:	Daily Average User Engagement
LTV	:	Life Time Value
UX	:	User Experience
UI	:	User Interface



1. INTRODUCTION

This thesis aims to analyze how the Creating Order out of Chaos (COOC) theory and the 'controlled randomization' design element can be applied to mobile game design. Most of the close likely games which use COOC and randomization are also puzzle genre as Xcube. For a better understanding of these games, fundamentals of game design and the puzzle game genre will be summarized from the perspective of a game designer. In addition to those explanations, we will also take a look into game mechanics, flow and other factors to understand the elements of the game design. Moreover, we will take a look at the basic definitions of fun, chaos, order, 'Creating order out of chaos' and game psychology behavior in the psychology field and analyze them for the game design. In this study examined games audiences are the most casual players and to this matter, we will take a look into the casual player profile in mobile games.

In these days mostly in mobile, match-3 games are also collectively known as *tile-matching match-three games*, new puzzle genre is very popular among casual mobile players. To explain the Match - 3 games those games are about matching a minimum of 3 same objects in a row to solve the puzzle. In a game design perspective, this kind of games uses mutual mechanics, gameplay and psychological background to make the game more addictive and fun. The mechanics of the match-3 games may be designed for the purpose of game theory 'Creating order out of chaos'. And in this study, we will examine the similar games using same or close likely mechanics that might be created in the purpose of COOC and how it affects the play motivation and fun. To analyze the similar games, I will use common examination methods like observation, playtest and examine the main elements based on the game design field. The match-3 game analyzed will be Bejeweled Blitz and Candy Crush as these games are well known and in my opinion they contain COOC mechanics. Regardless of the only match-3 genre, we will also look at some other games like Lego, Rubik's Cube, Tetris, 1010, Toy blast and Two dots as this games also well-known and might contain COOC elements or close likely

mechanics. Which also uses COOC and randomization in mutual mechanics and used in different ways of gameplay.

After the examinations of these games are completed we will understand what they have used in common and how they become successful by using those game design elements as COOC becomes mechanics of these games.

The examinations and the study over COOC & CR, I will explain how I used those game design elements in Xcube's game design. To understand if elements used in Xcube as COOC and CR, I will make a survey to the players gather feedbacks and we will conclude the results if they really create fun or not based on the theory COOC and CR used in game design.

1.1 RESEARCH GOALS

In this study, research goals are to understand the theory COOC used as mechanics are successful as fun or not and also examining the how other games use 'Creating order out of chaos' in their mechanics. How are they creating chaos and how player solves it and reaches order and gets fun out of it. How did randomization make the game more fun and affect the fun factor? As used in Xcube's game design by using common of those COOC mechanical elements and designing a new game based on those elements creates an experience as fun or not?

By using the results of player questionnaire & it's analytical data of Xcube.

1.1.1 Research Methods & Questionnaire

As research methods I will use common research methods like readings, documentaries, examining and reviewing. My main aim is to find how did 'Creating order out of chaos' and 'Controlled Randomization' effects the mechanics of the games. What makes players love those games and get fun out of them. To get to the conclusion if it's fun or

not, I will make an Interview with the group of players that played Xcube and make them a survey to get feedbacks and study if Xcube creates fun or not?

1.2 EXAMINING GOALS

In this thesis, similar games with similar design elements are analyzed and how they used COOC and CR is examined. The common COOC game design elements will be identified and their fun value will be discussed.

In this matter following games will be examined

- i. Lego
- ii. Rubik's Cube
- iii. Tetris
- iv. Bejeweled Blitz
- v. 1010!
- vi. Toy Blast
- vii. Two Dots
- viii. Candy Crush

1.2.1 Examination Methods

In examination methods, I will playtest the games and analyze their game design elements as mechanics, game flow and the COOC mechanics. The following elements will be examined and analyzed:

- i. Short description of the game
- ii. Puzzle design type of the game
- iii. Game mechanics of the game
- iv. Game controls of the game
- v. COOC mechanics of the game
- vi. Game flow as difficulty and player abilities in games
- vii. Fun types of the game
- viii. Randomization factors and affect over gameplay of the game

- ix. Gamer type of the game's audience of the game
- x. How did 'COOC' game theory take place in the game?



2. TERMINOLOGY AND DEFINITIONS

The purpose of this chapter is to define and explain the terminologies I have used for this thesis, the theories used, explaining the perspective on an introduction to game design elements I will examine, the definitions of theories I will look into and take a look at the basic gamer behavior.

2.1 THEORETICAL BACKGROUND

In this section, I will present the game design and psychology fields and discuss their relevance to my thesis, beginning with game design and moving towards with the relation in the basics of psychology.

As previously mentioned, this thesis takes a multidisciplinary approach from game design and psychology field. To examine the games and Xcube clearly, we need to take a look at the fundamentals of game design and understand the definitions of the game mechanics, game flow and the game loop. Those subjects are very important to determine the elements of the games. After understanding those, we will take a look at the fun concept and the COOC theory in psychology so that we can clearly understand the transformation of the COOC to a mechanic in examined games.

The genre of the examined games and Xcube is puzzle so that we will basically look into the requirements of the puzzle genre. Moreover, we will continue with the gamer's behavior and how did the casual player profile act in mobile games since Xcube is a puzzle game and the target audience is casual players in mobile.

2.2 FUNDAMENTALS OF GAME DESIGN

Before moving on with the elements of the game design, in this part, I want to take a look into what is the game, game design and basic requirements of the game design.

"A game is a type of play activity, conducted in the context of a pretended reality, in which the participant(s) try to achieve at least one arbitrary, nontrivial goal by acting in accordance with rules." (Adams 2009, p 3) In addition to the Ernest Adams's approach to the game, I wanted to add that games are play structures that enable the living experience for the players. There is plenty of entertaining methods like music and films etc. and these are also an experience. In my point of view, the most important difference between the experience and the living experience is players can able to participate and interact with the experience in games.

Game design is the field that determines the rules of play, set the game fundamentals and creates the living experience. The game designers role is to decide what a game should be.

They start from scratch and decide everything in the game to serve the living experience. Also game designer must decide to the concept, fundamentals of the game design, controls and many other multidisciplinary things that may include in the game.

In Art of Game Design, Jesse Schell simply summarize the requirements of the game designers as;

"animation, anthropology, architecture, brainstorming, business, cinematography, communication, creative writing, economics, engineering, games, history, management, mathematics, music, psychology, public speaking, sound design, technical writing and visual arts." (Schell 2015, pp 2-4)

In addition to Schell, every game may have much more requirements or disciplines based on what it will be.

After the explanations of game and game design concepts, I intentionally want to point that games are not just about video games. Because I will also examine how Lego and Rubric's Cube used COOC as a mechanic. But in general, I will move forward with the specific over the video game design.

To build a game structure, games must contain mechanics to play, a game flow to define the difficulty and player ability, a game loop to define the pattern of play and controls to play with. Fundamentals of the game design contain many elements but due to my thesis, I will focus over mechanics, game flow, game loop, and game controls.

2.3 GAME MECHANICS

As I mentioned in the Fundamentals of Game Design section, this part is about an explanation of what the game mechanic is and how they have used.

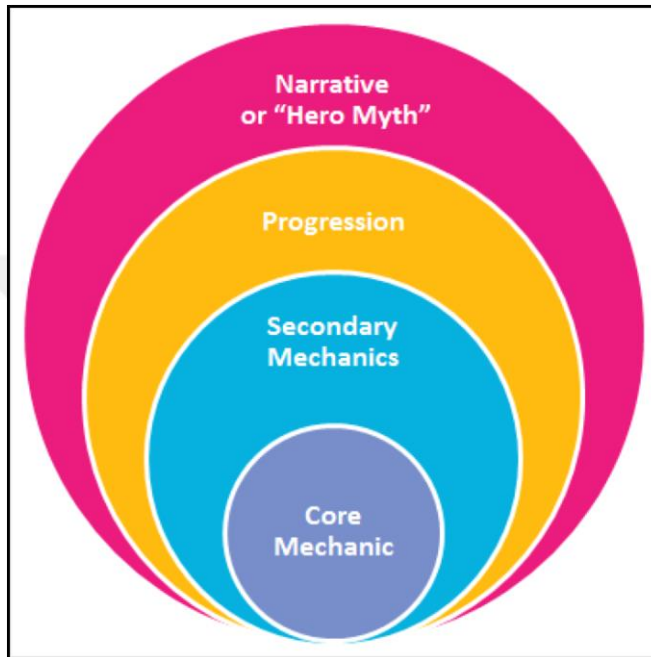
Game mechanics are the core elements that compose the game. Players are playing games over the mechanics and the game structures will be built over it. *"Game mechanics are the rules, processes, and data at the heart of a game. They define how play progresses, what happens when, and what conditions determine victory or defeat."* (Ernest & Dormans 2012, p 1) In the "Game Mechanics" book, Ernest Adams and Joris Dormans explained the mechanic as per above. In addition to their explanation, I want to add that mechanics are the element that becomes the interaction that what player does to play the game. There are two usages of the mechanics in game, one is called the main mechanic and the other one is the side mechanics. Main mechanics are the main element that game is built over and side mechanics are the supportive mechanics which gives secondary options to players or enables them to play in another way. Sometimes side mechanics may be the main mechanic for the player as they want to play with it.

To give a simple example for the game mechanics, in the "Flip coin" the *flipping* is the main mechanic of the game. The game may contain more than one main mechanic to play for example movement and shooting in the shooter games are the two main mechanics of it.

To giving a related example of a mechanic with this thesis subject, in match-3 games the 'matching' is the main mechanic of those games. For moving towards with the side mechanics in match-3 games, if you match more than three objects you can build bombs that can help you to destroy many more objects, the bomb building by combining more

than three objects is the side mechanic of the game. In her blog and Gamasutra, a game designer Charmie Kim made a core diagram to explain the mechanics and I will use this diagram method(Figure 2.3.1) while explaining the game design elements of the Xcube and other related games. (Kim 2012)

Figure 2.1: Game Design Elements Diagram



Source:https://www.gamasutra.com/blogs/CharmieKim/20120612/172238/Designing_around_a_core_mechanic.php

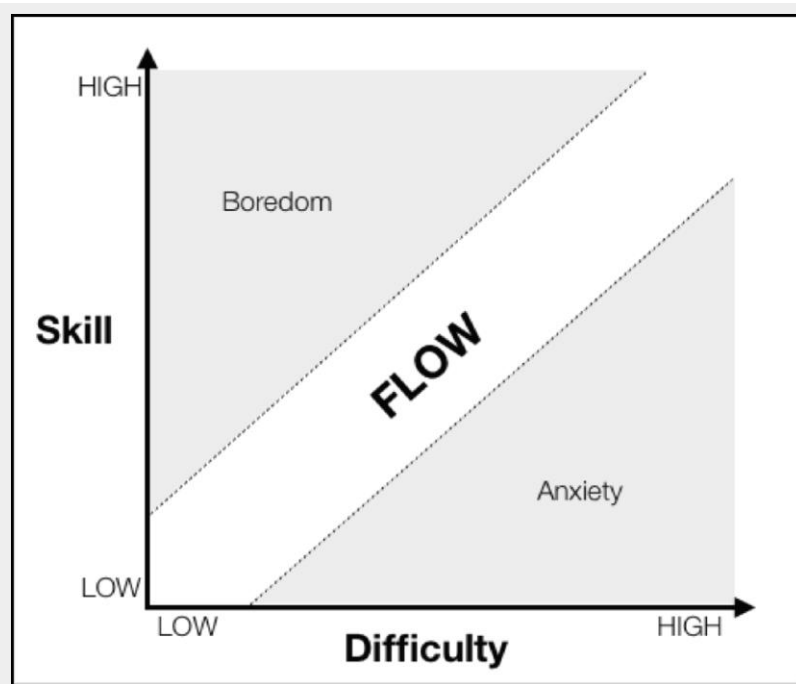
The main mechanic of the Xcube is arranging the blocks and the side mechanic is rotating the cube. In this thesis, we will examine the relation between COOC and how it takes place in these mechanics.

2.4 GAME FLOW

Game flow is one of the key element in the game design to entertain players and keep up the progression. Basically, game flow is the balance between the difficulty and the player ability to motive the play activity to keep the player engaged and continues with the progression of the game.

In the 1970s a psychologist named Mihaly Csikszentmihalyi experimentally evaluated the flow. He found that a person's skill and the difficulty of a task interact to result in different cognitive and emotional states. When the skill is too low and the task is too hard, people become anxious. Alternatively, if the task is too easy and skill is too high, they bored. However, when skill and difficulty are roughly proportional, people enters the low states (see Figure 2.4.1).

Figure 2.2: Flow, boredom, and anxiety as they relate to task difficulty and user skill level. Adapted from (Csikszentmihalyi, 2008)



Source:http://www.gamasutra.com/view/feature/166972/cognitive_flow_the_psychology_of_.php

As it shows in the Csikszentmihalyi's chart, when the difficulty of the game is increase coherently with the player's ability, the game becomes challenging. To keep the player in the optimal cognitive state while playing, game designers needs to balance the difficulty and the player ability. With the right game, flow games keep players engaged and entertained. The game flow takes importance when it comes to the fun and progression of the game. In some games, the game might have more than one flow to follow based on the requirements of it. But mostly the games have only one flow to follow. As flow's requirement, player might need to feel the improvement in the game.

For example, the level up or gathering better items in RPG 's are the motivators to keep the flow engaging and entertaining.

In Xcube' s game design I experimentally create a game flow for the infinite game based on the income of possibility of the shapes, the empty space possibility and with the player's ability to place the blocks. And to give the improvement progression, even its infinite at the beginning of the game, player starts the game with the 3x3 cube and after the player reaches enough point to follow the game flow, the cube gets bigger up to 5x5. I will explain detailedly how I designed the experimental game flow of the Xcube in game design section.

2.5 GAME CONTROLS

Game controls are the main interaction tools between the player and the game. In gaming history with the technological evolution, game controls changed based on the platform and game requirements. While designing a game, every game designer must also determine the controls for the best user experience in their target platform and game requirement. In his Gamasutra article Andrew Dotsenko(2017) defined three main principles for the game controls :

- i. *Accessibility* – the game controls should be easy to learn and use, and take into account human’s physical and cognitive limitations.
- ii. *Intent Communication* – the game controls should communicate the player’s intent in a way the player expects and create a feeling of full control.
- iii. *Expression Space* – the game controls should give the player enough expression space for mastery, and keep a sufficient level of variety.

These three principles will help us to understand the control requirements of the games that we are examining and the Xcube's controls. In mobile game platforms, common use of controls are swipe/slide and tap with finger, touch over the screen of the mobile device. The controls are one of the most important element to give the sense and the experience of the game. If controls are not designed well enough, they may cause loss of experience or can make the game unable to be played. And in mobile games, controls

are getting more important due to the optimization and device limitations. The controls also have a significant effect over the mechanics, if control possibilities are not enough for the game due to the device limitations then mechanics may change or will be iterated to optimise for the device. Many mobile games or games that ported to the mobile is suffering from mobile control limitations. Because the mobile screen is small and crowded, it directly affects the expression space of the game. With so low over expression space, intent communication makes it difficult to communicate with the player and limits the accessibility of the games in mobile. That information mentioned above, the controls are significantly important in mobile games rather than other platforms due to the limitations and it directly affects the fun factor of the mobile games. With that, we will study and examine those controls and solutions for mobile in the examinations. Further in the Xcube's game design part, I will explain why I decided to use swipe, drag and drop in the game and how it affected the fun of it.

2.6 PUZZLE GENRE

In simple terms, puzzles are the games based on problem-solving. They have very wide and expanded history and types of gameplay. In this thesis, we will focus on the video game's puzzle genre. Many puzzles have different gameplay and mechanics. Xcube is also one of them and the examined games are also in this genre.

In puzzles, the player's aim is to solve the determined problems. First, player needs to find the problem and then solves it. Many games contain problem-solving but the difference of the puzzle is it's based just for it. Puzzles have many types such as word, visual, mathematical, tactical, placement and many more. While examining the games, we will look into which kind of puzzle they are and the mechanics that make the puzzles.

In Tracy Fullerton's (Fullerton 2014) Game Design Workshop - A Playcentric Approach to Creating Innovative Games book defined two aspects of puzzle design.

"First, there are two aspects of puzzle design. Level design, as it applies to puzzles, is crafting a particular puzzle configuration within a fixed set of rules. For example, composing a crossword puzzle is a form of level design. The level designer's challenge is to craft a puzzle with a distinct sense of drama and coherence that is tailored to a particular difficulty level. The other type of puzzle design is rule design: inventing the overall rules, goal, and format of a puzzle. For example, Ern Rubik was a rule designer when he invented Rubik's Cube. Note that some rule sets, like Sudoku, are reusable forms that yield thousands of puzzles, while other rule sets yield only a single unique puzzle. Generally speaking, rule design is harder than level design. Second, puzzle design has the same goal as game design in general: to keep the player in a pleasurable challenging state of flow. That means capturing the player's interest with an attractive goal, teaching the player the rules in a seamless and interesting way, giving feedback during gameplay that keeps the player engaged, and rewarding the player appropriately at the end." (Fullerton 2014, p.42)

She separated puzzles into two aspects;

- i. Level design puzzles
- ii. Rule designed puzzles

This separation will be very helpful to understand the examined games as if they are level design oriented or rule design oriented. In some cases like Candy Crush or Two Dots, these two aspects might be used together and the rule design will be served with level design. The difference between the level design oriented and the rule design is very important to explain and understand the chaos types of games. By these definitions, Xcube is rule designed puzzle game.

To my point of view, I saw puzzles like the brain tries to beat himself by solving the given problem and getting motivated so that high repetitive value and allowing creativity puzzles are more fun to play with. The puzzle structure is also very similar to the COOC theory based on the relation between problem-solving. In the definition of the creating an order out of chaos game theory, I will explain the similarities much more after looking to the definitions of the COOC.

2.7 CONTROLLED RANDOMIZATION

Randomization, uncertainty or possibility can be a major subject to another research but for my thesis I'm focusing on controlled randomization theory. Many games contains randomization systems as game design element for unpredictability and chance factor.

Randomization can be an information that enters the game which can't be predictable by the player or becomes different outcomes than expected and changes the experience or the gameplay of the player. For to give a classic example of random systems in the games, it can be rolling dice, shuffling card or critical hits by chance. Randomization and possibility is always a natural thing in the universe. So that every game contains a little bit of randomization which improves the game experience and fun factor of the game by giving more similarity with the life itself.

Chess has many number of possibilities but didn't include randomness. It is limited with the turns to complete, after that it becomes unpredictable with the player moves. Its unpredictable but did not contain randomness. So with chess example I want to point out the difference between unpredictability and randomness because if we count unpredictability as a main part of the randomization every game can be count as unpredictable so that the difference between randomness and unpredictability is different things.

After move on with the chess example, I want to take a look at the backgammon game. Both of them is historical games that has different game rules. Both is based on player ability to win another but in one point they have major difference. Chess is unpredictable but doesn't contain randomness which makes it clear and based on the player ability. By saying that if a master player in chess plays with beginner player, the abilities of the master player will be a major factor for the win, the beginner player has so low chance to win against that player because there is no randomness in the chess and its based on players abilities. But in backgammon even the best player comes against the beginner player still its based on their abilities but determined by the result of the dice. So that beginner player still has higher chance to win the game with their abilities. In addition to that in chess, for the beginner player or low ability player has less chance and it affects the fun outcome from the game after the player understand the low chance to win and breaks the game experience. But in backgammon both player always has chance to win the game and every player move makes it more fun because the hope to win is still stands. Due to those comparisons and randomness for my point of view backgammon is more fun than chess as game designer.

Controlled randomization is like a backgammon's randomness, game designer defines the rule or limitation of randomness, defining the two six sided dice is the control and the outcome is the randomness. Backgammon dices, blocks in tetris or number of candy possibilities in Candy Crush can be an example for controlled randomization.

In Keith Burgun's (2014) online article 'RANDOMNESS AND GAME DESIGN' she defined two types of randomness as

- i. *Output randomness* – when we think of randomness in games, we're usually referring to this. Output randomness is noise injected between the player's decision and the outcome. Examples would be the dice roll combat in Risk or Memoir '44, or the random number generation combat in X-Com or FTL. I will refer to systems that do not have this type of randomness as “deterministic”.
- ii. *Input randomness* – this type of randomness informs the player before he makes his decision. Typical examples of input randomness would be map generation in Civilization or Rogue, or face-up tiles or cards in a worker placement game like Puerto Rico or Agricola. (People often use the term “procedural generation” to refer to this kind of randomness in digital games.)

The two types of randomness can help us to understand the randomness effect on the games. But I want to say that some games also contains both of them. For example, Tetris contains output randomness and also input randomness. It informs the player before making decision but gives new random block from regardless of the players input.

As a conclusion, controlled randomization can contain both of the randomness types that Keith Burgun defined. Randomness is also a important matter for this thesis in the section of COOC, as chaos is a random act and turns into a problem as game designer

role is to put a rule to the randomness can enable player to find the solution as order and turn it into a controlled randomization.

