



**FLOW EXPERIENCE AND ACHIEVEMENT OF ADVERGAMES ON  
SOFTWARE DEVELOPERS: AN EYE-TRACKING ANALYSIS**

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**FLOW EXPERIENCE AND ACHIEVEMENT OF ADVERGAMES ON  
SOFTWARE DEVELOPERS: AN EYE-TRACKING ANALYSIS**

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## **ABSTRACT**

### **FLOW EXPERIENCE AND ACHIEVEMENT OF ADVERGAMES ON SOFTWARE DEVELOPERS: AN EYE-TRACKING ANALYSIS**

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The idea of using advertising in games has been emerging recently, along with the software and hardware improvements in recent years. The game industry also got benefits from these improvements and became more widespread. Therefore, while the games started to reach more people, putting advertisements in games, or creating games just for promoting brands began has grown profitable. These games are called “Advergames,” which are designed for a specific advertising concept. This study demonstrates and analyses the achievement of advergames on software developers in different conditions. These advergames are created with different game elements and measure the flow of players with the flow state scale questionnaire. They also provide the suggestion of where to place the brands using the eye-tracking analysis.

Firstly, to be able to demonstrate the benefits of advergames, a total of 44 software developers were selected. They divided into two groups; each group played one of two advergames which were developed. The difference between the two games was the number of game elements included. The second game had a reduced number of game elements that were music, voice acting, story, time, and leaderboard. While they were playing games, an eye-tracker followed and recorded their eye movements. For both groups, when each individual finished their tasks, data was collected from questionnaires of flow state scale, recalled brands and their products and eye movements of players. Collected data was measured using the Mann-Whitney U test and correlation analysis methods. For measurement of the flow, data was obtained by using the flow state scale questionnaire, and analysis was conducted based on the collected data. Lastly, for providing a suggestion about where to place brands, eye-tracking technology was used to determine the places where players commonly look. To be able to decide on the most looked places, the eye-tracking data of each individual was combined, and heat maps were created.

As one of the results of this study, for both groups, promoted brands and their products were recalled more than non-promoted brands and their products; and there was a significant difference between them. Secondly, during the measurement of flow, it was observed that both groups had flow experience at different dimensions. Besides, when analyses were made on eye-tracking data; the results were showing that the players were mostly gazing at the mid and high-level shelves and ignoring the bottom level shelves.

**Keywords:** Advergame, Game Elements, Flow Experience, Eye-tracking.

## ÖZ

### YAZILIM GELİŞTİRİCİLER ÜZERİNDE OYUN REKLMLARIN AKIŞ DENEYİMİ VE BAŞARISI: GÖZ İZLEME ANALİZİ

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Son zamanlarda, bir markanın ya da ürünün reklamının yapılması adına reklamların oyunlarda kullanılması gelişmekte olan bir düşüncedir. Son yıllarda oyun endüstrisi de yazılım ve donanım alanındaki gelişmelerden faydalanarak daha da yaygınlaşmıştır. Bu nedenle oyunlar daha fazla kişiye erişebilirken, oyunların içine reklamların yerleştirilmesi ya da sadece markaları desteklemek adına oyunlar yapılması karlı bir hale gelmeye başlamıştır. Özel bir reklamcılık konseptini uygulamak için tasarlanmış bu oyunlara “oyun reklam” adı verilmektedir. Bu çalışma oyun reklamlarının farklı oyun elementleri ile oluşturulmuş farklı durumlarda yazılım geliştiriciler üzerindeki başarısını sergilemekte ve analiz etmekte, bu kişilerin flow değerlerini flow durum ölçüm anketi ile ölçmekte ve oyuncuların oyun oynadıkları sırada elde edilen göz-izleme analiz sonuçları ile markaların yerleştirilmesi adına tavsiyeler oluşturmaktadır.

Öncelikle, reklam oyunların yararlarını gösterebilmek için, toplamda 44 yazılım geliştirici seçilmiş ve iki gruba ayrılmıştır. Her gruba geliştirilmiş olan iki ayrı reklam oyundan bir tanesi oynatılmıştır. İki reklam oyun arasındaki fark, oyunda içerilen oyun elementleridir. İkinci oyun müzik, seslendirme, hikaye, zaman ve lider tablosu öğelerini içermemektedir. Oyuncular oyunu oynarken, bir göz izleme cihazı oyuncuların göz hareketlerini kayıt altına almıştır. Her iki grup içinde, her oyuncu oyunu tamamladığında flow durum ölçüm anketi sorularını cevaplamış, hatırlanan marka ve ürünler hakkında sorular sorulmuştur. Toplanan veri Mann-Whitney U testi ve korelasyon analiz metotları ile ölçülmüştür. Flow ölçümleri için, flow durum ölçüm soruları sonucunda elde edilen verilerin oluşturulan analizleri kullanılmıştır. Son olarak da markaların yerleştirilmesi konusunda oluşturulan tavsiyeler göz izleme teknolojisi kullanılarak oluşturulmuştur. Oyuncuların hangi noktalara daha uzun süre ve sıklıkla baktıkları belirlenmiştir. En çok bakılan yerlerin oluşturulması için bütün oyuncuların göz izleme verileri birleştirilerek ısı haritaları oluşturulmuştur.