In Xcube we provide player three random shapes and request from player to choose which one to place first and make lines out of it in that point input randomness types informs the player with the shapes it needs to place and after the placement of three shapes we give them new random three shapes. In that point before its come to input randomness we do the act of output randomness with giving totally random three shapes determined for the cube size from predefined block shapes and its how controlled randomization and both randomness types used in the Xcube to increase the fun and the experience of the player.

2.8 DEFINITION OF FUN

The fun has many ways to explain but we will focus over the fun in games. As basically fun is enjoyment and entertaining. The fun term in the games is the experience that players taking from the game. In theory of fun by Raph Koster (2013), overall looking explained that the human brain works as pattern solving and said; *"People are amazing pattern-matching machines"* and games are *'Based on my reading, the human brain is mostly a voracious consumer of patterns, a soft pudgy gray Pac-Man of concepts. Games are just exceptionally tasty patterns to eat up.'* (Koster, 2013, p 14) and I agree with Ralph Koster about the relation between how the brain works and what games are in the point of brain activities as pattern solving. As much as players solve or consume patterns they start getting fun out of those. This theory looks pretty rational to my point of view to the explanation of fun.

As nothing can be precise about how people entertain generally all of the experience in the games may count as fun because players may entertain from anything such as excitement, sadness or success or many other feelings. It's not precise but for many players as observation and common sense when players make success in games they get fun out of it.

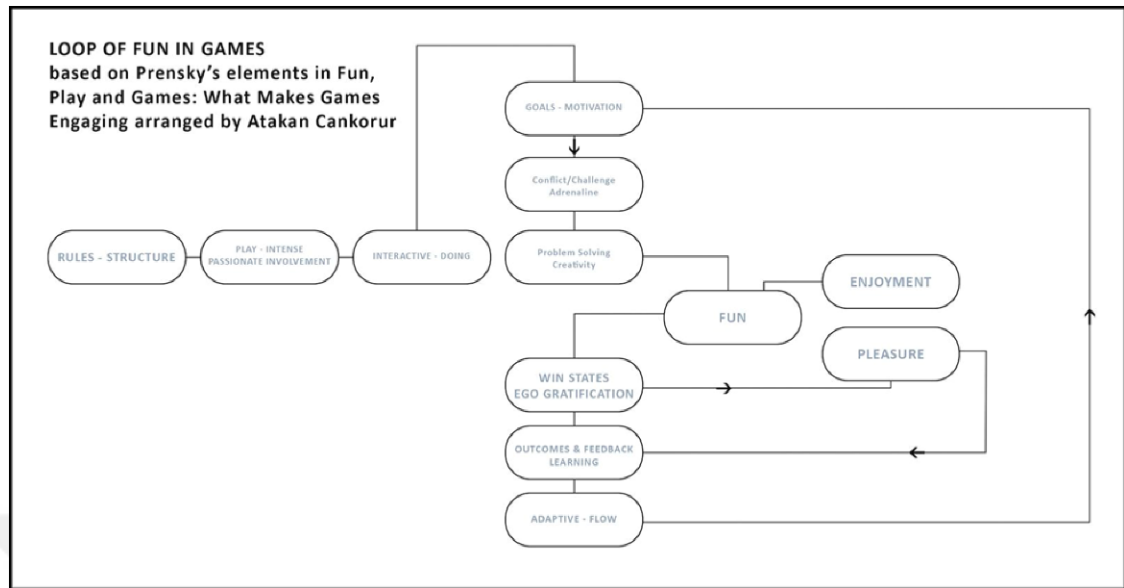
In addition to patterns and rational view to fun, I want to look at Marc Prensky (2001) has summarized twelve elements of fun in games;

- i. "1. Games are a form of **fun**. That gives us **enjoyment and pleasure**.
- ii. 2. Games are a form of **play**. That gives us **intense and passionate involvement**.
- iii. 3. Games have **rules**. That gives us **structure**.
- iv. 4. Games have **goals**. That gives us **motivation**.
- v. 5. Games are **interactive**. That gives us **doing**.
- vi. Games are **adaptive**. That gives us **flow**.
- vii. Games have **outcomes and feedback**. That gives us **learning**.
- viii. Games have **win states**. That gives us **ego gratification**.
- ix. Games have **conflict/competition/challenge/opposition**. That gives us **adrenaline**.
- x. Games have **problem-solving**. That sparks our **creativity**.
- xi. Games have **interaction**. That gives us **social groups**.
- xii. Games have **representation and story**. That gives us **emotion**." (Prensky 2001, p 05-1)

Prensky defined the relationship between the game and the fun in twelve elements and most of them are very clear statements about the fun. Regardless of eleven and twelve, because they are mostly about story-based games. I want to move towards the first ten and arrange them for my point of view about fun in games and game design. And after arranging them I clarify myself about fun comes out of the game.

First of all, games are structures that have rules which players get involved with their intense and passionate involvement creates the interactivity between the player and the game by play. Every game has its own goals which motivate the players to achieve the goal. While on the way to achieve that goal, players will struggle with **conflicts/competition/challenge** and in that moment **problem solving** and creativity comes to an act. In the moment of problem-solving for challenges, the **fun** comes out of it with enjoyment. When the player achieves the goal Win State comes out as consequence and ego gratification with the pleasure of **fun**. The outcome and feedback of being fun the player will also learn the problem solving of the situation and the feedback turns out to be a new challenge, with the adaptivity of the game, game designers set new goals based on what player learned and improved ability, they set new goals to keep player in flow and creates continuous **fun**. For a better explanation, I made the loop of the fun chart below with based on the Prensky's elements of fun by my arrangement from the game designer's perspective.(Figure 2.9.1)

Figure 2.3 Loop of Fun in Games



As I arranged this chart, I categorize three kinds of fun from games; an enjoyment moment which comes out when challenging with problems by solving them, a pleasure moment when player successful achieves the goal and comes to the win states and ego gratification comes out and the flow fun which keeps players engaging and provides continuous fun.

3 types of fun come out of this chart is:

- i. *Instant Fun* - Comes out in play action with enjoyment by solving problems or challenging.
- ii. *Conclusive Fun* - Comes out after player achieves the goal in win states and gets ego gratification with pleasure.
- iii. *Progressive Fun* - After getting pleasure from outcomes and feedback with learning it turns into the place in the adaptive game flow and by generating new goals and motivating players fun progression will continue by improved gameplay and flow.

Most of the games include all three fun types but some may not include all of them. I may not say if the game includes all of them will be better but in my point of view as much as they include all of this three types game will generate more fun by keeping

engagement and increase playability as patterns increase. With those, I will continue my thesis based on these three fun types that I defined and explain how did I use those over the Xcube.

2.9 DEFINITION OF “CREATING ORDER OUT OF CHAOS”

Basically, chaos is a definition for unstable, complicated and complex states. The definition of order is a stable, organized and certain state. It's a known balance and loop of nature. Every chaotic state may require an order and every order in some point turns into chaos so that it's a loop of nature. Generally human nature is not suitable for the chaotic state because of it is unstable and complex. According to the "Creating order out of chaos" theory in the psychology field, every human primitively or instinctively requires to create order out of chaos to organize and stable state. It also points out to a basic survival instinct of the humans in order to survive every human needs to create its own environment and stability. In 'Consciousness Encompasses and Reflects Chaos and Order' by Robert Berezin 's(2014) online article explained the relation between chaos and order by consciousness as;

“Chaos and order is the big subject of the universe – the creation of order out of chaos and the eventual return to randomness. This applies to the evolution of inanimate matter as well as all life forms including us. It should not be surprising that the operations of the brain itself encompass these processes. I certainly agree that “the brain’s main function is to protect us, like an umbrella, from chaos.” I propose that the brain not only operates via a balanced relationship between order and chaos on the micro level, but it operates in the same way on the macro level as well, fractal that the brain is. It is consciousness that protects us from the chaos of our random environment. It gives coherence to actions and meaning by imposing its learned order as it incorporates chaos from the environment.” Robert Berezin, 'Consciousness Encompasses and Reflects Chaos and Order' (Berezin 2014)

COOC, chaos theory or emergent states field in psychology is too deep and can be much more to say about but I want to focus on the game theory of the subject. In my point of view COOC as a very instinctive act, it may affect the player's behavior in games and effects the gameplay. While defining the fun, I mentioned from Raph Koster's explanation of fun is about pattern matching and pattern solving. In my point of view, I saw a similarity between the pattern matching/solving as problem-solving with chaos/order equation. With my observations and researches if we look into the COOC game theory in the puzzle, mostly chaos becomes a problem and order becomes a

solution. As psychologically, problems like chaos and solutions like order in mechanics may affect the instincts of the players and increase the fun factor, better experience or becomes more addictive in puzzle games. I will explain how COOC game theory becomes game mechanics in the section titled Game Theory: Creating order out of chaos in Puzzle Games.

2.10 GAMER PSYCHOLOGY AND BEHAVIOR

Usually "Gamer" term is used for the audience who play games more than usual but this term is mostly used for video game players. Nowadays with the mobile devices and reachability of the games, many of the casual players are turned into gamers. Due to that, we should briefly understand the gamer psychology and behavior. With the first ever question "Why do people play games?" There is no significant or precise explanation for this but in the most common approach is to amuse the time, fun or entertain.

"To further understand individual reasons of gaming we can refer to Richard Bartle's classic essay "Hearts, Clubs, Diamonds, Spades: Players Who Suit MUDs" where he describes four main player types (Bartle 1996):

- *Achievers: who are proud of their formal status in the game's built-in level hierarchy*

and how short a time they took to reach it.

- *Explorers: who are proud of their knowledge of the game's finer points, especially if we knew players treat them as founts of all knowledge.*

- *Socializers: who are proud of their friendships, their contacts, and their influence.*

- *Killers are proud of their reputation and of their oft-practiced fighting skills."*

(Bostan, 2016, p34) & (Bartle R, 1996)

Richard Bartle's (1996) player types can help us to understand the audiences and players behaviors. In these types, not every player needs to be a part of one but they can be part of more than one player types. For example, a player can be an Achiever and also be an Explorer or a Socializer. In my thesis subject, most of the puzzle game users are more likely to be an Achiever firstly and then might be an Explorers and a Socializers. While examining the games, we will look into the game design elements of those games and which player types they are allowing and fits the requirements of them. While designing Xcube, the player type is specially focused on Achievers and these player types will help us to understand the results of the Questionnaire.

2.11 CASUAL PLAYER PROFILE IN MOBILE GAMES

In addition to the gamer psychology and behavior, we will look into the casual player profile in the mobile games due to Xcube is designed for mobile platforms and for the casual players as the target audience and understand their requirements.

Casual players are usually playing games over mobile or browser platforms and most of the choices are about the simple playable games to get fun and spend time easily.

"According to the International Game Developers Association, the casual games are applications addressed to consumers in general, that is, for those who are not gamers. This definition applies to Facebook users, as most of them are not hardcore players. In general, these kinds of games demonstrate simple gameplay; they are easy to play, consume little time from five to twenty minutes, and they focus on entertaining and casualness." (Omori & Felinto 2012, p 2)

From my point of view, the answer to the "Who are the casual players exactly?" question is that everyone playing games but not specializes in a single game, concept or platform. In my opinion, the most significant difference between the gamer and the casual gamer is casual gamers are spending less time on a single game in a single session rather than a gamer. For example, a gamer profile can play a single game for more than hours in one session but casual players can spend fewer hours on a single game and might leave the game. For sum up, casual gamers are spending less time on a single game in a single session and they can play any game no matter age, gender, lifestyle or concept of the game.

Without those discriminations, casual gamers expectation from games is much lower than the core gamers like video game players. For example, a simple movement or simple puzzle can be enough to be a playable game for casual players. According to my general observations, casual gamers are more likely to play games that have less complexity and simplified games. The replayability of the game is always a factor for casual gamers to continue playing the same game after a single session. Bartle's player profiles still exist for casual gamers as they are behavioral types. Based on my observation, I can say that most of the casual gamers fall into the category of Socializer's profile because they are usually playing games on platforms like mobile or

social platforms such as Facebook. As for the last of my observations about casual gamer profile is that they consume games faster they require an easy learning curve, and games with easy to learn but hard to master concept which can be learnable in short time but requires more time to become better in the game.

For summarizing up the whole of my observations and researches about casual player profile, the requirements are simple, basic controlled, high replayability and easy to learn games. With those requirements, I have designed Xcube for casual players in mobile platforms as simple, basic controlled, high replayability and easy to learn but hard to master game.

2.12 ANALYTICS IN MOBILE GAMES

In this thesis as we are in search of if Xcube is being fun and the mass analytics data's of the game has significant importance because it was designed for mobile platforms. In mobile platforms, as commercial requirements we are looking for analytical datas to understand if the game is successful or not. We need to comprehend the basics of the mobile Analytic Datas for understanding the success of the game. Commercial success may not directly shows if it's fun or not but it gives an idea about if the game is fun or not. As games are mostly played for amusement and fun then the success of the game is depending on it. There is too many mobile analytic tracking tools to get the data. In Xcube, we used Firebase, Apple Analytical Data and Unity Analytics. The data's in the conclusion part is the average of all these tracking tools.

In mobile analytic data, first of all we are looking for the data called "Retention". *"Retention rate—How many of your users return after their first visit? This can be measured by the DAU/MAU calculation described above. Retention rate is also synonymous with the 'stickiness' of your game."*(Fields, T. & Cotton B., 2011, p. 64) Fields explained what the retention is in his own words very clearly. Retention is a metric in analytics that shows us even if the player return to game after the first visit, it may refer to that the players love the game so that they opened it again for playing it.

"Predicting and improving player retention is crucial to the success of mobile Free-to-Play games." (Drachen A. 2018, p. 23) Like Drachen said, retention is one of the main metric that gives the information about if the game is successful or not. Retention is looked for RD1,RD7,RD30 which is the refers to if same players open the game again. In first day, after they installed is called Day 1 Retention (RD1). After a week in 7th day if they opened it again called Day 7 Retention (RD7) and if they played it until day 30 is called Day 30 Retention (RD30). As retention time extends, the more game becomes successful. For long term designed games retention can be Day 90, Day 360 etc. But for games like Xcube, in the designing process, game designer's aim is to let user play it for 30 days, because of that in the conclusion part I will share the average data from analytics tools as retention to understand if its successful or not.

According to the common knowledge in the mobile industry, above RD1 %30-40 retention means the game is successful. For RD7, the common success is called around %20 and for RD30, if it is above %5 it is called successful. As the casual players and the mobile industry is consuming the games too fast, the lifetime gets lower. It is also because the crowd market keeping the %30-40 of the users in the first days is count as successful.

In my opinion there is more metrics that can show if the game is successful and fun beside the retention which is the main one. As for me the second important metric for if the game is being fun or not after the retention can be Daily User Average Engagement (DAUE). DAUE shows the time that players spend in the game. If the game is funny, DAUE increases due to players are playing the game more than usual.

"Engagement in mobile technology and its ubiquitous service drives value and satisfaction which can lead to future loyal users."(Kim, Y. H., Kim, D. J., & Wachter, K. 2013, p. 361) Also the DAUE shows how the players are satisfied from the game and it may refer how they get fun out of the game. In addition to DAUE, another metric called session length which shows us how long time did player spend while playing just once they opened the game, DAUE and session length might considered differently than each other.

I will focus on DAUE instead of one session length in this thesis because of understanding the fun, players may open the same game more than one time a day but we had to look it's overview as DAUE to understand if they love the game or not which may refer to the game is successful or not. In to the common industry knowledge DAUE count as successful when it's more than 4-5 minutes in average. To give information about other data's which I will mention later in the conclusion part, LTV is Life Time Value that shows the commercial or monetization success of the game, DAU is Daily active users, MAU is monthly active users and generally download numbers will matter in the conclusion.

As this thesis is focusing over if the Xcube is fun or not as COOC elements, I will focus over the retention and Daily Average user engagement to understand if the players loved the game and they returns to play it and average time that they spend in the game. If players didn't like the game they will not open it again or they don't spend time in the game. So that if we look into retention and DAUE metrics of the Xcube, it can give us the information if the game is successful and generates fun or not. In addition to the survey and player feedbacks, in the conclusion part I will explain and inform about the first month data of the Xcube after it released in mobile platforms to understand if it generates fun for the mass audience.

3. GAME THEORY: “CREATING ORDER OUT OF CHAOS” IN PUZZLE GAMES

As I explained chaos and order equation briefly in the definition of COOC in Terminology and Definitions, chaos is a state that takes place problem as a game mechanic and order becomes the solution as game mechanics. The chaotic states always require a complex or unstable situation with unknown and random uncertainty so that in many games chaos states comes to the player as ongoing problem and players are always feeling the requirement to solve the chaos in order to settle the order to the game as the solution. I believe it was also supported with the instinct of human nature as its a field in psychology and primitive human instinct.

The COOC theory mostly takes place in puzzle games because all of the puzzle genre is mostly based on problem-solving and it turns into mechanics very easily. For giving an example about how chaos takes place in the games as mechanics, let's look at the Candy Crush when candies dropps on the field, the chaos is given to the player and much as player match three candies, the player is restore the order to the game field. In that example, giving player a field full of complex candies becomes the chaotic state's mechanic and the match three is the mechanic of restoring the order. In my point of view there is more than one chaos and order mechanics in games I will explain those more in the next part.

While designing Xcube I have used chaos and order mechanic solutions in the game to increase the fun and addictiveness of the game. From my observations on puzzle games that using this theory mostly becomes successful as also we can notice from public awareness of those games. And in this thesis, I will define those chaos and order mechanics and we are in search of if they really generate fun and made them successful due to finding it we will examine the games that have success which I thought they use COOC and how I used it in the design of Xcube and at the end of the thesis we will make questionnaire and look for the analytic data if those really created fun or not.

3.1 CHAOS AND ORDER AS MECHANICS

While I was examining how did COOC take place as a mechanic in games, I defined two chaos generation models from my observations;

- i. *Game Determined Chaos:* In this chaos generation model, the game gives the chaotic state to the player without their control and requests from player to solve the chaotic state with game rules. For example, Candy Crush fills the area with candies in the field and creates a chaotic state. I can say that most of the game determined chaos models are designed as puzzle level design instead of rule design.
- ii. *Player Determined Chaos:* In player determined chaos model, chaos is generated by the game but given to the player, the player has a choice to create chaos as their decision and can able to solve the problem from the beginning. But as contrast in this model, players are creating their own chaos to solve. For example, In Tetris game has a rule set to give the player choices to place the blocks. As much as they place the blocks player is creating their own chaos to solve as a loop. Most of this player determined chaos model is designed as rule design instead of level design.

Both of these mechanic models are used as a variety of ways such as limitation, goals etc. in COOC based puzzle games. Both of the chaos mechanic models have their own ways of order and chaos, with every gameplay both of them point different abilities of the user.

From my observations, as order solutions for both chaos models, GDC kind of mechanic is mostly based on players attention for problem-solving ability. For example in Candy Crush, the complicated field of candies given to the player and player needs to find the solution by giving attention and finding the best match for them. While searching for the best match they also need to focus on the limitations and possible bomb combinations that they have a very low chance to get matched. As much as

players match objects, the objects get destroyed and with that player sets the order for a moment. But after that, game generates more candy so the chaos is unending but the level is ending by reaching the goals by player. That's why as this kind of model GDC never ending, it's based on players ability of attention to find the best possible match and accomplish the level.

For order solution model for PDC is based on players ability for making decisions. For Player Determined chaos mechanics order setting player must make the best decision to set the chaos as minimum as possible from the beginning. For example in Tetris, when the player starts placing the objects as much as they place correctly by making placement decisions, the chaos is starting getting solved from the beginning. When players make lines from the blocks by deciding when they make lines from different shapes order is settled and lined blocks will disappear. So chaos and order comes in the same decision in PDCs.

For a sum up to both Game Determined Chaos and Player Determined Chaos and order solutions:

GDC: Game determined chaos model mostly based over puzzle level design structure and depending on players attention and ability to figure out the solution.

PDC: Player Determined Chaos model based over puzzle rule design structure and depending on players ability to make correct decisions.

Even both models are designed for different play styles and different abilities of the players, both of them still creates chaos and allows players to restore order. They are still based on the same COOC psychological infrastructure.

3.1.2 Chaos and Order Game Loops Based on Mechanics

Mostly GDC and PDC have different game loops and I will define both of them below based on my observations from known games.

Game Determined Chaos Models Chaos/Order and Game Loop:

Chaos has given to player > Player figure out the solution and restore order > Chaos continues until the player reaches to level designed goal.

Game over condition is set for if the player reaches the goal of the level or not, regardless of the chaos and order equation.

Player Determined Chaos Models Chaos/Order and Game Loop:

Based on the rule set one possible object given to the player to decide placement > Player makes decision > if the object has restored order or turns into chaos object > Next object

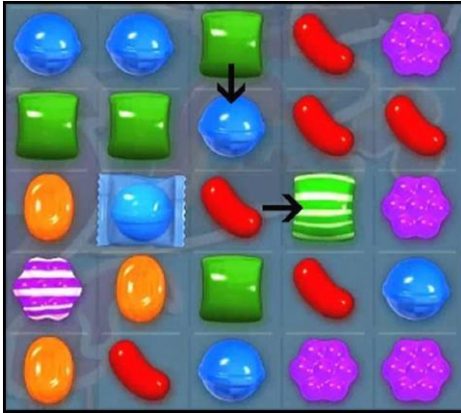
Game over condition for the PDC is based on the chaos-order equation if the player didn't decide correctly and place the objects wrongly the game field will get full of chaos objects. And when the player didn't have any place for the next object and no chance to make decisions game will be over.

3.1.3 Chaos and Order Game Controls based on Mechanics

As both models target a different kind of player abilities of the games mostly have different controls. In that point, control has significant importance to give the player an ability to restore the order and both models use different controls based on their needs.

Most common GDC model controls:

Figure 3.1: Slide Control



Slide: Sliding and switching objects with another or matching them by color or shape. Example games can be Candy Crush or Bejeweled Blitz.

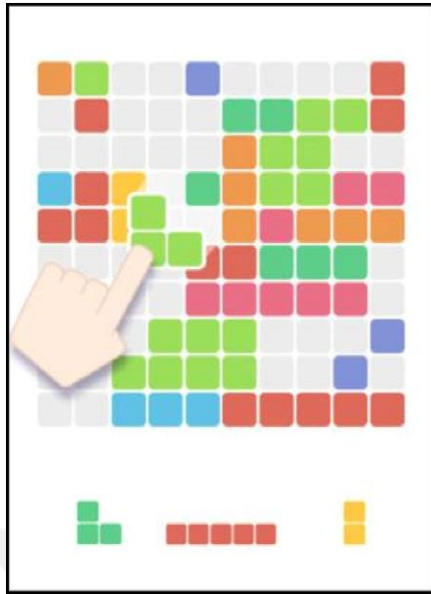
Figure 3.2: Tap Control



Source: <https://apps.apple.com/us/app/diamond-dash-gem-puzzle-game/id461402734>

Tap/Click: Clicking on the same colored or shapes objects to restore the order and destroy the objects. Example games can be Diamond Dash or Toy Blast.

Figure 3.5: Placement Control



Source: <https://play.google.com/store/apps/details?id=com.gramgames.tenten&hl=en>

Placement&Insert: Placing the objects into the field by making decisions. Example game can be 1010, Lego. (Figure 3.1.3.5)

3.1.4 Chaos and Order Based on Game Flow

As most of the games contain flow which I mentioned in the 2.4.Game Flow, every game has difficulties and player abilities. Due to my observations and examinations, I will define the flow most common requirements of GDC and PDC models.

Game Determined Chaos Flow Requirements

GDC Difficulties

- i. *Gameplay Field:* As the gameplay field gets bigger the number of matching possibilities increase and as the field gets smaller the matching possibility decreases equally. For example, in Candy Crush, if the field is 9x9, 81 ($9 \times 9 = 81$) possible objects in the area with 5 different shapes, match chance is $81/6 = \%16.2$. It increases chaos but also offers the more possible matching to the player. But if the field is $5 \times 6 = 30$ possible object in the are count is 5 different shapes, match chance is $\%6$ and increases the difficulty to get the match.

- ii. *The goal:* Since most of the GDC model is level accomplish and goal oriented, as much as the game designer makes the goal harder to reach the game difficulty increases.
- iii. *The Limitations:* Most of the GDC model games contains limitations for the player to accomplish before the limitation is over. For example in Candy Crush uses movement or time-oriented limitation. In movement oriented levels, game designer set limitation for the player to accomplish level before the limitation is over. In every correct slide or swipe in Candy Crush movement drops down per move or destroy. In time oriented levels have a time limitation to reach the goal before time runs out.
- iv. *Object variations:* When the number of possible different objects in the field increases the difficulty of the game gets harder because the matching possibility decreases. For example in 9x9= 81 object field, if the number of shape variation is 5, the minimum matching possibility is $81/5/3 = \%5.3$ and if it has 6 different variations then matching possibility will decrease into $81/6/3 = \%4.5$.
- v. *Obstacles:* Most of the GDC based games contains obstacles in the field, as much as obstacles increase the difficulty increase with it. Also, obstacles increase difficulty because they are taking place of the possible matchable objects by filling the field. In most of the games, those obstacles can be destroyable by conditions determined by game designers.

GDC Player Abilities

- i. *Object variations:* As variations of objects decrease the player ability to increase. It's vice versa of the difficulty.
- ii. *Destroying more than 3 objects creates bombs/better objects:* In many GDC based games if the player matches more than 3 objects as its better solution game gives players a better object to interact with and when the player destroys those objects they destroy more objects than it's used to be. For example, in Candy Crush matching 4 objects give vertical or horizontal bomb which destroys the horizontal or vertical lines and destroys more objects.
- iii. *Limitation:* Vice versa of the difficulty, as limitations increase the difficulty decreases.

- iv. *Powerups/Boosters:* It's not actually an ability, a monetization model but some games use serves this option as players ability.

Player Determined Chaos Flow Requirements

PDC Difficulties

- i. *Gameplay Field:* It's nearly the same in the GDC. As the field gets bigger possibility increases. For example in 1010 gameplay field is $10 \times 10 = 100$ possible space to place an object.
- ii. *Object Variations, shapes, and Space occupy:* In most of the PDC as the player decides where to place the object, shape or space occupation of the object affects the difficulty. Also, the shapes compatibility with others affects the gameplay as they need to make lines with the given shapes and ends with destroying the field occupying objects. Example a 2×2 grid occupying shapes take place in the field as 4 blocks. A 4×2 object takes place as 8 blocks and makes it difficult to compatible with next objects.
- iii. *Limitations:* Same as GDC model movement or time is given to the player. For example, in Tetris, the fall speed of the blocks is one of the limitations. As fall speed increases the time for making the correct decision decreases.

PDC Abilities

- i. *Limitation:* Vice versa of limitation in difficulty. As a time to think increases the possibility to give the right decision.
- ii. *Decision:* Giving more than one choice to the player increases the ability of the player. For example, showing three possible shapes in 1010 and giving choice to the player which to place first gives too many opportunities for the player to decide the best. But in Tetris, it has no choice for the player to choose which object will be next.
- iii. *Power-ups/Boosters:* As same as in GDC.

3.2 EXAMINING & ANALYSING METHODS FOR GAMES USING “CREATING ORDER OUT OF CHAOS”

All of the definitions and game design elements in the previous chapters will help us to examine the following games and how COOC used in those. For this matter, games will be examined with the following elements:

- i. Short Description of the game
- ii. Puzzle Design Type of the game
 - a. Level Design
 - b. Rule Design
 - c. Level & Rule Design
- iii. Game Mechanics of the game
- iv. Game Controls of the game
 - a. Accessibility
 - b. Intent Communication
 - c. Expression Space
 - d. And as player interaction controls: Slide, Tap/Click, Draw, Movement, Placement&Insert
- v. COOC Mechanics of the game
 - a. Game Determined Chaos
 - b. Player Determined Chaos
- vi. Game Flow as difficulty and player abilities in games
- vii. Fun Types of the game
 - a. Instant Fun
 - b. Conclusive Fun
 - c. Progressive Fun
- viii. Randomization Factors and affect over gameplay
- ix. Gamer type of the game's audience
- x. How did "COOC" game theory take place in the game?

In this matter, the following games with the above elements will be examined:

- i. Examining: Lego

- ii. Examining: Rubik's Cube
- iii. Examining: Tetris
- iv. Examining: Bejeweled Blitz
- v. Examining: 1010!
- vi. Examining: Toy Blast
- vii. Examining: Two Dots
- viii. Examining: Candy Crush

After examination of these elements and games at the conclusion part, we will take a look at the common points of those games and if these games really get affected by the COOC games theory or how these games take place in the COOC theory.

3.3 EXAMINING GAMES AS COOC

3.3.1 Examining: Lego

Figure 3.6: Lego



Source: <https://www.nationalforest.org/visit/events/construction-club>

3.3.1.1 Short description

Lego is a well-known toy&game brand that players are building what they imagine or try to build something from bricks since the 20th century. In most of the common knowledge, Lego is a toy, not a game. But in my point of view, Lego has its own rule structure and may also count as a game and a toy together, not a video game but a game.

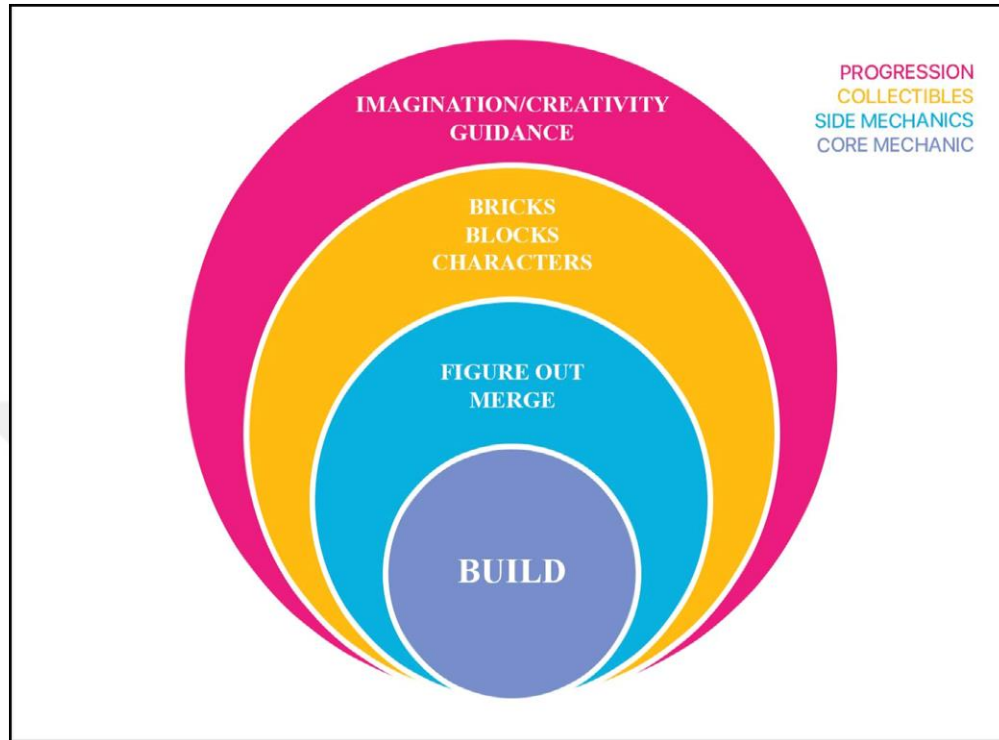
"The feature fundamental to Legos' "creativity" is, in fact, the logic of their physical coupling: individual Legos can be reconfigured in many different ways to create new objects or systems, according to simple rules of assembly." (Bogost 2007, p 256) In that point Lego's rules are the brick types, as brick types only match with other types it puts a rule for the user. The upside of the Lego brick will always merge with the downside, so that it simply puts a rule to the player by giving bricks and sometimes it also gives user a guidance to build a puzzle in that point Lego turns into a game with a toy. Lego has too many different gameplay types, but in this thesis I will focus for one Lego box that has guidance to build and can be studied as a game and I will examine game elements of it. Lego can also be count as build up game but may also turn into the puzzle too, due to the subject of this thesis I will examine lego as puzzle game. In my point of view, with an unlimited number of possibilities and uncertainty, it shows similarity with the chaos requirements and may contain COOC.

3.3.1.2 Puzzle design type

As puzzle design type of Lego is rule design, it certainly explains how to play with it, set the rules of play and leave the user with its own creativity. Regardless of main rule design, if Lego has guidance to build a certain thing then level design also may count as a puzzle design type.

3.3.1.3 Game mechanics

Figure 3.7: Lego Mechanics Diagram



3.3.1.4 Game controls

Because Lego is also a toy still it contains the game controls, from three UX principles of Dotsenko. (2017)

Lego contains accessibility, by having easy to learn and compatible with human physical and cognitive limitations. *Lego contains intent communication*, by communicating the player's intent in a way the player expects and create a feeling of full control. *Lego does not contain expression space* because it doesn't have any UI or video game limitations.

In addition to the UX properties, Lego's main control is based over Placement&Insert.

3.3.1.5 Cooc mechanics

As Lego's COOC mechanics are depending on player determined chaos model, as much as player tries to put the block/bricks they might make mistake and that might continue so repetitively players puts themselves into chaos until the imagined or guided build is over. As much as player figures out the true placement for the Lego they start restoring order by correct building.

3.3.1.6 Game flow and challenge

Lego's difficulty is coming from the complexity of the bricks and to build the guided or imagined structure. Players ability is based on their imagination and ability to build. There might be far more difficulties or abilities depending on the other possible Lego types but for this thesis I'm just focusing on those.

3.3.1.7 Fun types

As mentioned in 2.8 Definition of Fun, I separated fun into 3 types and Lego contains two of them.

First is *instant fun* which is coming from every correct combination and imagination players gets enjoyment. Second is *conclusive fun* which comes when the building structure is over the pleasure of completing the goal and ego gratification from restoring order and building the structure.

3.3.1.8 Randomization factors and affect over gameplay

As Lego's main mechanics are depending on the complexity and uncertainty, definitely Lego is built over the randomization and it created the fun of it.

3.3.1.9 Target audience and play styles

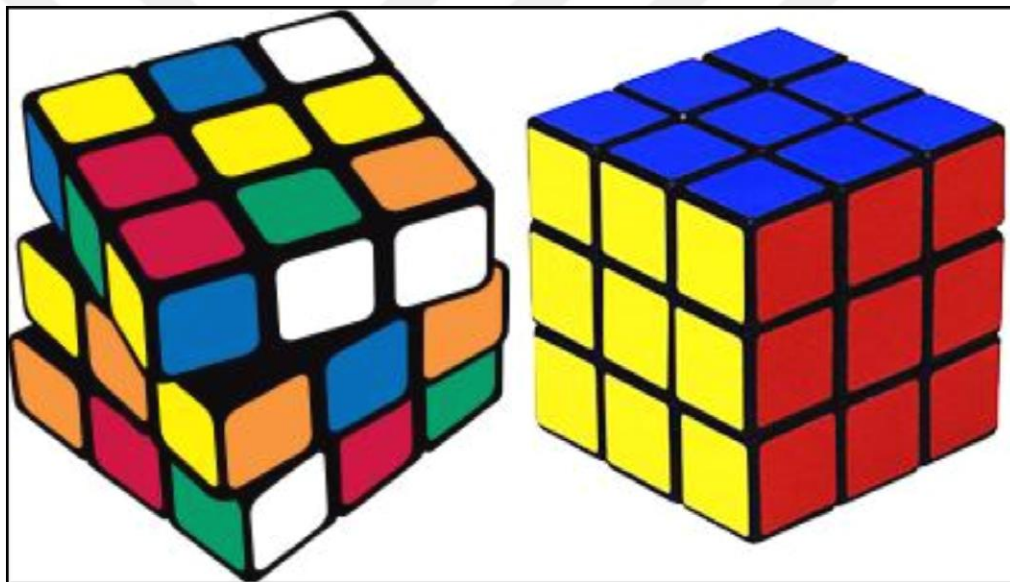
Lego is a casual player game and have no focus of age or gender. In my point of view Lego's audience gamer types can be achievers and explorers. Achievers are focusing to build things correct or perfectly and explorers are getting fun out of imagination and possible other combinations.

3.3.1.10 Cooc game theory

According to me as Lego based on separate uncertain and complex structure it certainly fulfil the requirements of the chaos and shows similarities with it. When players are building the structures from blocks or bricks they are started restoring order and shows similarities with the requirements of order. So that we can say Lego fulfills the requirements of the COOC and it may be affected by the psychological factors of the theory and increase the fun factor in the game.

3.3.2 Examining: Rubik's Cube

Figure 3.8: Rubik's Cube



Source: <https://www.rubiks.com/>

3.3.2.1 Short description

Rubik's Cube is a 3D combination puzzle invented in 1974 by Ernest Rubik. Rubik's Cube is actually a toy like in Lego example but in my point of as Rubik's Cube also contains rule of play it also makes it game. Rubik's cube has six colored sides and they are in same color over one face. When players starts shuffling the cube, the puzzle begins and players aim is to settle the cube back to the first six color sides by rotating, sliding and movement as it was shown on the (Figure 3.3.2.1) above. In his online Article on Gamasutra Ernest Adams said:

"Rubik's Cube is a classic look-ahead puzzle: every move changes not just one, but eight 'sub-cubes' (the one in the center of the face that is turning is unaffected -- it only rotates in place). The classic sliding-tile puzzle is another, though not nearly as difficult as Rubik's Cube: moving one tile enables up to three other tiles to move into the gap it left, but no others." (Adams 2003)

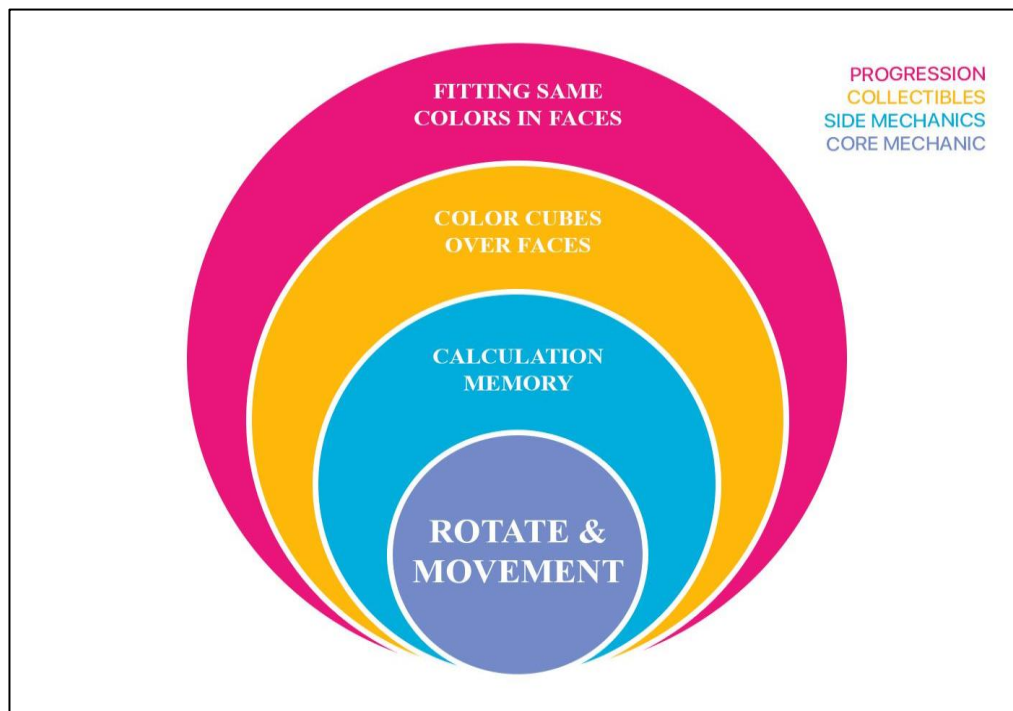
As much as player tries to solve the puzzle until they figure out clear solution, In my point of view Rubik's Cube starts generating chaos. And player's goal is to restore the order in the colored sides. In addition to the description, Rubik's Cube has significant important for this thesis due to it's one of the essentials used in the design of the Xcube.

3.3.2.2 Puzzle design type

We can say that puzzle type of Rubik's Cube is rule design. Game simply gives the rules of play to the player and leaves the player to figure out the solution. As it was a single toy, there is no possibility to contain as puzzle type Level Design. From his own words, *"The other type of puzzle design is rule design: inventing the overall rules, goal, and format of a puzzle. For example, Ern. Rubik was a rule designer when he invented Rubik's Cube." (Fullerton, 2014, p.42)*

3.3.2.3 Game mechanics

Figure 3.9: Rubik's Cube Mechanics Diagram



3.3.2.4 Game controls

As Rubik's Cube is also a toy it still contains the game controls, from three UX principles of Dotsenko;

Rubik's cube contains *accessibility* as it easy to learn and use and fits with the human physical and cognitive limitations. But in my point of view as nature of the Rubik's Cube it pushes the cognitive limitations with memory and physical correlation.

Rubik's Cube does not contain *intent communication* as it was based on their mechanics and gameplay it shouldn't give the intent communication and does not feel to the player the full of control.

Rubik's cube also does not contain *expression space* to the user as it was toy.

In addition to the UX properties, Rubik's cube main control is based over slide, rotate/movement.

3.3.2.5 Cooc mechanics

Rubik's cube COOC mechanics are also based on PDC. As players actions enable the chaos to continue until it was fully solved and the goal of the user is to restore the color order in the cube.

3.3.2.6 Game flow and challenge

I may not say Rubik's Cube contains game flow, but it contains difficulties and player abilities. As much as player shuffles or rotates pieces of the cube or while trying to solve the puzzle might increase the difficulty or allow player to solve the cube. Players cognition skills are the basic abilities of the player.