Bu araştırmanın sonuçlarından biri ise, her iki grup için, reklamı yapılan markalar ve onların ürünleri reklamı yapılmamış marka ve ürünlere göre daha çok hatırlanmış ve aralarında anlamlı bir fark çıkmıştır. İkinci olarak, flow ölçümleri sırasında, her iki grubun da flow deneyimini farklı boyutlarda yaşamış olduğu belirlenmiştir. Buna ek olarak, göz izleme verisi ile analizler gerçekleştirildiğinde, sonuçlar, oyuncuların çoğunlukla orta ve yüksek seviyedeki raflara baktıkları; aşağıda yer alan rafları ise dikkate almadıkları gözlemlenmiştir.



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## **LIST OF ABBREVIATIONS**

HCI: Human-Computer Interaction

AOIs: Area of Interests

FSS: Flow State Scale

MWU: Mann Whitney U Test

G1: Group 1 (Experimental Group)

G2: Group 2 (Control Group)

H1: Hypothesis 1

H2: Hypothesis 2

H3: Hypothesis 3

# CHAPTER 1

## 1. INTRODUCTION

Games motivate players to play by satisfying their needs, such as competence and autonomy. For this reason, there is a growing body of literature aimed at understanding the significance of games. While computer technologies were improved recently, the computer game industry has also benefited from that emerging trend. With these improvements, we see that some of the game companies also had noticeable growth, and these companies started to collaborate with other industries. Studies about using games have been carried out in recent years to give a solution for different areas like education, advertisement, serious purposes, political, etc. [1]. In particular, advertisement in games is born as a new concept of these areas, and these types of games are called “Adgames,” also known as “Advergames,” shortened from Advertising Games, which promote a brand or advertising slogan [2]. The number of people who can be reached around the world by using advergames is considerably high compared to conventional media tools [3]. Most importantly, advergames have a positive impact on the connection between a brand and the perceptions of the consumers [4]. Therefore, we see that the experiments on the usage of advertisements in games are increasing in recent years.

Human-Computer Interaction (HCI) comprises the design, implementation, and evaluation of interactive systems to develop a system that people use efficiently and effectively [5]. HCI finds out the process of the human brain, where they can focus on a system, how they can interact with the system and gives development principles. Eye-Tracking is one of the methods of HCI that collects eye movement data of individuals [6]. This method uses a camera that records human eye movements and software that can extract eye movements from camera recordings while recording the computer screen as well [7]. Therefore, data of the screen locations where people are looking at can be obtained. In this research, we used the eye-tracking method to collect

quantitative data on the player's decision-making process without affecting the player's behaviors and habits.

As mentioned before, game companies are using advertisements in games recently. On the other hand, computer games are different than other media tools that are using advertisements because they are more interactive. While using advertisements in the games, the players' abilities, behaviors, and habits also affect the success of advertisements. Therefore, to enlighten the path of advergaming, this research investigates the players' attitudes in advergaming by using the Eye-Tracking method of HCI and questionnaires.

**Chapter 2** starts with the definitions of game and advergence. It reviews the history of advergaming. The description of flow and flow dimensions are explained in this section. Lastly, eye-tracking analysis technology and its potential metrics are defined.

**Chapter 3** describes the research and experimental design, which are conducted in the study. Participants demographic information; and the reason why these participants are selected are clarified. Experimental and control groups are determined. For each hypothesis analyzing is indicated which data source and test method will be used. Dependent and independent variables are also explained for these hypotheses.

**Chapter 4** details the game design and implementation process. It explains the formal, dramatic, and dynamic elements of the proposed game. Then, the game development tools and the brand's models and their creation process are explained. More detail information is discussed about the two games.

**Chapter 5** gives the results of hypothesis testing. The results of tests are applied statistical analysis and illustrated by using visual elements. Two groups are compared and the differences between them are discussed.

**Chapter 6** draws the conclusion of this study. Contributions are also summarized and ideas shared for future work.

This study contains six chapters including with the introduction chapter. Structure of the thesis is given above.