3.3.2.7 Fun types

Rubik's cube contains two fun types I mentioned before, the first is instant fun, while playing the game figuring out the solution and started setting colors over the faces the game generates enjoyment. The second is conclusive fun, when the cube is restored it gives the user pleasure from completing and ego gratification increases.

3.3.2.8 Randomization factors and affect over gameplay

As Rubik's Cube only contains determined number of cubes, it still has too many possibilities that calculated by mathematicians it has 519 quintillion permutations makes it difficult to calculate.

As it can be calculated we can't call it contains randomization with fullfil of the definition but it's still makes it unpredictable for the players as of human cognitive limitations. In this case Rubik's cube creates different kind of affect it gives the feeling of being calculable but makes it too difficult to be predictable creates its own unique case which has been a subject to many scientific thesis or researches.

3.3.2.9 Target audience and play styles

Gamer type of the Rubik's Cube is casual players from no range of age or gender. And clearly Rubik's cube player audience is achievers due to game only has one option that is to achieve the goal.

3.3.2.10 Cooc game theory

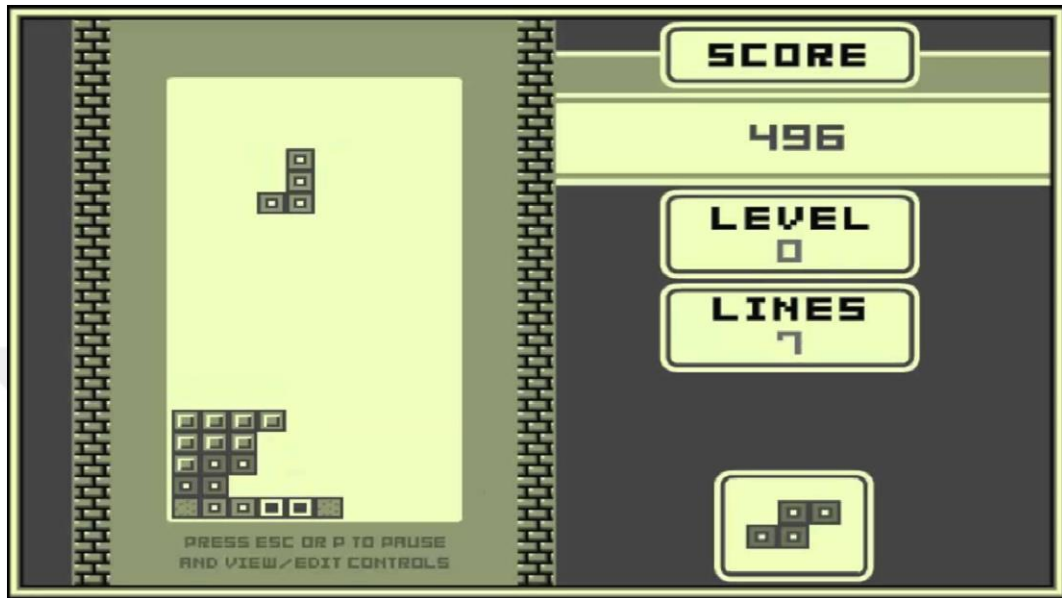
I would say Rubik's Cube enables players to create the chaos requirements as much as they play the game can get into the chaotic state as uncertain, unpredictable and increases complexity. But as calculable state it gets out of the chaos. But from the players perspective it still preserve the aspects of the chaos and the aim of the player is to restore the order in the cube, which fits the basic definition of creating order out of chaos. It can be very debatable if it's COOC or not, but at the end the goal of the game is to restore order over the cube from complex state still makes it able to be COOC.

In addition to those from my observations as game designer perspective, I want to add that, Rubik's Cube feels the user that chaos can be endless if the player didn't have ability to solve in time, game comes into anxiety state as feeling and the feeling of chaos might not end makes players leave the game/toy by making it frustrating as it becomes too challenging and complex.

3.3.3 Examining: Tetris

3.3.3.1 Short description

Figure 3.10: Tetris



Source: <https://www.vrplayer.fr/playstation-vr-test-tetris-effect/tetris-effect-psvr-vr4player-img020/>

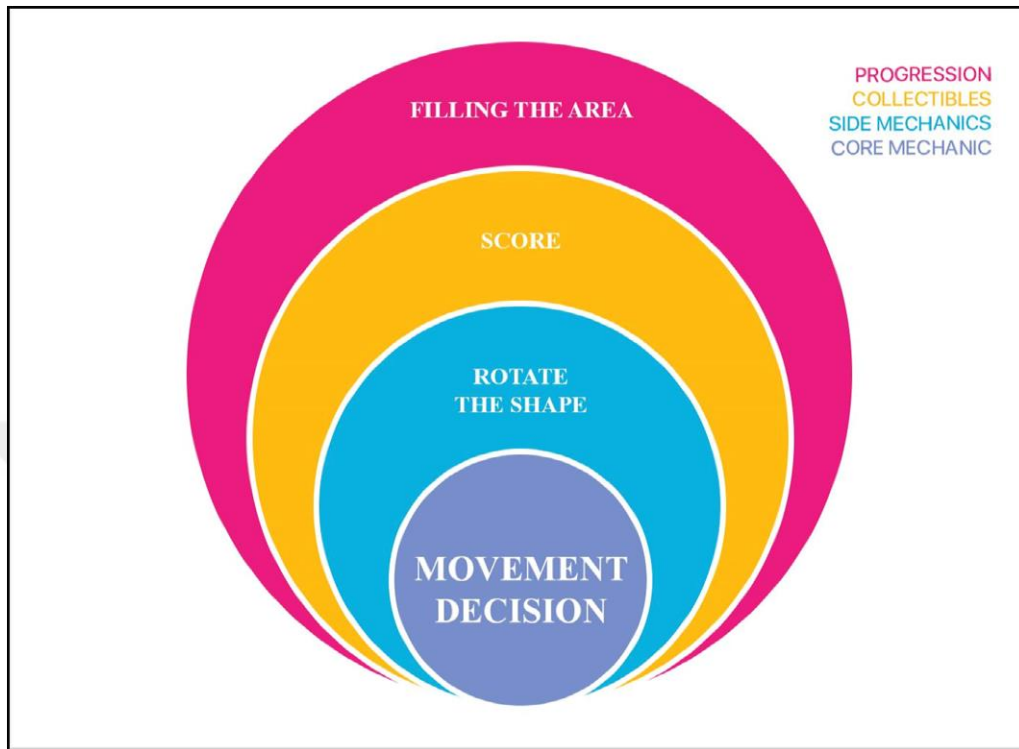
Tetris is a tile or block matching puzzle video game originally designed and programmed by Alexey Pajitnov in 1984. Tetris is a most selling video game of all times and very well-known game. Basically it's about arranging the given block to create a line and the line will get destroyed. One of the important points I want to mention in Tetris is it gives shapes one by one and just telling the player what the next shape will be so player can arrange the placement while thinking of next incoming shape. Tetris has a significant importance for this thesis one of the most important essentials of Xcube and many other games.

3.3.3.2 Puzzle design type

Tetris is definitely designed by the rule design. The rules of the play determined by the game and player plays the game until the game is over fulfilling the area with wrong blocks and there isn't any level design set for the game.

3.3.3.3 Game mechanics

Figure 3.11: Tetris Mechanics Diagram



3.3.3.4 Game controls

Tetris contains whole of the UX requirements as Accessibility, Intent Communication and Expression Space. The main control of the Tetris is movement.

3.3.3.5 Cooc mechanics

Tetris uses Player Determined Chaos model, which only gives user the defined blocks and with that blocks players are creating their own chaos and also players aim is to clear up their chaos by aligning the blocks to make the line and restoring order.

3.3.3.6 Game flow and challenge

Tetris contains game flow as PDT chaos model. Even if it's a infinite single game, it has its own flow by speeding up the block falling and making it harder for the player to decide faster.

"The most basic rule system of game mechanics is the constant challenge of the player and his avatar: the game presents the player with a clear challenge (Tetris: falling rocks and overflowing containers) and offers opportunities to solve the problem (Tetris: moving and turning the stones). Subsequently, the game evaluates the decision of the player: 'right' decisions are rewarded (Tetris: a line disappears, positive sound, points, longer playing) and wrong decisions are punished (Tetris: blocked situation, gloomy sounds, exclusion from the game). Perfectly challenged, with dosed punishment and well rewarded, the player cruises or floats through the game." (Suter 2018, p 24)

In his own book Suter (2018) mentioned that Tetris contains game flow as it challenges player and gives opportunity to solve them. In addition to Sutter I want to add that Tetris contains linear game flow that exponentially raises with the score of the player and even its challenging and repetitive it still gives player a fun and it's a nice example for linear game flow that creates fun out of it. For difficulties, the ability of the user determines the difficulty of the game by player deciding where to put the blocks and that's one of the important points that make Tetris unique. In addition by increasing the speed of the falling block is a one of the difficulties in flow. And player abilities are limited by deciding, rotating the objects and movement. In my point of view as player increase its own challenge, the flow of the Tetris works fine.

3.3.3.7 Fun types

Tetris contains Instant fun by making lines and getting scores from destroying the lines. Also in some point players are able to destroy more than one lines which I think creates the conclusive fun by satisfying the player in gameplay and in addition to that giving new high score or the score Tetris still creates conclusive fun by pleasure and ego gratification. It may contain progressive fun by having a game flow and high score goal. In every play, players' tries to get higher score so that it creates progression.

3.3.3.8 Randomization factors and affect over gameplay

Tetris contains controlled randomization, that shapes are defined by rules and gives them randomly to the player by one by one. The Importance here is Tetris giving shapes one by one and informs the player with the next incoming shape is very helpful for player to decide the current shape's place. The randomization and players own determined randomization by placing the shapes Tetris creates great randomization by making it unpredictable affected the game play by increasing the fun factor of the game.

3.3.3.9 Target audience and play styles

Tetris audience is also casual players without age or gender priority and it's gamers type is also achievers by always trying the reach the high score and game doesn't enable any other player types to participate.

3.3.3.10 Cooc game theory

Tetris is a great example for the theory of Creating Order Out of Chaos as it allows player to create and solve their own chaos. In Tetris wrong decisions while deciding the placement of the blocks means player starts creating chaos state and with wrong decisions it continues and with randomization it becomes unpredictable and uncertain. And by aligning blocks correctly, making horizontal or vertical lines it cleans up the blocks and opens space for the new shapes by restoring the order to the game. On the contrary game never ends even if player cleans whole the gameplay area, it needs to fill with the whole area by blocks which means chaos as game theory, the end comes with the chaos and in my point of view it triggers the instincts of the players more than other games. As much as player fails to restore the ending order they still get fun out of the game by cleaning up the tiles and restoring order. For COOC game theory Tetris is a great example for the creating order out of chaos as it ends with chaos but players always gets fun out of restoring the order.

3.3.4 Examining: Bejeweled Blitz

3.3.4.1 Short description

Figure 3.12: Bejeweled Blitz



Bejeweled Blitz is the one of the popular modern games coming with the social platforms. In previous examinations all of those games are designed before 2000's and Bejeweled is designed in 2010 and published by PopCap games. In Bejeweled Blitz as you can see from the above (Figure 3.3.4.1) game gives player a field of jewels to destroy, by matching three same colored or shaped object together by sliding the shape into the similar shapes the matched jewels will get destroyed. As much as player destroys the new shapes come from above, players get new score and can able to make combos with matching more than three shapes in single movement. The aim of the game is to get raise the high score.

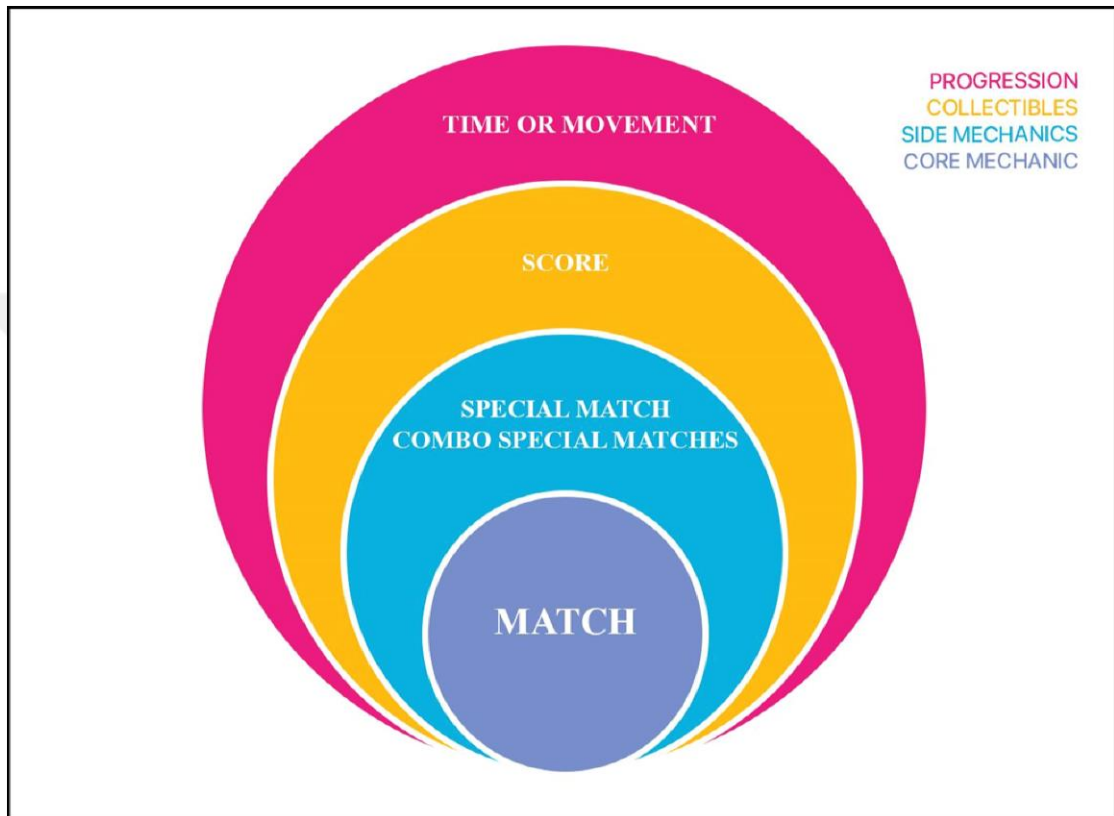
3.3.4.2 Puzzle design type

"However, many games are based on simple puzzle concepts, and their entire game structure depends on that puzzle. Games such as Tetris, Bejeweled , and other similar games have come to be known as puzzle games."(Perry 2009, p 628) In his book David

Perry mentioned BBZ as puzzle. BBZ is a rule designed puzzle game that gives the play rules to the player does not contain any levels.

3.3.4.3 Game mechanics

Figure 3.13: Bejeweled Blitz Mechanics Diagram



3.3.4.4 Game controls

As UX BBZ contains accessibility by easy to learn and compatible with the human requirements. It also contains intent communication that gives player a full control over as their intention to do. It contains expression space but in my point of view making the background transparent makes it a bit harder to understand narrows the expression space. As main control of the BBZ is slide.

3.3.4.5 Cooc mechanics

Bejeweled Blitz contains Game Determined Chaos Model that the game gives the player the chaos itself and requests to solve it. When the game begins the objects/jewels drop down from the above of the field and player search for a solution to match and

destroy the objects to restore the order. As much as player solves by matching, game continues generating new objects from above and chaos continues.

3.3.4.6 Game flow and challenges

As Bejeweled Blitz is not a level designed game it's hard to figure out the flow of it but the beginning of the game is always the hardest part because the player has time limitation and needs to find the fastest match, as much as they match the new possibilities always comes with the chance to create better special gems themselves and increases the ability of player to destroy. Abilities of the player is based on their attention and figure out the best possible match.

3.3.4.7 Fun types

BBZ contains instant fun by matching the objects and destroying or making better special objects. And It has conclusive fun which comes at the end of the game. BBZ may contain progressive fun by making high scores as Tetris or passing friends in the Facebook version may create ego gratification and pleasure. Also in the end of the chapter if player left some special chips game enters a special scene just before the game over and explodes those left over special chips and creates very high scores to the player if they are successful in the play with that I believe it creates very impressive moment for the players and players may want to repeat the gameplay due to that last moment special scene.

3.3.4.8 Randomization factors and affect over gameplay

BBZ is uses controlled randomization which always played on 8x8 grid and only playable with defined six type of color and shapes objects. Its limitations are 8x8 and six variety of object it creates the controlled, but which object comes next is totally random and it makes the gameplay random. With random effect, it sometimes work for the player and objects gets destroyed by themselves by chance and in that moment I believe it feels the player a moment of feeling being luck and increases the fun factor. If we take randomization out of BBZ the game will lost huge amount of fun by making it linear and the games main mechanic finding the possible solution will disappear and

game structure will be broken. So that we can say one of the most important BBZ fun factors is based on the randomization.

3.3.4.9 Target audience and play styles

BBZ's audience is casual player in the social platforms and recently in mobile platforms. As it's based on reaching the high score, BBZ gamer type is achiever but in addition to achiever BBZ also contains socializers that in the Facebook they are able to see their friends and compete with them. In my opinion BBZ players are always contain both achievers and socializers due to game makes players compete with each other with high scores.

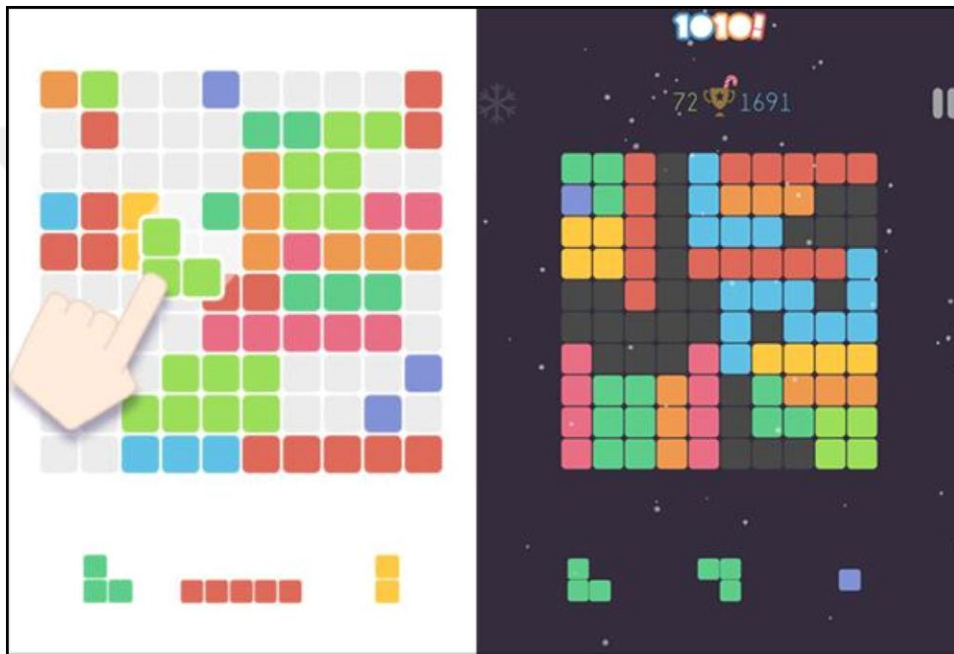
3.3.4.10 Cooc game theory

As game's one of the most important fun factors based on randomization it gives the game unpredictability and unstable which has similarity with the requirements of the chaos. At the beginning of the game, it gives the chaotic state to the player for to solve it. As much as player matches the objects they are getting the feeling of solving the problem and restoring order, even with biggest explosions to the objects by specials it gives more of the feeling of being restored order. As one of the chaos state features, it continues creating chaos to the player by dropping down new objectives as much as they solved. In the end of the game chaos actually doesn't end, in the instant fun moment player get the amusement from restoring order by matching the objects. BBZ contains timer for the player needs to score more in limited time. In my point of view the COOC combines with the stress pressure and gives the player feeling of being in chaotic state more intensively and creates more fun out of the situation.

3.3.5 Examining: 1010!

3.3.5.1 Short Description

Figure 3.14: 1010!



Source: <https://apps.apple.com/us/app/1010-block-puzzle-game/id911793120>

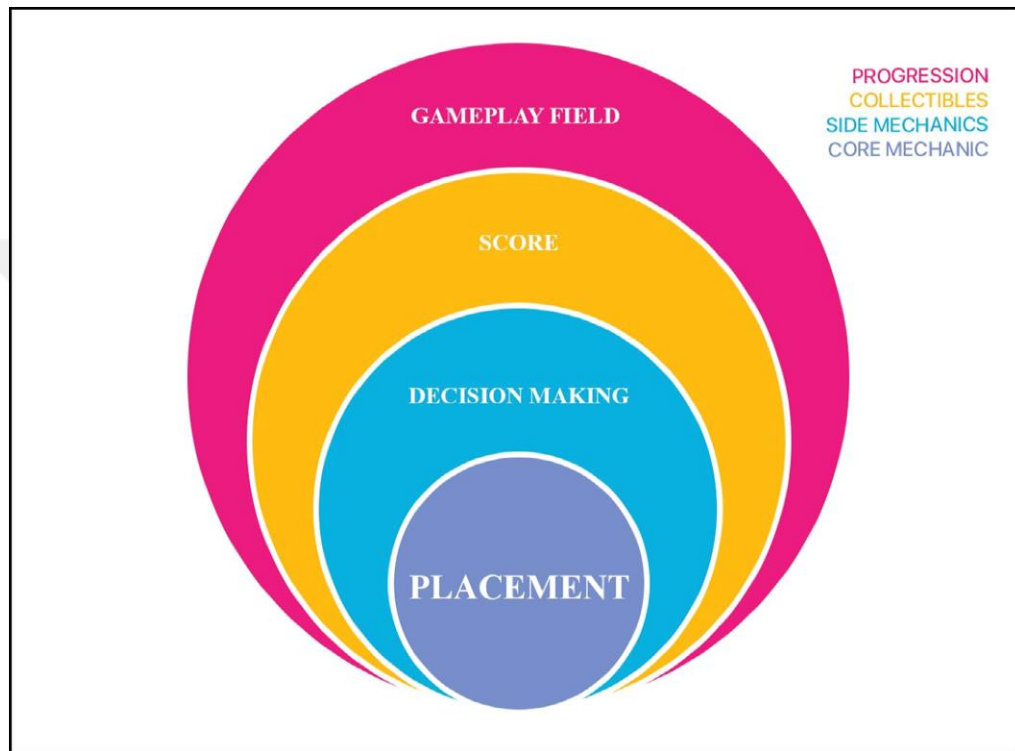
1010! is a mobile puzzle game that made a hit and become known brand designed and published by Gram Games in 2014. The game gives player a 10x10 grid space and requests from player to place the given blocks into the grid. When blocks comes together and makes line, the line gets destroyed and opens space for new blocks/shapes. The game gives player three shapes simultaneously and after player places the all three shape it gives another new three shape without informing the player with what comes next. The game continues until the area is filled with objects and there is no space left to place the new shape/block. Player's goal is to achieve new highest score.

3.3.5.2 Puzzle design type

1010! Has Rule design type of puzzle game. Game determined the rules for the player and leaves the player with it, it doesn't contain any level design elements.

3.3.5.3 Game mechanics

Figure 3.15: 1010! Mechanics Diagram



3.3.5.4 Game controls

As UX 1010! contains accessibility by easy to learn and compatible with the human requirements. It also contains intent communication that gives player a full control over as their intention to do. It has well designed expression space that even 10x10 Grid it gives the user the feeling of expression space and relaxes the player by lowering the variety of elements in the area. Main control of the game is placement.

3.3.5.5 Cooc mechanics

1010! contains Player Determined Chaos model which sets the rule for the user and user creates its own chaos by making decisions and placing the shapes/blocks. When players destroy the lines by placing the blocks/shapes they simply restore order to the field. As

it was in the previous games the game is over when player cannot able to restore the order or left over the possibility of restoring the chaos.

3.3.5.6 Game flow and challenges

In my opinion 1010! doesn't have any game flow but it generates fun with difficulty and ability of the player. Difficulties are the players wrong placements and ability of the player is to decide which shape to place first, game gives three shapes randomly simultaneously so that player always has priority to decide the chance factor. As in Tetris game has linear flow that exponentially raises and creates for challenge to the player, in contrary 1010! does not include any increase or decrease flow, in my opinion it makes the game a bit repetitive with lack of challenge but also creates a chill moment and relaxing game for the players.

3.3.5.7 Fun types

1010! has Instant fun factors as players get enjoyment by destroying lines and contains conclusive fun by getting new high score at the end of the game. As in the Tetris example I may not say it contains progressive fun but high score may count as progressive fun too.

3.3.5.8 Randomization factors and affect over gameplay

1010! contains controlled randomization that it gives limited number of shapes at the same time but totally with random possibilities. Every time it gives a new shapes, player has feeling of always has chance to survive and this makes it more fun. In Tetris, it informs players for the next incoming object and player have no choice to decide, In 1010! even its random player has chance to decide which to use first and in my point of view it makes it more strategic and makes decision making more meaningful. With the chance to make decision for which shape to place first and having opportunity to survive the game at the end 1010! Generates fun with it.

3.3.5.9 Target audience and play styles

As same as the other games, 1010! also has casual audience from range of players. 1010!'s gamer profile is also achievers that only goal in the game is to reach the highest score.

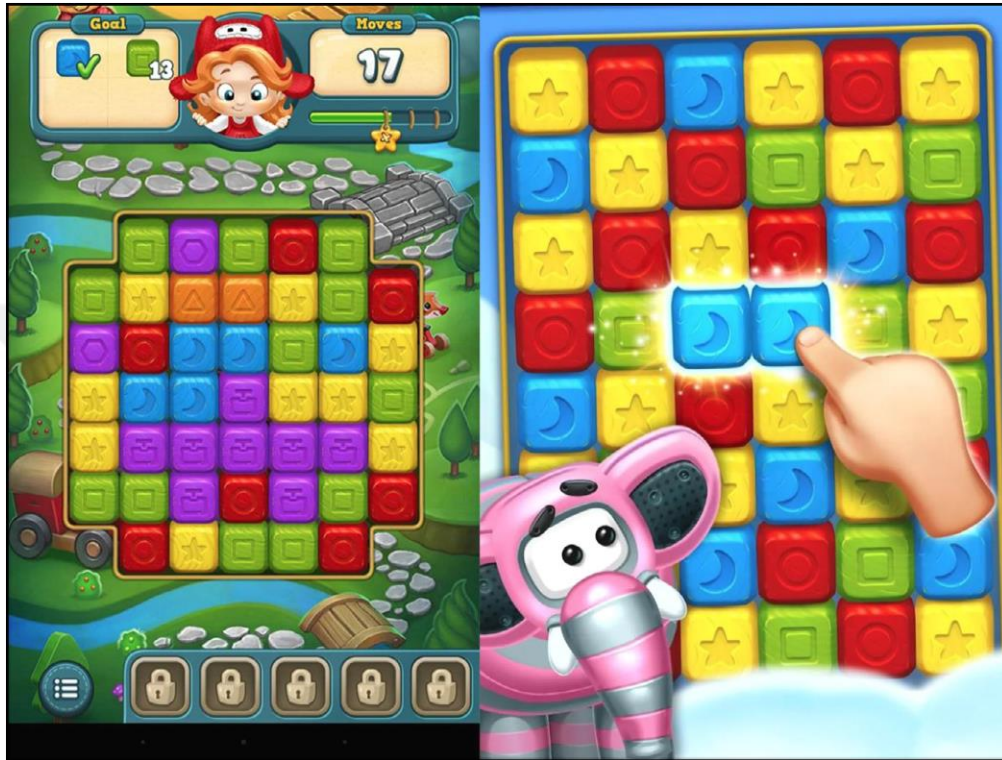
3.3.5.10 "COOC" Game Theory

By giving random shapes and the placement over the field is decided by the player without knowing the next incoming shapes game fills the requirements of the chaos as uncertainty and unlimited possibilities. As much as player places the objects chaos beings and continues with randomness. And as much as player makes lines and cleans up the field, it generates the feeling of restoring order out of chaos. As the requirement of the chaos it also continues generating chaos by player itself as same as in the Tetris. In my opinion with a factor of deciding which shape to use first and makes decision more meaningful it gives feeling of control and restoring order more intense, generates more fun out of it rather than the close likely games.

3.3.6 Examining: Toy Blast

3.3.6.1 Short description

Figure 3.16: Toy Blast



Source: <https://apps.apple.com/us/app/toy-blast/id890378044>

Toy Blast is a mobile puzzle game that made a hit and become known brand designed and published by Peek Games in 2015. Toy Blast has blocks as shown on the above (Figure 3.3.6.1). When player finds and clicks/taps to blast the two adjacent block they destroyed and new blocks comes in if player click more than three or more block game gives special blocks that has special effects and destroys more than usual. Players goal is to reach the defined number of objectives in the levels before they run out of moves. Players main goal is to reach the next levels. Toy blast has different match type than regular match-3 games, it allows players to match 2 of blocks to destroy and it easier for the players.

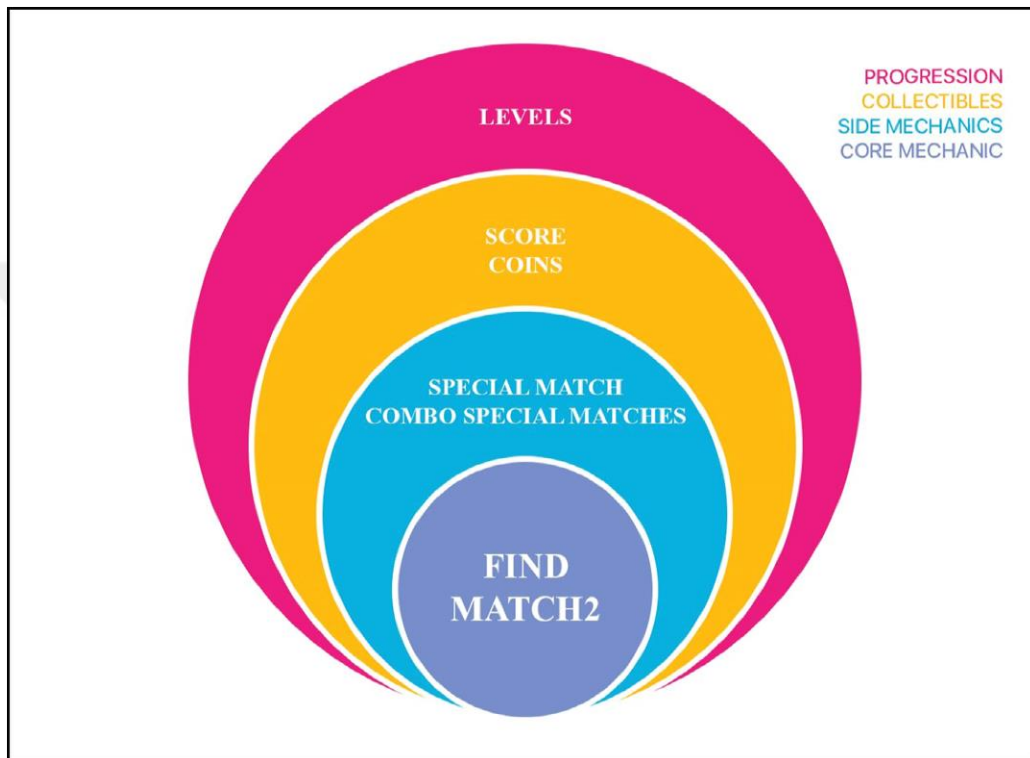
3.3.6.2 Puzzle design type

Toy Blast puzzle design type is based on Level Design which has objectives to complete in the single level without running out of limitations and contains many levels

to complete. All of the previous examinations are Rule Designed puzzles which didn't have levels to complete or without any objective.

3.3.6.3 Game mechanics

Figure 3.17: Toy Blast Mechanics Diagram



3.3.6.4 Game controls

As UX factors Toy Blast contains accessibility, intent communication and also have nice expression field even it has crowd level area it clearly designed to give right information to the players. The main control of the toy blast is tap.

3.3.6.5 Cooc mechanics

Toy Blast contains Game Determined Chaos model which generates chaos itself as much as player restores the order with the objectives of the level. As much as player destroys the blocks new ones continue coming from above which makes it unpredictable and complex about what will comes next as it was in the bejeweled blitz. BBZ is also GDC model but Toy Blast has level design puzzle type instead of rule

design and which makes it more unique in its own case. As much as player destroys/blasts the blocks they restore order in the game.

3.3.6.6 Game flow and challenges

As Toy Blast has its own levels to be solved, it contains level design based game flow which is changing difficulty in order to serve the best flow to the user. Difficulties may vary by the obstacles in the level designs and abilities of the player is based on the variety of the field and possible object variations, if objects to destroy varies decrease the more game becomes easy, if they increase difficulty increases. Also limitations like movement and objectives to reach is a difficulty factor in game.

3.3.6.7 Fun types

Toy Blast contains instant fun as creates enjoyment in every movement, It contains conclusive fun at the end of the game by reaching the goal of the level generating the pleasure and ego gratification. And also in addition to those types as game contains flow it directly generates progressive fun. The flow of the game is one of the key success factors of the game as progressive fun. Toy Blast contains all of the fun types that I mentioned in 2.7 definition of fun.

3.3.6.8 Randomization factors and affect over gameplay

In Toy Blast even levels are set for the objectives, blocks still generated by controlled randomization. With controlled randomization it creates more fun by always giving a player chance to destroy more or unluckily get struck in the level. Also the levels are starting without predefined blocks as I observed some might not but most of them are not predefined and random which makes the game more unpredictable and may improve the complexity to pass the level.

3.3.6.9 Target audience and play styles

As like other games, Toy Blast audience is casual players. Possible gamer type of the Toy Blast will be achievers because rising levels and scores, socializers that game

enable to interact with the friends through Facebook connect and players can compete with each other. As it can different objectives in each levels and reveal the obstacles and objectives one by one it may contain explorers type too.

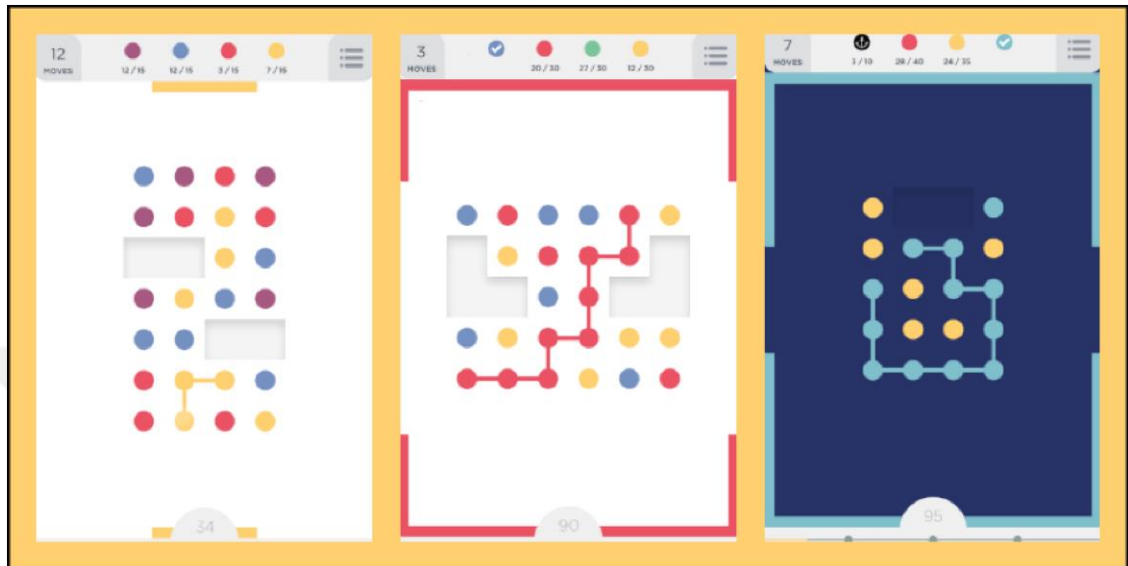
3.3.6.10 Cooc game theory

As the levels are set to the rules, the game still generates blocks by random, uncertain for the player, gameplay field got complexity and mixture of the objects that fulfil the requirements of being chaos, and when players destroy blocks they are restoring order to the field. In most of the COOC cases it keeps chaos going until the end of the game. Like in Bejeweled examination, Toy Blast also takes place in the COOC as matching game. In my point of view, In addition the previous examinations, Toy Blast has level structure and when player reaches the goal of the level as an animation the game destroys all of the blocks and gives intense feeling of restoring the order at the end of the level and encouraging players to continue the game and makes it more fun with the game flow as progressive fun.

3.3.7 Examining: Two Dots

3.3.7.1 Short description

Figure 3.18: Two Dots



Source: <https://apps.apple.com/us/app/two-dots/id880178264>

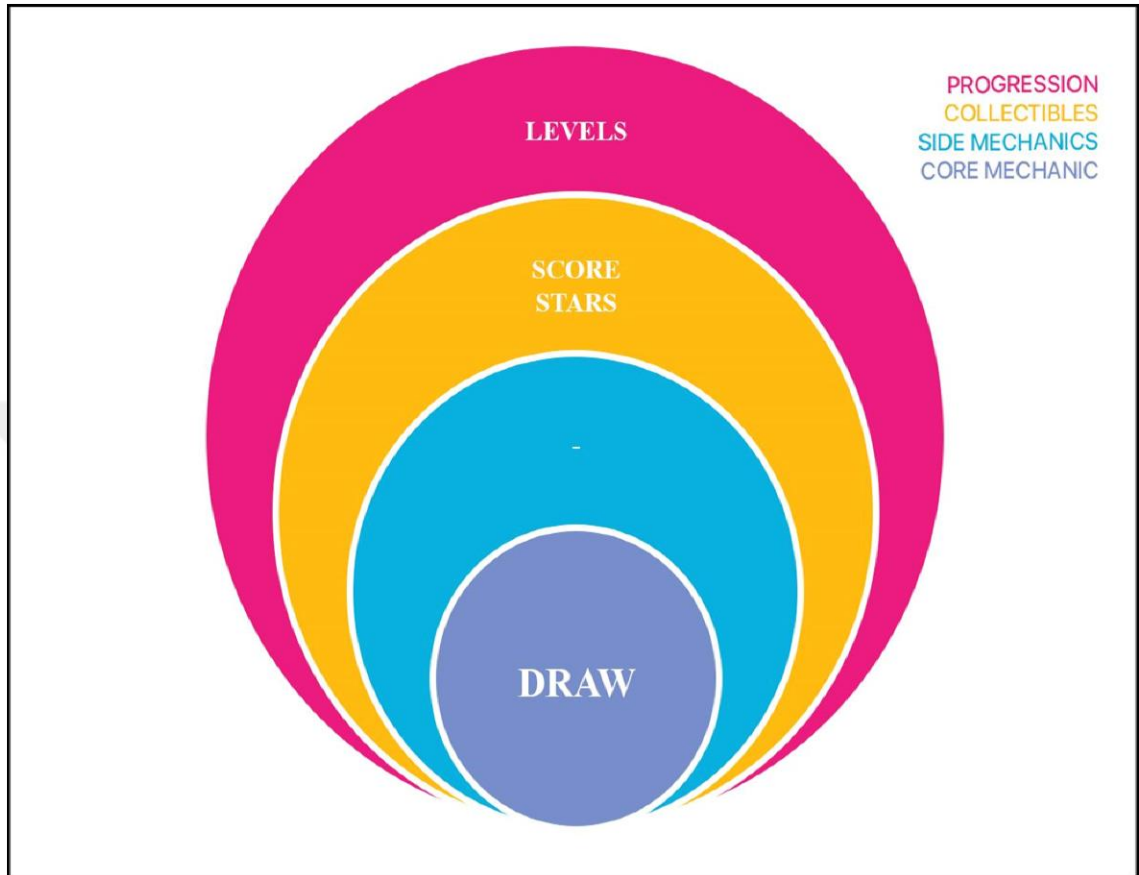
Two Dots is a mobile puzzle game that made a hit, designed and published by Play Dots around 2014. The object is to find as many vertical and horizontal lines of same colored dots on the grid as much as player find dots in single draw then those dots will disappear and new random dots will fall from above. When the objective of the level is completed before moves out the level will be completed and players gets achieved and moves onto the next level. If player is failed to complete the level in the given limitation then they had to replay the level.

3.3.7.2 Puzzle design type

Two Dots puzzle design type is based on Level Design which has objectives to complete in the single level without running out of limitations and contains many levels to complete like in the Toy Blast examination.

3.3.7.3 Game mechanics

Figure 3.19: Two Dots Mechanics Diagram



3.3.7.4 Game controls

As UX elements Two Dots contains accessibility by easy to learn and compatible with the human requirements. It also contains intent communication that gives player a full control over as their intention to do but sometimes it makes it harder to see the drawn line under the finger while playing on mobile. It has well designed and stylized as flat that gives the feel of expression space even due to the level design the area is a bit crowded it still leaves a space for the expression. As main controls two dots are draw it makes it unique for this thesis and an essential for the first ideas of Xcube as I was trying to design close likely game as draw over cube but it didn't work as development and expression space so that I switched the controls to placement.

3.3.7.5 Cooc mechanics

Two Dots also contains Game Determined Chaos model which has uncertain by what will come next and has complex field of gameplay to fill the requirements of being chaos. As much as the draw action is different control than others by giving ability of extending the possibility of restoring order in one draw it creates unique feeling as COOC element for restoring the order action.

3.3.7.6 Game flow and challenge

As Two Dots also level design type of puzzle, it contains flow the difficulty is to figure out the best possible longest draw in single movement and ability of the user is just based over their attention to figure out the solution. The game and level flow of the Two Dots contains a limited type of objectives rather than other level designed games and comes into repetitive but balanced with the flow.

3.3.7.7 Fun types

Two Dots also contains instant fun as every correct and longest draw. It also contains conclusive fun by reaching the goal of the level and creating pleasure with ego gratification and has progressive fun with the flow and level design.