## **1.1. Background and Motivation**

Games play an essential role in human life, which is considered to be a social glue between individuals who have similar interests. Games enable people from many different nationalities to communicate with each other. Besides, games allow feeling emotions that haven't been experienced in real life.

There are many motivating factors which occur during a gameplay session. Along with some of these various motivating factors are competition, cooperation, socialization, discovery, strategy, etc. [8]. Players are motivated voluntarily to play a game, and they make a great effort to learn the rules of the game [9]. Using the motivating factors and strengths of games, it has been occurred a source of encouragement to examine whether games are successful within different usage. Notably, games have been used in game-based learning areas, and they improve the knowledge and decision-making skills of the players [10]. Similarly, this research investigates the achievement of advertising a brand or product in games and how many advertised brands or products are remembered after gameplay.

To understand the motivations of the players, the flow, which is an optimal experience of fully immersing in an activity and feeling deeply happy [11], the experience is measured and analyzed in games [12] [13] [14]. When players experience flow, they are more concentrated in games, and the time of gameplay increases along with the experience [13]. There is a relationship between the visual attention of the players, the flow experience and game-based learning [14]. In addition, it is hypothesized that people have better cognitive learning under the flow state [15]. From this point of view, the purpose of this research is to analyze whether there is a relationship between flow and advergaming using the eye-tracking analysis Human-computer Interaction (HCI) method. To achieve this purpose, the state of flow that could be captured from people while playing games and the success of brand or product advertisements in a game will be measured with the support of eye-tracking data in a newly designed and developed supermarket game.

## **1.2. Research Questions and Hypotheses**

This research mainly focuses on the achievement of advergames and investigates the impact of advergames on players. Advertising in games is performed in two ways, which are advergaming and in-game advertising [2]. The first one, the main goal of the game is advertising a brand or product. The second one, the primary purpose of the game is not an advertisement, but advertisement is performed using names of a brand or placing it anywhere in games like a billboard. Brand placement on a billboard and the effects of this method on players are examined; however, after gameplay, it is failed to remember the names of the brands and products [16]. Promoting a brand and product placement are investigated in this research. Besides that, flow is measured, and players' reactions in advergames are investigated. Visual representation where players are looking intensively on a screen is analyzed.

### **4.2.1. Research Questions**

**Question 1:** Can players remember the brands or products when they see them on the advergame?

**Question 2:** Is there a correlation between number of game elements and the flow experience?

**Question 3:** In advergame, it is suitable place advertisement on any game area?

### **4.2.2. Hypotheses**

**Hypothesis 1:** Players can remember a brand and its product which is promoted by the advergame.

**Hypothesis 2:** Players have an experience of flow when the game elements increase.

**Hypothesis 3:** Players focus more on the positions corresponding to their eye levels.

## **CHAPTER 2**

### **2. BACKGROUND AND RELATED WORK**

#### **2.1. Introduction**

This section of the study gives information about the background and related work on the topic of the thesis. Firstly, chapter 2 starts with the definition of games and continues with the definition and history of advergames. Furthermore, there will be an explanation of the flow and flow's observation in games. The literature review part contains the past literature information about advergames and the flow in advergame. Lastly, the end of this chapter explains eye-tracking analysis in human-computer interaction and how eye-tracking technologies can be used to observe players' actions and their flow.

#### **2.2. Definition of Games**

There are several different definitions found in literature, and these definitions should be analyzed more in detail to understand the logic behind the games. Suits [9] points out that games give meaning with rules, goals, and limits; eventually, players play the games and willingly accept the rules of the game. A game can be defined as a system, organized with interrelated ideas or principles where players interact within an artificial conflict determined by rules, and at the end of the game, they get measurable results such as numerical scores [17]. In addition, according to Juul [18] a game defines as a system which is constituted based on rules and measurable results that players try to influence. Abt [19] defines a game as an activity with two or more participants, which consist of adversaries or cooperatives, which make an effort to accomplish their goals within restricted sources.

Consequently, selected definitions of a game state that all games are designed by specified rules and also that a game is an activity that contains goals, measurable results, conflicts, or cooperatives. In addition, the rules, goals or the story of the game gives information about the type of the game. Some types of games are action, adventure, educational, fighting, horror, strategy, puzzle, racing, role-playing game, shooter, sport, serious game, etc. [20]. Serious games differ from other types of games due to beyond entertainment they comprise training, health, social, advergaming [21]. Advergaming are a type of serious games that promote brands which can be by messages, logos, or any other characteristics [22].