3.3.7.8 Randomization factors and affect over gameplay

Two Dots also contains controlled randomization factors with the similar effects of the BBz and Toy Blast. As much as new dots generated with the rules it keeps uncertain and creates more fun out of the game.

3.3.7.9 Target audience and play styles

As like other games Two Dots audience is casual players and contains aims to achievers and explorers as gamer type it was in the Toy Blast but not including the socializers that game does not allow to compete with other players.

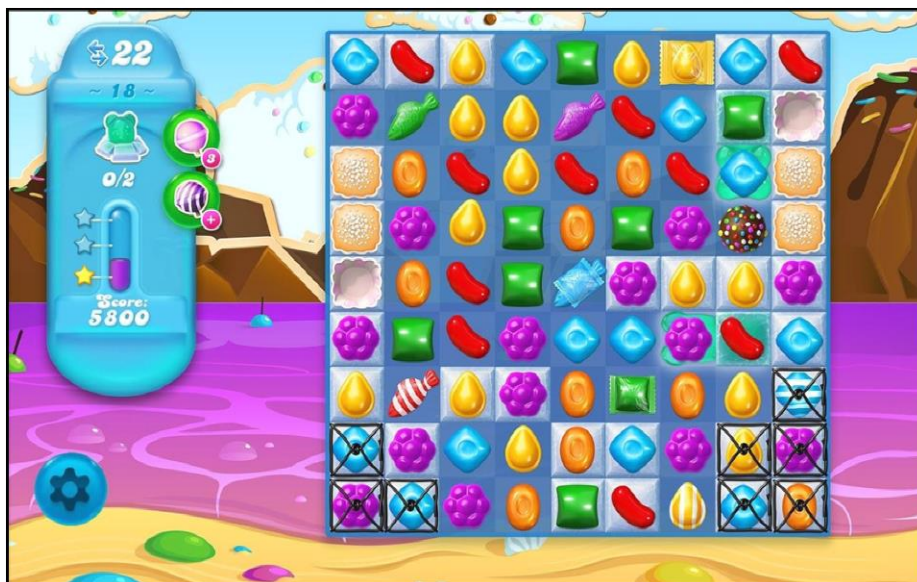
3.3.7.10 Cooc game theory

As the levels are set to the rules, the game still generates dots by random, uncertain for the player, gameplay field got complexity and mixture of the objects that fulfil the requirements of being chaos, and when players destroy dots they are restoring order to the field. In most of the COOC cases it keeps chaos going until the end of the game. Like in BBz or Toy Blast examination also the Two Dots is match game but with possibility to figure out the best way to restore the order as eye and cognitive correlation. It's a unique game in its own case for match types and COOC. In my point of view as much as players are enabled to draw the longest they can restore order with more enjoyment and it gives the very intense feeling of the restoring the order in one single action rather than other examined games.

3.3.8 Examining: Candy Crush

3.3.8.1 Short description

Figure 3.20: Candy Crush



Candy Crush is the one of the most popular puzzle games in mobile and in Facebook. The game is designed and published by King in 2012 and still has significant amount of players in 2019. Candy Crush is also a match-3 game like BBZ but with level designed

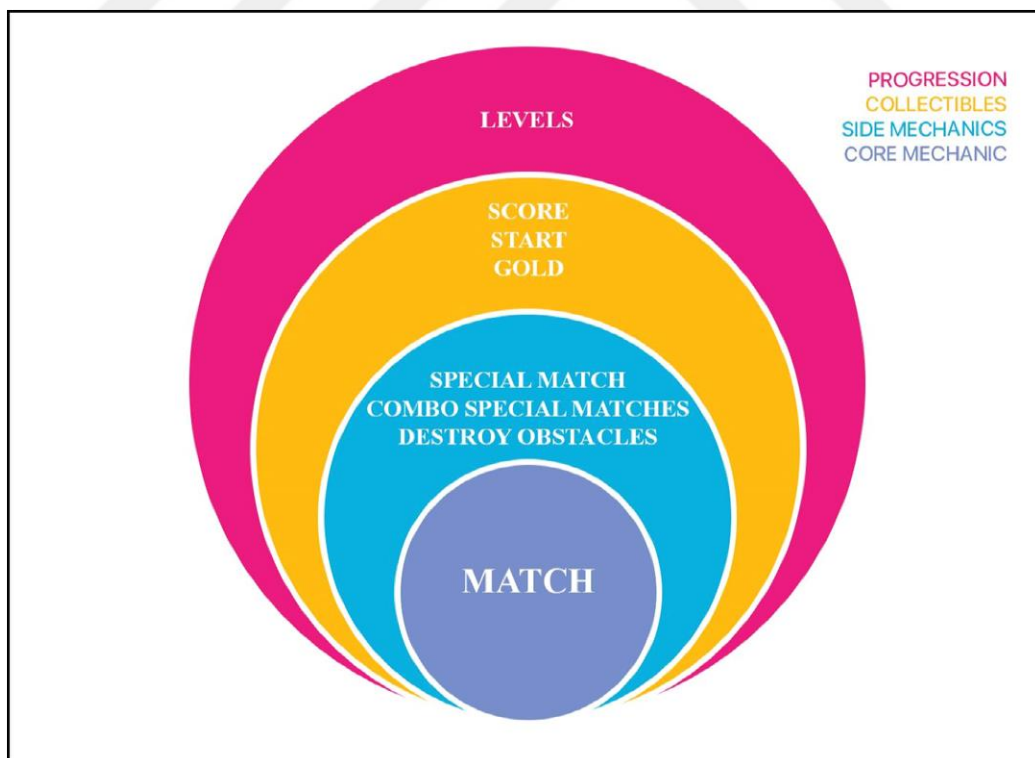
and more socialized elements. Most significant differences between the BBZ and Candy Crush is Candy Crush contains level design, obstacles and many new features designed for the match-3 games and improved the match-3 type of the games.

3.3.8.2 Puzzle design type

Even it has many common parts with BBZ such as combining and making special objects or gameplay etc. Candy Crush is Level Designed puzzle game that gives players a level to complete and achieve a goal. The significant difference between the rule design and the level design is in level design oriented puzzle type the player is trying to figure out how to achieve the goal regardless of anything else, in rule design it continues until the player is game over. From my observations Without level the game does not include win state but only contains lose state and that increases the survival instinct in rule designed games.

3.3.8.3 Game mechanics

Figure 3.21: Candy Crush Mechanics Diagram



3.3.8.4 Game controls

As UX elements Candy Crush also contains accessibility and Intent communication. But when it comes to the expression field the UI and the artstyle of the game is too crowded that narrows the expression field and makes the game looks a bit more complex. Games main control is slide.

3.3.8.5 Cooc mechanics

As it was same as the BBz, Candy Crush contains Game Determined Chaos model which gives field of objectives and randomly generates new objectives makes in unpredictable and uncertain that becomes a chaotic state. And as it was in the BBZ restoring order comes with the matching and destroying action.

3.3.8.6 Game flow and challenge

With nearly containing same difficulties as BBZ but Candy Crush also includes obstacles and limitations as difficulty in level design like Toy Blast, the ability of the player is making bombs and combos but in addition to that as monetization model Candy Crush offer powerups to the player to make the level easier for them. As BBZ is not level design oriented it does not include game flow but with level design candy crush includes game flow and it makes it less repetitive than BBZ and more focused for the achiever type of players. From my observations Candy Crushed reached more audience than BBz and has more lifetime than BBz with flow.

3.3.8.7 Fun types

Candy Crush contains instant fun with matching the candies/objects, creates conclusive fun at the end of the level by achieving the goal of the level. And in addition to those with the game flow and level design it contains progressive fun which makes it more addictive and enables to have longer playtimes.

3.3.8.8 Randomization factors and affect over gameplay

It's nearly same with the BBZ factors but in addition to BBZ, Candy Crush also uses randomization factors to generate also obstacles which increases difficulty significantly. As obstacles are generated by controlled randomization they also takes place of the objects and narrows the field and makes more unpredictable and uncertain chaos. With that randomization, In my point of view Candy Crush randomization make it more challenging to players. It may increase or decrease the fun factor.

3.3.8.9 Target audience and play styles

One of the significant audience of Candy Crush is socializers like achievers,

"When it is integrated with Facebook, Candy Crush Saga shows the progress of Facebook friends on the game's level map, which fosters competition among the player's social network and pushes them to keep engaging in the game, sharing achievements, and requesting extra 'lives' and moves." (Chen, C., & Leung, L. 2016, p 2)

In that moment socializers shows reactions to each other with their achiever behaviour as game shows up the competition between the players. Also it was same audience with BBZ and Toy Blast, Candy crush is for casual gamers and contains achievers, explorers and socializers as gamer types.

3.3.8.10 Cooc game theory

With most common match-3 elements, with uncertain, unpredictable and randomization COOC also works in the Candy Crush. But with also randomized obstacle generation, Candy Crush creates more intense feel of chaos in it, makes the game more challenging and fun. After too much difficulty and challenging game might become anxiety state in the flow. The order takes places as it was in the other match games, when match with some other same objects or with combo and clear the field the restoration of order feeling takes place. Because Candy Crush is more challenging and unpredictable as it also generates obstacles it was more difficult and when it comes to the achieve and the win state in the level it generates more fun which comes from the passing the anxiety state to achieve. In addition to that, at the end of the Candy Crush if some left over moves from limitation left and after player reached the goal, game use those movements

as bonus to the player and generates more score in the end of the level and gives too much encouraging feeling of restoring the order by clearing the field by exploding the candies and increases the addiction. I would say that Candy Crush contains one of the most intense feelings of COOC as chaos and order.

3.3.9 The Conclusion of Examined Games as “COOC” Theory

All of the examined games above has global success for the mass audiences since 1934 from Lego to Candy Crush. They all have been played by millions of people with different platforms or devices. Even they are played with toy or a game platform, they all made success that which can refer to they created fun for the players. In the table below I sum up the features of examined games.

Table 3.1: The features of examined games

	Lego	Rubik's Cube	Tetris	Bejeweled Blitz	1010!	Toy Blast	Two Dots	Candy Crush
Release Date	1934	1974	1984	2010	2014	2015	2014	2012
Platforms	Toy Ole Kirk Christiansen	Toy Ernő Rubik	All Aleksy Pajitnov	Social PopCap Games	Mobile Gram Games	Mobile Peak Games	Mobile Playdots Inc.	Social & Mobile Sebastian Krumsson/King
Designed & Published	✓	✓	✓	✓	✓	✓	✓	✓
Puzzle: Rule Design								
Puzzle: Level Design								
UX: Accessibility	✓	✓	✓	✓	✓	✓	✓	✓
UX: Intent Communication	✓		✓	✓	✓	✓	✓	✓
UX: Expression Space			✓		✓	✓	✓	✓
Main Control	Placement Insert	Slide/Rotate Movement	Movement	Slide	Placement	Tap	Draw	Slide
Game Determined Chaos				✓		✓	✓	✓
Player Determined Chaos	✓	✓	✓		✓	✓	✓	✓
Contains Game Flow			✓			✓	✓	✓
Instant Fun	✓	✓	✓	✓	✓	✓	✓	✓
Conclusive Fun	✓	✓	✓	✓	✓	✓	✓	✓
Progressive Fun						✓	✓	✓
Randomization	✓	✓	✓	✓	✓	✓	✓	✓
Audience	Casual	Casual	Casual	Casual	Casual	Casual	Casual	Casual
Gamer Type: Achiever	✓	✓	✓	✓	✓	✓	✓	✓
Gamer Type: Explorer	✓			✓		✓	✓	✓
Gamer Type: Socializer				✓		✓		✓

Source: https://docs.google.com/spreadsheets/d/1BYIwhUZOYtQv_6cYifwd2BOSwOnqoAilEofza8xLoZw/edit?usp=sharing

As it can be seen from the table two of the examinations are toys, five of them served to the player as mobile game and three of them are also published in Facebook as social platform and browser game.

All of the examined games contain COOC elements, five of the examined games designed by puzzle rule design and three of them are level designed puzzles. As for UX elements all contains accessibility that allows players to that easy to learn and compatible with human psychological and cognitive limitations. Seven of them contains intent communication that enables players have a full control over the game. Five of them contains expression space for the player. Most of them have different but similar controls, three controls become significant as placement, movement and slide. Four of the games contains Game Determined Chaos model and four of them contains Player Determined Chaos model. From my observations four of them contains game flow. All contains Instant fun and Conclusive fun and only three of them contains progressive fun. All of the examined games contains Randomization and refers to that they might generate chaos. All of the player audiences are casual regardless of if they are toy or game platform. From my observations all of the games contains Achiever player type, four of them might contain explorer player type and three of them contains socializers as player behaviour.

As all of the games contain randomization they all have similarities with the requirements of the chaos as unpredictable, unknown and unstable state. Which refers that those games can contain COOC. But this is not directly refers to that all randomized games contains chaos and can contain COOC elements. Randomized games must also contain order restoration to become containing the COOC elements and user experience they are giving user the chaotic feedback to the player such as in examined games.

For COOC mechanics as game determined chaos and player determined chaos, I sum up the similar and commons of the examined games.

Examined containing GDC mechanic games are Toy Blast, Two Dots and Candy crush.

Examined containing PDC mechanic games are Lego, Rubik's Cube, Tetris, BBZ, 1010!

From the examinations as break down of the GDC mechanic, all of them are level designed puzzles, based on the ability of the player to figure out the solution by giving them problematic chaotic state and has win condition to the player that reach the goal by solving the problem, which leads us feeling that gives restored order by winning the game. And all of the GDC based games contains game flow that creates progressive fun to the player and in my point of view extends their lifecycle that players continue playing those games more than others. In addition to those all GDC games in win condition also have ending scenes that clear the chaotic area at the end of the game and satisfies the player with the feeling of restored order.

As break down of examination for PDC mechanic, all of the PDC games are rule design oriented based on players ability to make correct decisions, four of them does not contain winning condition and ends with raise of the chaotic state except Rubik Cube. All of them are one time and infinite type of games that player can continue until they lose the game, they didn't have any winning condition but the game is always ending with game over. And PDC games except Rubik's Cube and Lego has high score as goal.

I can't say which of the model is better but I just examined the commons of those games to understand the requirements of the PDC and GDC. And as a result of those examinations I break down to the elements of PDC and GDC which may also count as definitions of the requirements of the both PDC and GDC models. Also while examining I noticed that there is unique case games such as Tetris, Rubik's cube and BBZ. which have differences than other GDC and PDC models. First of all Tetris as PDC and rule designed puzzle game contains game flow which I explained in the examination with flow it creates more challenge to the player. And the game flow of the Tetris inspired me while designing the Xcube and I try to add not a linear but changing game flow to the game. Rubik's cube has unique case as even if is PDC and Rule Designed game it has winning condition by completing the cube and restoring the order is the winning condition. And also BBZ is designed as Rule Design but has game determined chaos model which creates a unique case and against the GDC break down.

Then those cases shows us that even they create chaos, GDC or PDC conditions might change based on designers choices over the game and which may create different states and unique gameplays.

From my observations I also want to say that some of those games contains intense feeling of COOC by their unique design decisions. Rubik's Cube contains best feeling of restoring order as the goal of the game is to order the colors in the cube. Tetris has increasing stress by time and speed with game flow that creates time based challenge and with stress pressure game creates fun in progression. BBZ has timer for the player to accomplish, instead of Tetris model increasing speed and time equation, BBZ has timer for the player that creates stress pressure over the player to increase the feeling of order has time to being solved. 1010! Provides best decision making and control for the player for restoring the order feeling and making the solved state more intense. Two dot's have possibility for player to find the longest solution by drawing that player can able to solve most of the order in a single movement by their own decision creates the most satisfied feeling of restoring the order. Candy Crush has most intense of challenge by its game flow and level design. All of the GDC based games has the ending scene with destroying the chaotic field might ending with the satisfaction of the player to restoring the order. In my point of view, those unique game design elements of the examined games creates more intense feeling of COOC.

As conclusion, all of the examined games contains "Creating order of out chaos" game theory in their own approaches, contains randomization and have uncertainty, complex and unstable condition in common and gives player a ability to restore order by making correct decision or figuring out the solution. They either have Game Determined Chaos model or Player Determined Chaos both of takes place in the game design as COOC mechanics. All of them become successful games, loved and played by mass audiences for the long time. It's will not be correct to say COOC directly creates fun but that might refer that it increases the fun of the examined games and gives better experience for the player based on human psychology. All of them become successful and created fun for the players, COOC might take place in player psychology and as instinctively players might become more addictive to those games. Also we can't say that due to only COOC

that created addictiveness, there might be much more elements in game design that makes those games successful and fun. In my opinion COOC is also a one of the psychological factor that might make those games fun and addictive.

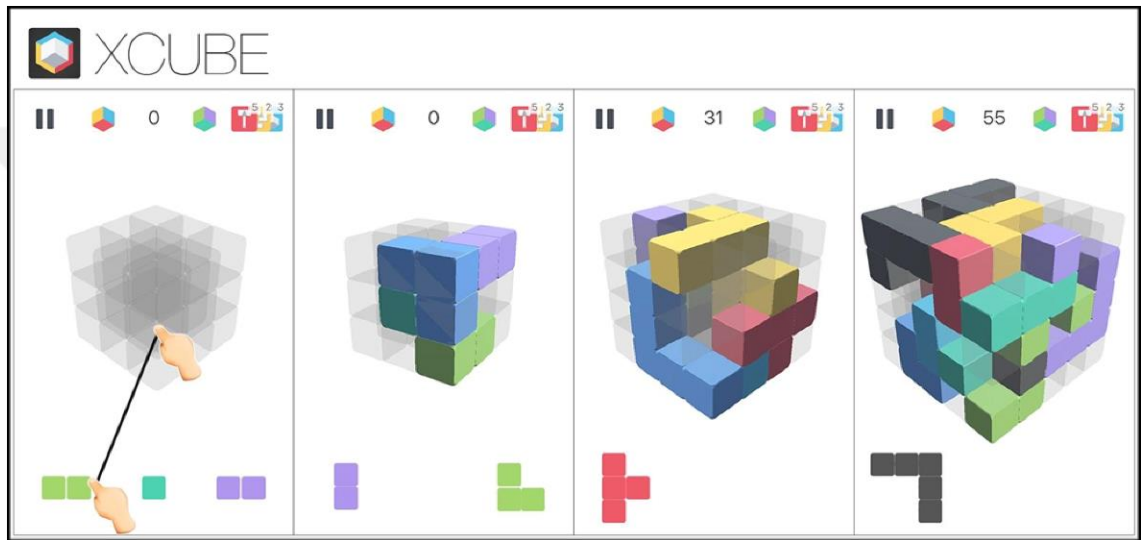


4. XCUBE GAME DESIGN FUNDAMENTALS

4.1 Short Description of Xcube

Xcube is a mobile commercial puzzle game that I had designed while working with Capella Entertainment and published in August 2017 in Appstore and Google Play.

Figure 4.1: Xcube



In Xcube, a 3x3 3D transparent empty cube is given to the players and they are place the block shapes into the cube. Players are able to rotate the 3D cube 360c and place the shapes to anywhere they want. As much as the player places the blocks into the cube when they made a line from the blocks that line will disappear. When the player puts all three shapes into the cube, the new three shapes will be given. The player's goal is to make a high score by placing more blocks into the cube as much as they can. When the player is unable to place any given block shapes, the game is over and players get the new high score. When the player passes the score limit cube gets bigger into 4x4 and finally to 5x5 but it will not grow anymore after it reaches to 5x5. Xcube got more than 100.000 downloads in its first month.

4.2 Game Design Elements & Design Goals

While designing Xcube my goal is to create a new unique puzzle game. For that matter, I observed the games that players love, researched and considered their common parts and designed Xcube. In the designing process of it, I was thinking about to create a game that will also has the effect of Creating Order out of chaos. With that matter, I designed Xcube with COOC elements. In the idea stage, while prototyping many things have changed, the original idea was to create a GDC based game, over the 3D cube but it was not created the expected fun and UX possibilities didn't have accessibility so that we continued iterating it until it becomes the finest version for the players. While designing I was inspired by the Tetris and its game flow. In Tetris, while examining I was mentioned Tetris contains game flow that increases the speed of the block falling and shortens the time for the player to give a decision. In Xcube I try to apply game flow into the game by growing the cube and giving more difficult shapes to the player. Also one of another inspiration of Xcube is Rubik's Cube and its rotation system. As Rubik's Cube has Intent Communication problem with the player which is not allowing players to have total control over the game, I try to fix it with making the 3D cube transparent so that players can see through the cube to other the sides to understand the placement and to have full control over the cube. But as much as players are placing the blocks wrongly and cube gets filled with the shapes the Intent communication issue become a challenge to the players as it was in Rubik's Cube. So for the UX view, it solved Rubik's Cube UX problem temporarily but also created another difficulty for the players and become a challenge. While searching for placement and randomization, I was inspired by 1010!'s shape placement which has given the player the best decision making. With those inspirations, I had designed the Xcube and published it.

The Game Mechanics of Xcube

Figure 4.2: Xcube Mechanics Diagram

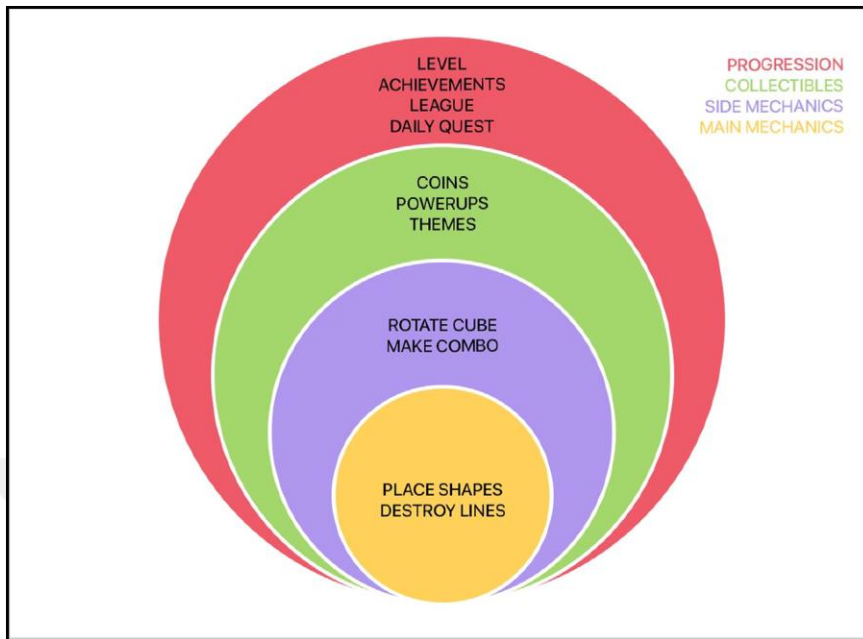


Figure 4.3: The Game Loop of Xcube

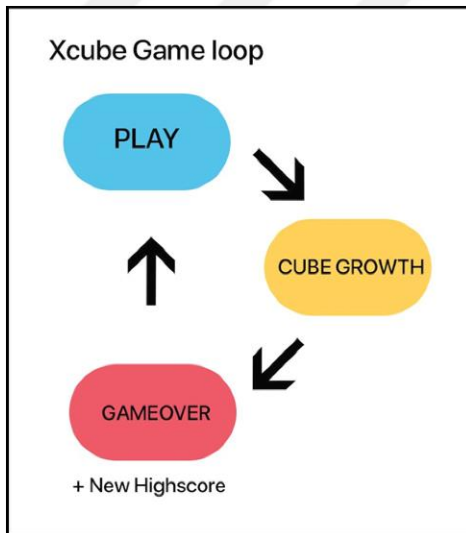
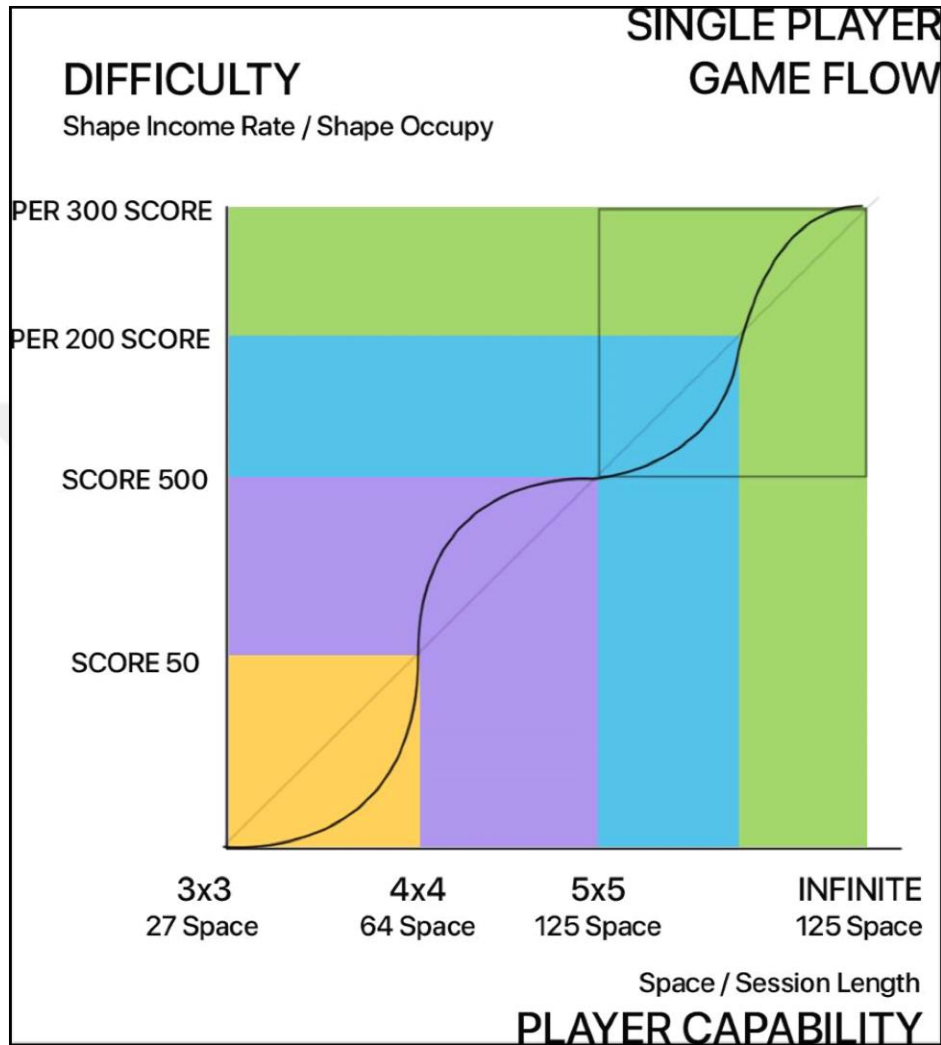
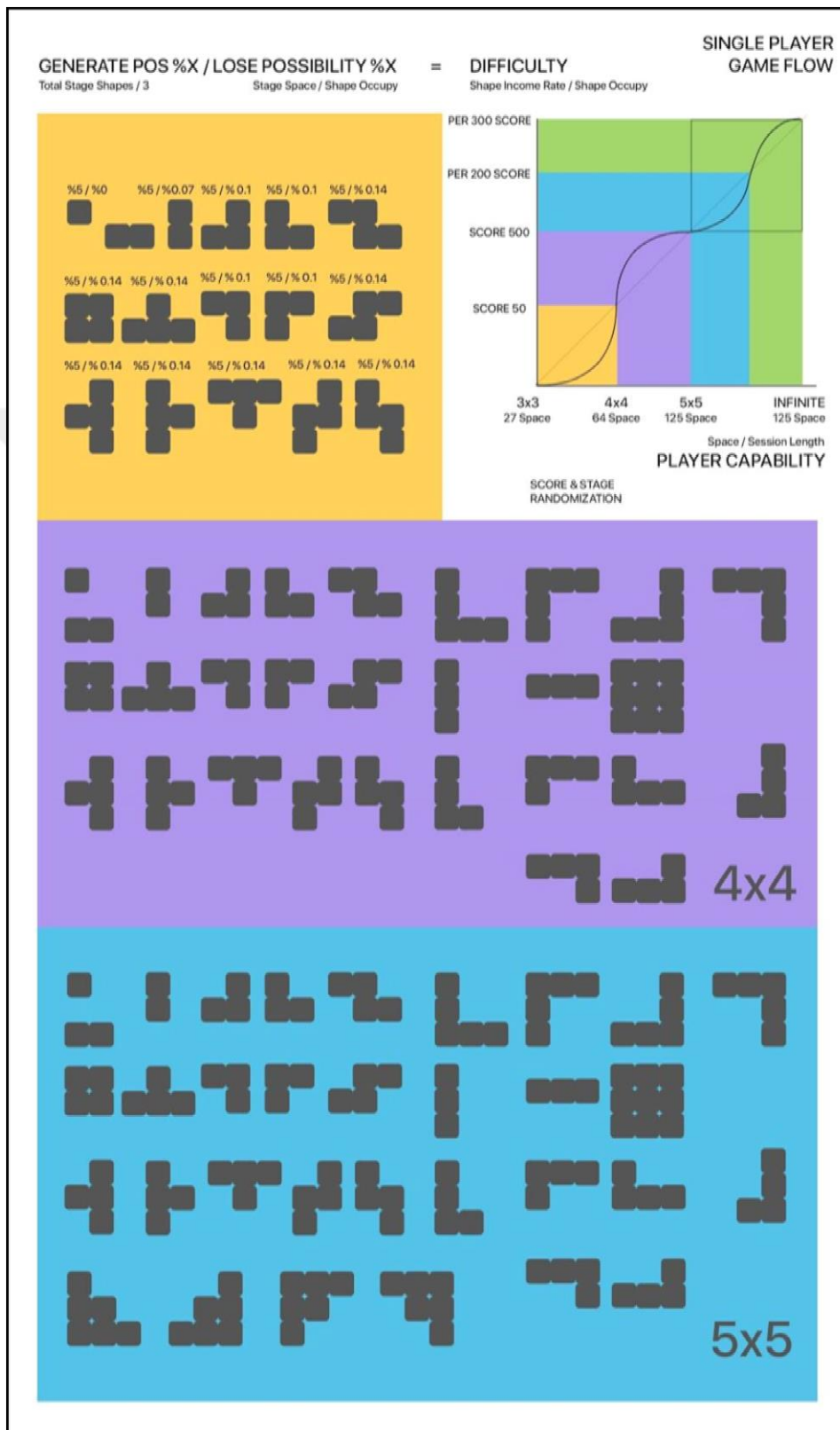


Figure 4.4: The Game Flow of Xcube



As you can see from Figure 4.2.3, I tried to design a game flow for the Xcube that increases the difficulty by score. When the game begins the 3x3 has 27 possible placement over the cube that players will place the blocks, in 4x4 they have 64 empty space and in 5x5 have 125 possible space to place the shapes. When cube gets growing the difficulty reduces due to the possible space of the placement increases. To create a difficulty, I designed shapes that also grows with the cube and occupies more space than previous cube phases. In the below table (figure 4.2.4) you can see the possible shape growth with the cube.

Figure 4.5: Shape Possibilities of Xcube



Even it still gives random shapes, the shape growing is important to keep the player in flow to create the challenge. As you can see for a basic explanation in 3x3 stage cube has very low chance for user to lose the game, in the first stage our goal is to let the player get into the game and in 4x4 stage it's becoming challenging for the player and in the fifth and final stage its infinite beyond but while growing from 4x4 cube gets filled by 4th stage and becomes more challenging and with randomization calculation we try to give the feeling of the flow to the user. There is no certain timing that we can set for the game over for the users as it depends on their own ability. Inflow with shapes, we are just changing the challenge with randomization. With those goals and elements, I had designed and published the Xcube in August 2017. In the conclusion part, I will share the data and user feedbacks of the Xcube to understand if it created fun with game design elements or not.

4.3 Examining Xcube as "COOC"

As all other examined games, Xcube is containing COOC elements that I was thinking over the COOC game theory and used the elements of it in the Xcube while I was designing. In the next parts as we examined previous games, I will explain the Xcube's approach to the COOC.

4.3.1 Game Controls of Xcube

Xcube contains accessibility to the players that they can understand and use it without any directions, I observed that sometimes they can't get the rotation option the first place but they eventually understand it without direction.

As Intent communication I had explained previously, Xcube rotating model is inspired by Rubik's Cube which didn't have any Intent Communication that prevents a user from being in the full control. In Xcube we tried to solve the issue by making the transparent so that players can see through the cube and understand the possible placement points in the other parts of the cube but as much as cube gets filled, the Intent Communication in the Rubik's Cube also started a challenge to the players and increases the difficulty.

Besides without our control, game gets more difficult for the players with UI instead of the game flow but as much as we investigate the situation, players didn't get frustrated from it as we observed even that they tried to solve it more due to see the other sides of the cube. So that the negative situation becomes a challenge that players get used to it and liked it from our observations. As a conclusion for the Intent Communication issue, we temporarily solved the problem of the Rubik's Intent Communication problem but it turned into a challenge for the players that we didn't expect at the beginning.

Also, Xcube contains expression space for the users that they can act as much as they want in the 3x3 cube, but as much as cube growth it fills the expression space for the user and fills the empty areas of the screen. Also with the cube growth expression space becomes another issue for us that we tried to solve it with zoom in and zoom out for the users with mobile pinch control but it also ended up with another problem that while trying to pinch some users started rotating the cube that was solved by more development limitations to handle the situation.

In my point of view, one of the most struggling parts of the Xcube's design is the UI and UX issue that I never expected before we prototyped and tested it. After that, it took us some time to solve and make playtests. Even with those UI/UX issues, players still play it and we continued the project but I still believe those issues always be a problem for us. And the main controls of the Xcube is rotation and placement.

4.3.2 Puzzle Design Type of Xcube

Xcube is also rule designed puzzle game that I designed the rules of play to the players as other examined games like Lego, Rubik's Cube, Tetris and BBZ.

4.3.3 COOC Mechanics of Xcube

Xcube uses player determined chaos model in the game as the player decides where to place the shapes as it was in other PDC games.

4.3.4 Fun Types of Xcube

Xcube contains Instant fun for players with destroying the lines and with growth, it gives the feeling of progression. Also, Xcube contains conclusive by ending the game and getting a high score. But in my point of view as much as player sticks to the game, we observed that after playing more than one hour, players saves and continues the game next day which they continue their single session progression with that I believe at the end of the game it's not creating conclusive fun but creating the feeling of being failed as it took so long to game over. It might be also another issue for us but we can't scale or observe this situation as it takes so long.

Xcube also didn't contain any progressive fun even if has game flow as Tetris. The game didn't contain any meta game or progression that players will stick to the game for the long term. As it was an abstract game without level design it's hard to give that progression to the player, as all other PDC and Rule designed games Xcube also contains High Score as a goal to the player.

4.3.5 Randomization Factors and Affect Over Gameplay of Xcube

Xcube has randomization with shape producing that all of the shapes defined and given randomly to the players. As it was in other COOC containing games Xcube also fulfills the requirements of being chaotic as it was unpredictable and random. Also to get more information for this in question survey I have added two questions for the user to understand if they liked the randomization.

In my opinion, if we give user one shape instead of three shapes, the game will lose the decision making an effect for the players by narrowing their opinions as it was in Tetris. But if we also give more than three shapes to the player, the players will get confused by the decision and also it may break the flow of the game makes it easier for the player that may lead to boredom.

The first question in the survey is about if we give one shape to the player did they like it? And the second one is if we give them whole shapes and you decide which to pick.

The goal of these questions is to understand the effect of the randomization factor. In my opinion, also with randomization, the fun of the game increases due to player always felt they had a chance to survive instead of being game over. If we give shapes one by one to the player they don't have the option to survive. As also flow is depending on shape generation the randomization affected the gameplay and fun of the game directly. Also, I mentioned that with randomized games the feeling of being natural is increasing in my opinion due to nothing is straight in the life itself too.

4.3.6 Gamer Type of The Game's Audience of Xcube

Xcube is also a casual game without any gender or age targeting. Also, it aims the achiever type of gamers that ultimate goal is the high score, to enhance the experience of the achiever we added achievements to the game that players will also try to complete them too and it worked. Xcube does not contain explorer gamer type as it has no option for that type. For socializers, we tried to add Facebook and game platform leaderboard tables into our game which we hope to start a competition to the players, but unfortunately, only %0.1 of players logged in with Facebook and socializer type will not get into the game and we didn't use the opportunity to start a competition between players. Also, game platform based leaderboard just attracted less than %1 of the players which is also not working for us. And the structure of the game does not allow us to add more options to the game.

4.3.7 How Did “COOC” Game Theory Take Place in the Xcube?

As Xcube is also a randomized game and fulfills the requirements of the chaos and offers a solution as line destroying an order, it fits the requirements of being COOC and also as game field as much as the player makes wrong decisions the game field becomes chaotic that player needs to solve the issue. With the same issue with the other PDC and Rule designed puzzle games Xcube is also ending with the chaos rising and when the cube is filled the game is over. With many inspirations and common parts with other examined games, Xcube shows the COOC elements and contains it. In addition to being COOC, before designing the Xcube I was thinking over this game theory and I tried to

add COOC elements in the design part of the game to increase the intensity of the game. While trying to increase the feeling, I inspired from Tetris flow, 1010! Decision making and Candy crush likely challenge to create a more intense feeling of the COOC. I was expecting to make Xcube challenging game and in the data part from the user feedback we will see the result by question is the game is challenging or simple from the player's feedback. With all of those elements, I tried to increase the feeling of the game with COOC elements as I mentioned before and tried to create fun with game design.



5. QUESTIONNAIRE & DATA

In this part, as I explained in 1.1 Research Goals, the questionnaire has been completed with the 54 participants which played the Xcube before and collected the feedback data of those players via google forms. (<https://forms.gle/YLtmXR5kGxoxzc737>) In addition to the user feedback, I will explain the analytical data's of Xcube in the 5.3 Analytical Data.

In this thesis, my aim is to find out, if Xcube created fun for the players or not with the design elements and COOC elements used in the game. Like in the explained fun section and the common knowledge; it's not certain to say if the game created fun or not but we will estimate the conclusion with the collected data.

5.1 Questionnaire Profile

Questionnaire profile is the players are who have experienced the Xcube before and who can give us feedback about their experience. Most of the users are casual players who have experienced examined games too, not all of them are experienced but we have asked them if they played those games and enjoyed or not. The aim of the asking examined games is to understand if the same profile also played those COOC mechanical games and did they love it to compare it in and conclude it in the conclusion part. In the survey e-mails, name and surnames of the participants are recorded. All of the questions are marked as required so that all answers are as a percentage based on 54 participants results.

5.2 Questionnaire Result Table

With 54 participants the questionnaire is completed. The first question asked to the participants is "Which platform do you prefer to play games mostly?" and this aims to understand the favorite platform of the player and if they are compatible with the mobile user habits to play the Xcube or examined games. The answer contains four

options as mobile, browser, pc or console. %70.4 of the 54 participants responded as their favorite platform is mobile, %27.8 of the participant's favorite platform is PC and %1.9 of the participant's favorite platform is consoles. As a result of the first question, we found out that most of the participants with %70.4 favorite platform are mobile which is compatible with the requirement of this thesis as Xcube and examined games are mobile.

The second question is "Do you call yourself a casual player?" this question aims to understand players gaming behavior as if they are compatible with the requirement of this thesis. The question has three answers, the first is YES, the second is NO and the last is I DON'T KNOW. %66.7 of the participants responded as YES and they call themselves casual players, %22.2 of them answered as NO and %11.1 of the responders are not aware of if they are casual players or not. As a result, most of the participants are compatible with the thesis requirements as they are casual players.

The third question is "Do you like puzzle games?" This question aims to understand the players like puzzle games or not which may affect the conclusion directly as Xcube and examined puzzle games. The question contains two answers as YES or NO, %87 of the participants responded as YES and %13 of the Participants responded as NO. As can be seen from the result the most participants love to play puzzle games.

The fourth question is "Did you played Xcube?" This question aims to understand if the players are experienced the Xcube or not. The answers are YES, NO and I DON'T KNOW. %94.4 of the players said yes and experienced the Xcube, %5.6 responses as NO and they didn't experience the Xcube. As a result, most of the participants experienced Xcube.

The fifth question is 'Did you have fun while playing Xcube?' This question aims to understand if the players get fun out of Xcube and how was their experience. The question contains three answers as YES, NO, I DON'T KNOW. %87 of participants said YES, %5.6 of participants answered as NO and %7.4 of participants answered as I DON'T KNOW. This shows us the most of the participants are getting fun out of

Xcube, %5.6 of them didn't like the game or didn't get fun out of it and %7.4 of the players have doubt if they get fun out of it or not. In addition this question, there is two following question which is related to this question as an option to the participants which they are not required to answer but some of them decided to answer it. The first following question is "If YES - What is the fun part of the game for you?" There was a blank for filling in so that only 21 of the participants answered in Turkish and English mixed. The most significant three answers are placing the shapes, growing the cube and scoring. The results of the commentary question have an importance that may help us to understand the strong fun points for the conclusion part. And the second following question is "If NO - Why did you get bored of it?" Two participants answered the question as very close likely that says to us they bored the game because of repetitive actions. Which can be a unique case that those players might not like infinite games as all of the infinite games continue repetitively. As can be seen from the answers most of the participants get fun out of the Xcube.

The sixth question is "What is your Highscore in Xcube? As you remembered" This question aims to understand if the player has the ability to play the Xcube likely games or not. The question has four answers 0-250 score, 250-750 score, 750+ score and I don't Remember. The 0-250 score answer show players have the low ability or not get used to the Xcube, 250-750 score shows that player has the middle ability, the 750+ shows that player has high ability to play Xcube or close likely games. As some of them might not remember the answer so that they might answer as I don't remember. %59.3 of the players answered as 750+, %25.9 of them answered as 250-750, %14.8 answered as they don't remember and none of them answered as 0-250. This shows us the %85.2 of players have the ability to play Xcube or similar games.