### **2.3. Definition of Advergaming**

The main objective of some games so-called advergaming, which are a type of serious games, is advertising a brand [21]. Kanth [23] describes that advergaming which are designed for a particular objective, are using to convey brands, products or messages of the companies. When players play an advergaming, they know about the promotions that are offered by the company. Kanth [23] also defends when a brand is placed in the game as the main character, the player learns a lot of things regarding the brand at the end of the game. Advergaming are mostly video games whose purpose is to advertise and keep a place in the consumer's minds [23]. Groot defines [24] that interactive video games, which are designed around a brand or product, to provide promotional incentives and to enhance consumer awareness. They are an effective way of delivering the advertising message to customers on these games and affect the knowledge of the campaign in a short time [25]. The other definition is, advergaming are online games that contain marketing content [26].

Svahn [27] identifies a three-step systematization of the advergaming, according to Jane Chen and Matthew Ringel. The three categories could be a guide to understand the design structures of advergaming.

**Associative:** Associative means that the relation between brand logo and the lifestyle themes in a game. The association demonstrates aesthetics matches the brand themes and game themes. Products are not directly work in a game, and in-game billboards are the best example of these types [27].

**Illustrative:** Illustrative means products are appeared as a feature in a game and players interact directly with the products [27].

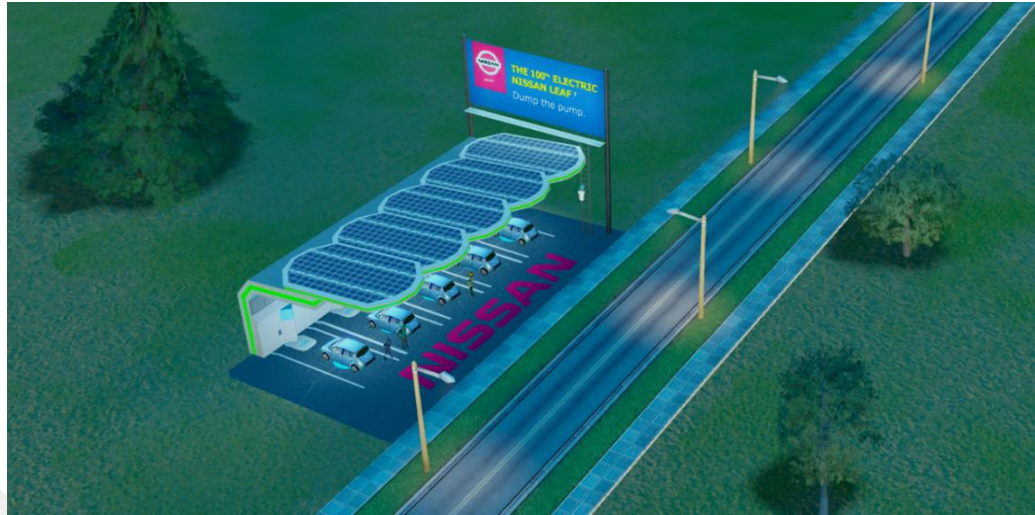
**Demonstrative:** Demonstrative designing a game and the game story is associated with the attributes of individual product, for instance; a digital basketball game, the achievement depends on the selected shoes [27].

## 2.4. History of Advergame

Firstly, in the early 1980s, some brands started to use advertisements experimentally in games [28]. A game (Tooth Protector), which gives message regarding tooth protection and mouth hygiene, was published for Atari 2006 in 1983 [28]. Teeth are protected from snack attack furthermore when they are saved from decay the game gives more points. It is an advergame which offers a social message concerning hygiene. Advergames collect a data insight of consumers, and they promote people their messages. For instance, U.S. Army Game, which is an advergame, provides to increase recruitment numbers of American Army [2]. Smokefree is an advergame to teach how cigarettes cause cancer [2]. The game gives a social message about that smoking should be avoided. Advergames are widely famous in racing video games. For instance, “Need for Speed: Porsche Unleashed” promotes Porsche sports cars in the game [29]. Another example is “Gran Turismo,” which is a real driving simulator games, and the game producer created a vehicle for Red Bull [30]. Furthermore, after the game is developed, AUTOart announces that these cars will be produced in real life [30].

On the other hand, some video games are not only developed for advertising purposes, but they might take advertisement from a brand or product, and they use in the game part. SimCity offers components that players can build a city in a blank space and later versions; SimCity publishes “Nissan Leaf Charging Station” in 2013 [31]. This content has a buildable charging station which includes Nissan’s chargeable electric cars and increases the happiness of sims (people living in SimCity cities) when built on a city. Figure 2 shows that the brand of Nissan is written on the car charging station. “Darkened Sky” is promoted a brand Skittles which is a type of candy. When the player

collects candy, her life points are increased, and she can attack by using these candies [32].