The seventh question is "How long did you play Xcube in one session? As you remembered." This question aims to understand how much time did players spend in the game and if the game flow is working ideally. Also, this answer can give us an idea about if they get fun out of the game or not because if players didn't like it they will not spend time on it. The question has four answers, 0-10 minute, 10-30 minutes, 30 Minute + and I don't remember. The participants answered as %53.7 of them played more than

30 minutes, %31.5 of them played between 10-30 minutes, %9.3 of them didn't remember how long they spend in the game and %5.6 of them played between 0-10 minute. As can be seen from the answers %85.2 of them spend more than 10 minutes in the game, which may give us an idea about they love the game, played it and game flow might working ideally.

The eighth question is "How did you define Xcube as a simple game or challenging game?" This question aims to answer the players choice of play style if they love simple games or challenging games. The question contains three answers as SIMPLE GAME, CHALLENGING GAME, I DON'T KNOW. %68.5 of them answered as a challenging game, %25.9 of them answered as a simple game and %5.6 of them answered as they didn't know. This shows us that Xcube is a challenging game more than a simple game due to players responds. And these answers show us that most of the players love Xcube as a challenging game.

The ninth question is "If Xcube gives you one shape instead of three shapes, do you like it or not?" This question aims to understand if the players love limitation or not and as decision making it the design decision is working correctly. The answers are YES, NO and I DON'T KNOW. %50 of the participants answered as no, %35.2 of them answered as YES and %14.8 answered as I DON'T KNOW. This shows us that half of the participants liked the design decision as giving them three shapes and didn't like to limit it into the one shape instead of three. And some of them answered as YES which might be debatable if the decision or right or wrong maybe the YES answers can lead us to due to the game is too challenging and with that decision making for the players gets more simplified with it.

The tenth question is "If Xcube gives you all possible shapes instead of three shapes, and you can choose whatever you want, do you like it or not?" This question aims to answer if the randomization working ideally, players are fine with it and with limitations. The question has three answers YES, NO and I DON'T KNOW. %53.7 of the users are answered as NO, %33.3 of them said YES and %13 of them answered as I DON'T KNOW. These answers show us that most of the players liked the

randomization and the design decision about only giving three shapes might be the right call. This question is also a vice versa of the ninth question that limitation to one or no limitation, both of them declines by the users that give us an idea about the design decision over the decision making might be the right that players declined both questions. Also, both ninth and tenth answers have very similar percentages about results that may give an idea about around %30 of the players might like the changes in the game.

From eleventh to the seventeenth questions are about examination to understand if the participants know those games and if they like them or not which can give us an idea about if they love puzzle games that might use COOC if they experienced and liked Xcube likely games. All questions have the same answers as "YES, I PLAYED AND ENJOYED", "YES, I PLAYED BUT DIDN'T LIKE IT", "NO, I DIDN'T PLAY IT." and "I DON'T KNOW".

The eleventh question, "Have you ever been played with 'Lego' and did you enjoyed it?", %79.6 Yes, I Like it and enjoyed it, %13 of them didn't play it, %3.7 played but didn't like it and %3.7 of the answered as I don't know. As a result, most of the participants also played Lego and enjoyed it.

The twelfth question, "Have you ever been played with 'Rubik's Cube' and did you enjoyed it?", %72.7 Yes, I Like it and enjoyed it, %13 of them didn't play it, %13 played but didn't like it and %1.9 of the answered as I don't know. As a result, most of the participants also played Rubik's Cube and enjoyed it.

The thirteenth question, "Have you ever been played with 'Bejeweled Blitz' and did you enjoyed it?", %50 Yes, I Like it and enjoyed it, %29.6 of them didn't play it, %14.8 played but didn't like it and %5.6 of the answered as I don't know. As a result, most of the participants also played Bejeweled Blitz and enjoyed it.

The fourteenth question, "Have you ever been played with '1010!' and did you enjoyed it?", %63 Yes, I Like it and enjoyed it, %24.1 of them didn't play it, %5.6 played but

didn't like it and %7.4 of the answered as I don't know. As a result, most of the participants also played 1010! and enjoyed it.

The fifteenth question, "Have you ever been played with 'Toy Blast' and did you enjoyed it?", %38,9 Yes, I Like it and enjoyed it, %48.1 of them didn't play it, %5.6 played but didn't like it and %7.4 of the answered as I don't know. As a result, most of the participants did not experienced the Toy Blast. But the %38.9 of them played and loved it compared to the %5.6 played and didn't like, we can say that the experienced players liked the game.

The sixteenth question, "Have you ever been played with 'Two Dots' and did you enjoyed it?", %50 Yes, I Like it and enjoyed it, %42.6 of them didn't play it, %1.9 played but didn't like it and %5.6 of the answered as I don't know. As a result, half of the participants also played Two Dots and enjoyed it.

The seventeenth question, "Have you ever been played with 'Candy Crush' and did you enjoyed it?", %77.9 Yes, I Like it and enjoyed it, %5.6 of them didn't play it, %14.8 played but didn't like it and %1.9 of the answered as I don't know. As a result, most of the participants also played Candy Crush and enjoyed it.

Table 5.1 SUMMARY OF QUESTIONNAIRE RESULTS

Questions	Answers			
	Mobile	Browser	PC	Console
1- Which platform do you prefer to play games mostly?	70.40%	0%	27.80%	1.90%
2- Do you call yourself a casual player?	66.70%	22.20%	11.10%	
3- Do you like puzzle games?	87%	13%	1%	
4- Did you played Xcube?	94.40%	5.60%	0%	
5- Did you have fun while playing Xcube?	87%	5.60%	7.40%	
6- What is your Highscore in Xcube? As you remembered.	0-250	250-750	750+	I don't remember
7- How long did you play Xcube in one session? As you remembered.	0-10 Minute	10-30 Minute	30+ Minute	I don't remember
8- How did you define Xcube as a simple game or challenging game?	5.60%	31.50%	53.70%	9.30%
9- If Xcube gives you one shape instead of three shapes, do you like it or not?	Simple Game	Challenging Game	I don't know	
10- If Xcube gives you all possible shapes instead of three shapes, and you can choose whatever you want, do you like it or not?	25.90%	68.50%	5.60%	
11- Have you ever been played with 'Lego' and did you enjoyed it?	Yes	No	I don't Know	
12- Have you ever been played with 'Rubik's Cube' and did you enjoyed it?	35.20%	50%	14.80%	
13- Have you ever played 'Bejeweled Blitz' and did you enjoyed it?	33.30%	53.70%	13%	
14- Have you ever played '10101' and did you enjoyed it?	Yes I played and enjoyed.	Yes I played but didn't like it	No, I didn't play it.	I don't know
15- Have you ever played 'Toy Blast' and did you enjoyed it?	79.60%	3.70%	13%	3.70%
16- Have you ever played 'Two Dots' and did you enjoyed it?	72.20%	13%	13%	1.90%
17- Have you ever played 'Candy Crush' and did you enjoyed it?	50%	14.80%	29.60%	5.60%
	63%	5.60%	24.10%	7.40%
	38.90%	5.60%	48.10%	7.40%
	50%	1.90%	42.60%	5.60%
	77.80%	14.80%	5.60%	1.90%

As a result of the examination questions, all examined games are experienced by most of the participants and they enjoyed the examined games. This may give us an idea about if COOC also worked and supported the feelings of those games or it helped to increase the fun factor of those. None of the examined games have a negative answer as players didn't like them.

As a questionnaire result summary, %70.4 of participants are played games over mobile, %66.7 of them call themselves as casual players, %87 of them loved puzzle games, %94.4 of them experienced the Xcube and %87 of them have fun while playing the Xcube. %59.3 of them scored more than 750+ and %53.7 of them spend more than 30 minutes in one session. %68.5 of them call Xcube as a challenging game and %50 of them didn't want to change the randomization and limitation mechanic which refer us that the design decision might work fine as giving only three shapes to the players. As an overview and average, we can say that %70 of the participants are compatible with the Xcube audience and with %59.3 of them high scored, %53.7 of them spend more than 30 minutes in the game and %87 of them answered as they had fun while playing the Xcube, as average above %60 Xcube was fun for the participants.

And for the examined games as average %53.6 of them played all examined games and enjoyed those games too. Which may give us an idea that examined games are also similar to Xcube as design elements and those elements might contain COOC in common to increase the fun of the games as instinctively.

5.3 Analytical Data

I mentioned analytical data's importance in the terminology and definitions part, with more than 100.000 downloads in the first month of release of Xcube. Xcube generated day one retention was %35-50 which can give us an idea that nearly %40 of the players returned to play the Xcube again. Xcube has RD7 retention around %15-20 and as day 30 retention it has %5-10. Which I mentioned before for the common industry knowledge as RD1 %30-40+ games count as successful. It may refer that Xcube might be successful and generated fun for the players. In addition to retention as daily average user engagement (DAUE), Xcube DAUE is above 22 minutes as an average engagement of the players. Which is the common industry standards are around 4-5 minutes count as successful for the puzzle games. That also might give us an idea that Xcube might generate fun for the players as they spend time in the game more than industry standards.

Figure 5.1: XCUBE RETENTION METRICS

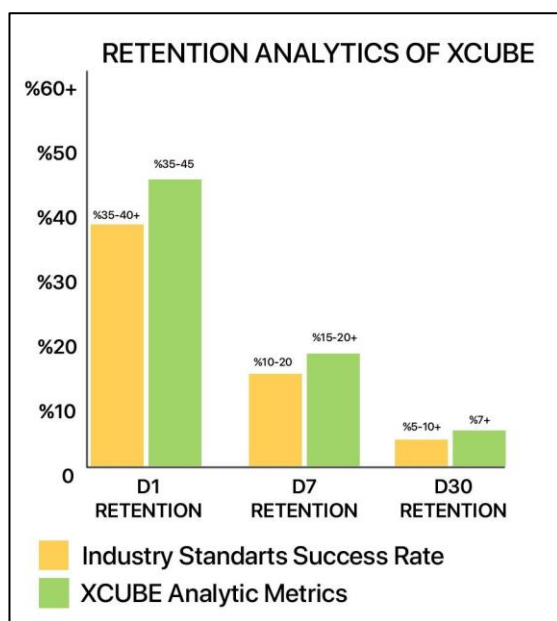
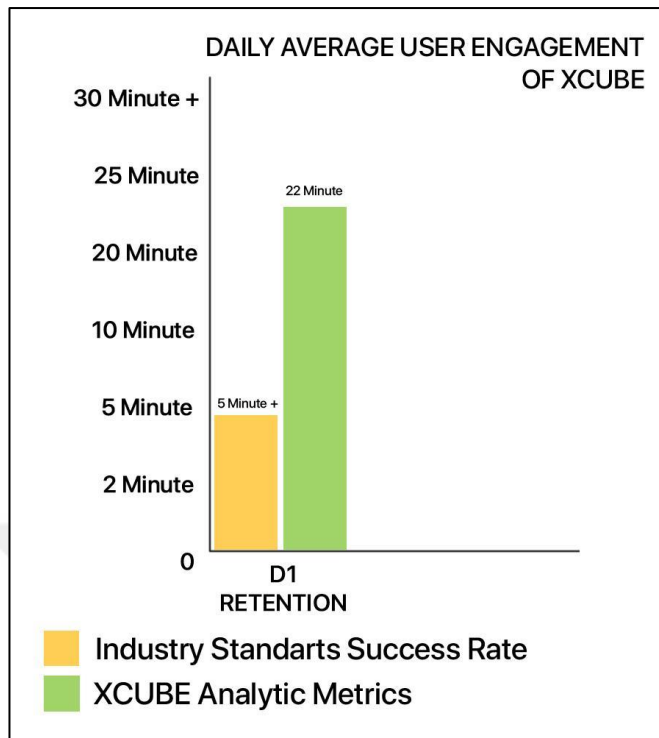


Figure 5.2: XCUBE DAILY AVERAGE USER ENGAGEMENT



As an analytical conclusion for the mass audience, Xcube attracted %40 of its players in the first month and they spent more than 22 minutes in the game which might be count as successful and generated fun for the players. The industry standards might change based on the time the game released, the trend or genre and for many other factors. The consideration has made over the common knowledge and might change in time. The analytical datas of the Xcube is also not certainly shows us it created fun or not but as an analytical conclusion, it reaches a significant amount of number as metrics.

6. DISCUSSION & CONCLUSION

By explaining the COOC theory and its relevance in Chapter 2 and 3, the discussion comes to point that if the COOC and its elements create any effects over those games. As a fun, itself is a not certain thing, this discussion part will be over ideas and assumptions. Creating order out of chaos as explained in chapter 2 and 3 is a psychological field that too much depth and based over primitive human instincts to survive but as in many common resources, it's certain that psychological effect exists over many fields. In this thesis, we take a look into the COOC, its effects over games and break down of the elements of how COOC take place in puzzle games. In chapter 3, I defined two different chaos generation models for COOC containing puzzle games as Game Determined Chaos and Player Determined Chaos. In addition to that, I explained the usage of both models detailed in Chapter 3. Both of these chaos models as games examined have many common elements. Accordingly,

GDC type of puzzles contains level designed and depends on the player's ability to solve the problems.

PDC type of puzzles contains rule designed and depends on the player's ability to make the correct decision.

All of the examined games contains randomization in it and it's the first indicator that points out those games might have chaos as they fill the requirements of it. All of the games also have to restore order options as with their approach to the solution for the player. Accordingly in the simple terms examined games and Xcube contains the basic requirements of being chaos and order as terminologically. Also in the psychological section, I slightly mentioned the psychological effects of the theory.

A psychological approach to the subject is very deep; I take look at how they might take place in the games as a theory. I assume that examined games contain COOC elements and it might affect players by it instinctively and psychological that increases the fun factor or the addictiveness of the game. It's wrong to say it will be certain but they assume it might have an effect over games. This theory as psychologically takes place in many fields why didn't it affect games and players get affected by it? In my point of view, COOC theory takes place in games too as it was in other fields but it's not a thing to be proven or certain. As it can't be certain I just break down the theoretical usage of the COOC and examine the games as a game designer that might contain this theory.

If we also take a look at the examined games, for many years all of those games made a success and being fun for the player. In that point, I believe those games might get affected by this theory. It will be wrong to say it's only affected by the COOC but COOC might take place in those games for success factor to increase the fun and addictiveness. There can be also one important thing to discuss can be I assume those games use creating order out of chaos but all of the games ended with chaotic states as the player makes a wrong decision in PDC's and in GDC the chaos never actually ends and it always exists. According to me, it's very natural that order always comes with the chaos, if the chaos never exists nor the order will be. So that ending with the chaotic state instead of the order, strengthens the addictive of those games as it urges players to that chaos still exists and they need to restore it to order. Only one game, especially in my thesis, has ended with order state and its Rubik's Cube if we take a look at after completing the order in Rubik's Cube, from my observations we can notice that player's leave it in the order state and it decreases the playability of the toy as most of the players leave the toy in order or solved. According to it, chaos sustainability might be the key factor for the COOC games playability and lifetime.

Also, I as explained in detail in chapter 3 all of the examined games contains many elements in common, in my point of view this can be beyond coincidence that can refer us that those games have in common. In my point of view, one of the key factors might be the COOC takes place in all of those games and increases the fun or addictiveness of the games as psychologically. In that matter, while designing the Xcube I especially studied the theory and tried to implement it into the game elements as mechanics. I explained how I used COOC in game design elements detailed in chapter 4. With that in chapter 5 from the questionnaire and analytical data of the Xcube, Xcube might also have increased fun with the COOC elements that I used.

As a conclusion, the usage of the theory can't be certain but it exists and may be used in the games or it can create a field of research for the future works. With regards to the research question of this thesis, if Xcube creates fun for the users and did it affected by the COOC, by taking all the findings, examinations and qualitative data acquired above, it can be said that,

a) COOC can take place in the games as mechanic and might affect the experience of the player and also can increase the fun or the addictiveness of the puzzle games as a psychological factor. For the successful games examined in chapter 3, all of them got many game design elements in common and it might be beyond being a coincidence and which also may refer the usage of the COOC might increase the fun or addictiveness of the games.

b) Regardless of my definitions about COOC mechanical usage in games, as game determined chaos or player determined chaos model, it may have many other usages or approaches to games as game design. I defined those to give a point for the future works and how I observed before designing the Xcube.

c) As a game designer, I explained how the theory takes place in my design for Xcube and other design elements of the Xcube. The strong and weak design decisions for the Xcube might affect future designs to give an idea.

d) The main research purpose of this thesis is if Xcube created fun or not and also if it gets affected from COOC. If we calculate the average success of the Xcube from questionnaire results and analytical data of the Xcube, it shows that %60 of the participants enjoyed the Xcube. According to the common industry knowledge and analytical metric's of the Xcube with %40+ RD1 retention and 22 minutes average playtime, we can conclude that Xcube might create fun for most of the players. It can't be certain to say that COOC theory just creates success or fun. In my point of view, it might affect the player experience, increase the fun factor and increase the addiction of the Xcube.

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APPENDIX



Survey Questionnaire contains following questions

1-Which platform do you prefer to play games mostly?

- a. Mobile
- b. Browser
- c. PC
- d. Console

This question aims to understand the gameplay type of the player.

2-Do you call yourself casual player?

- a. YES
- b. NO
- c. I DON'T KNOW

This question aims to understand player behavior.

3-Do you like puzzle games?

- a. YES
- b. NO

This question aims to understand if the player likes puzzle games or not.

4-Did you played Xcube?

- a. YES
- b. NO
- c. I DON'T KNOW

Questions aim is to make sure players have experienced the Xcube.

5-Did you have fun while playing Xcube?

- a. YES
- b. NO

Questions aim is to understand if players are getting fun out of it or not.

'If YES - What is the fun part of the game for you?'

Questions aim is to understand the motivation factor and experience of the player.

'If NO - Why did you get bored of it?'

This question aims to understand the experience of the player and why they didn't get fun out of it.

6- What is your Highscore in Xcube? As you remembered.

- a. 0-250 Low ability
- b. 250-750 Medium ability
- c. 750+ High ability
- d. I DON'T KNOW

This question aims to understand if the player has the ability to play Xcube kind of games or not.

7- How long did you play Xcube in one session? As you remembered.

- a. 0-10 Minute
- b. 10-30 Minute
- c. 30 Minute +
- d. I DON'T REMEMBER

This question aims to understand if the game experience is continuous and game flow is working ideally.

8- How did you define Xcube as a simple game or challenging game?

- a. SIMPLE GAME
- b. CHALLENGING GAME
- c. I DON'T KNOW

This question aims to understand the players choice of gameplay.

9- If we give you just one shape, do you like it or not?

- a. YES
- b. NO

- c. I DON'T KNOW

This question aims to understand if the player loves the limitation or not.

10- If the game gives you all shapes and you decide which to use, will you prefer that kind of gameplay?

- a. YES
- b. NO
- c. I DON'T KNOW

This question aims to understand if CR is working or not. If the player's answer is YES then this means CR makes the game more challenging by limiting the ability of the player and they get fun out of it. If they say NO its fine to play like CR then this shows us CR will make the game more playable for the player because it limits the decisions and makes the game more simple. This answer will be compared and reviewed by the answer to question six.

11- Have you ever been played with 'Lego' and did you enjoyed it?

- a. YES, I PLAYED AND ENJOYED
- b. YES, I PLAYED BUT DIDN'T LIKE IT
- c. NO, I DIDN'T PLAYED
- d. I DON'T KNOW

12- Have you ever been played with 'Rubik's Cube' and did you enjoyed it?

- a. YES, I PLAYED AND ENJOYED
- b. YES, I PLAYED BUT DIDN'T LIKE IT
- c. NO, I DIDN'T PLAYED
- d. I DON'T KNOW

13- Have you ever played 'Bejeweled Blitz' and did you enjoyed it?

- a. YES, I PLAYED AND ENJOYED
- b. YES, I PLAYED BUT DIDN'T LIKE IT

- c. NO, I DIDN'T PLAYED
- d. I DON'T KNOW

14- Have you ever played '1010!' and did you enjoyed it?

- a. YES, I PLAYED AND ENJOYED
- b. YES, I PLAYED BUT DIDN'T LIKE IT
- c. NO, I DIDN'T PLAYED
- d. I DON'T KNOW

15- Have you ever played 'Toy Blast' and did you enjoyed it?

- a. YES, I PLAYED AND ENJOYED
- b. YES, I PLAYED BUT DIDN'T LIKE IT
- c. NO, I DIDN'T PLAYED
- d. I DON'T KNOW

16- Have you ever played 'Two Dots' and did you enjoyed it?

- a. YES, I PLAYED AND ENJOYED
- b. YES, I PLAYED BUT DIDN'T LIKE IT
- c. NO, I DIDN'T PLAYED
- d. I DON'T KNOW

17- Have you ever played 'Candy Crush' and did you enjoyed it?

- a. YES, I PLAYED AND ENJOYED
- b. YES, I PLAYED BUT DIDN'T LIKE IT
- c. NO, I DIDN'T PLAYED
- d. I DON'T KNOW

These questions aim to understand if the player loves the other games that use COOC and CR. And why do they like them?