*Figure 1: Nissan Leaf Charging Station in SimCity [31]*

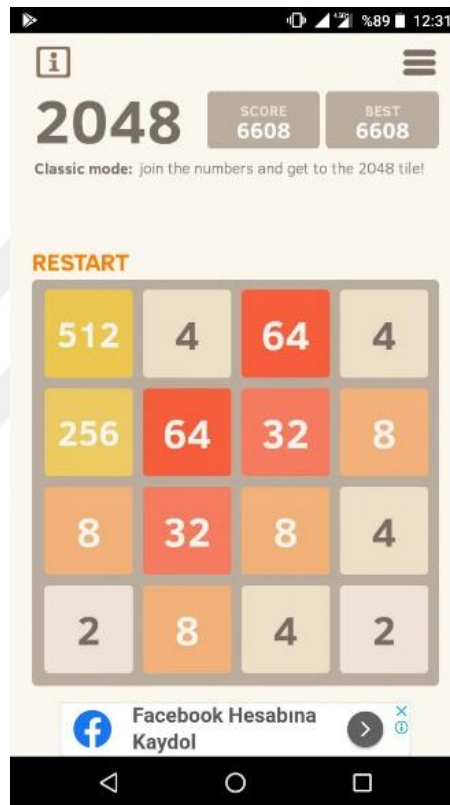
On 6 December 2018 Capcom employee Andy Wong announced “Sponsored Content” in Street Fighter V Arcade Edition game [33]. With this addition, players either choose not to show advertisements (called “ads” in the game) or accept displaying advertisements and earning in-game currency. Figure 2 shows that there are “Capcom Pro Tour 2018” logos are placed on both fighters’ gloves and costumes.



*Figure 2: Capcom Pro Tour 2018 Street Fighter V: Arcade Edition*

However, on 17 December 2018 Street Fighter series producer Yoshinori Ono made an announcement on twitter about in-game advertisements in Street Fighter game and the advertisement system was removed from the game [34].

On the other hand, in the mobile game development industry, advertisements in games are being used commonly in free games of Google Play. In Figure 3 under the game area of the game named 2048 [35]; Facebook advertisement can be seen clearly. When a player touches the advertisement intentionally or mistakenly, the game redirects the player to the Facebook front page.



*Figure 3: Facebook Advertise on 2048 game*

Godzilla: King of the Monsters, which is a movie published 2019, advertises their Godzilla visual items on t-shirts in PUBG mobile [36]. Figure 4 represents the t-shirts in-game.



Figure 4: PUBG Godzilla t-shirts

## 2.5. Flow in Games

Observing effects of flow is one of the ways to learn whether the player is enjoying in a game. The flow will also assist in measuring whether the game has achieved its own goals. Flow is a guide to clarify of optimal experience state which people focus their attention activity and to achieve the activity goals. Flow is a guide to explain the optimal experience state which people focus on an activity and pay attention to achieve the goals of that activity [11]. Besides, Csikszentmihalyi [37] describes the flow items under the nine main titles which are a challenge-skill balance, action-awareness merging, clear goals, feedback, the concentration of task, control, the loss of self-consciousness, the transformation of time, autotelic. According to flow items, people's cognitive situations can be described how they feel when they concentrate on activity [37].

**Challenge-skill balance:** Person skills should be proper to accomplish the goals of the requirements of activity [38]. Similarly, mechanics and rules of games should be arranged according to the player's ability in case players are bored from the game.

**Action-awareness merging:** When a person in the flow state, the person is completely immersed in an activity, for this reason doing the activity becomes spontaneously and automatic. The person doesn't separate herself/himself from the activity [37].



**Clear goals:** Goals of an activity should be defined clearly to involve in the flow state [37].

**Feedback:** Reliable feedback gives a piece of information about what the people situation is in an activity [38]. It also brings away people in flow state.

**Concentration of task:** While people are doing an activity, they concentrate on success goals of the activity, and they forget unpleasant things of their life [38]. People also don't think about things unrelated to the activity.

**Control:** People have got control of their own decision results whether fail of activity or not [38]. Results are not vital for them so they can easily make a decision.

**The loss of self-consciousness:** When people have deeply engrossed an activity, they sense self-separate from the world around, and don't pay attention to consider past, future, or any other stimulus [37].

**The transformation of time:** While people are doing an activity in the flow state, the people lose sense of time [37]. They spend long hours, but this time may be felt a couple of minutes.

**Autotelic Experience:** The term of "autotelic" comprises of two Greek words, auto meaning self and telos meaning goal that means doing the activity with intrinsic motivation instead of external expectations [37].

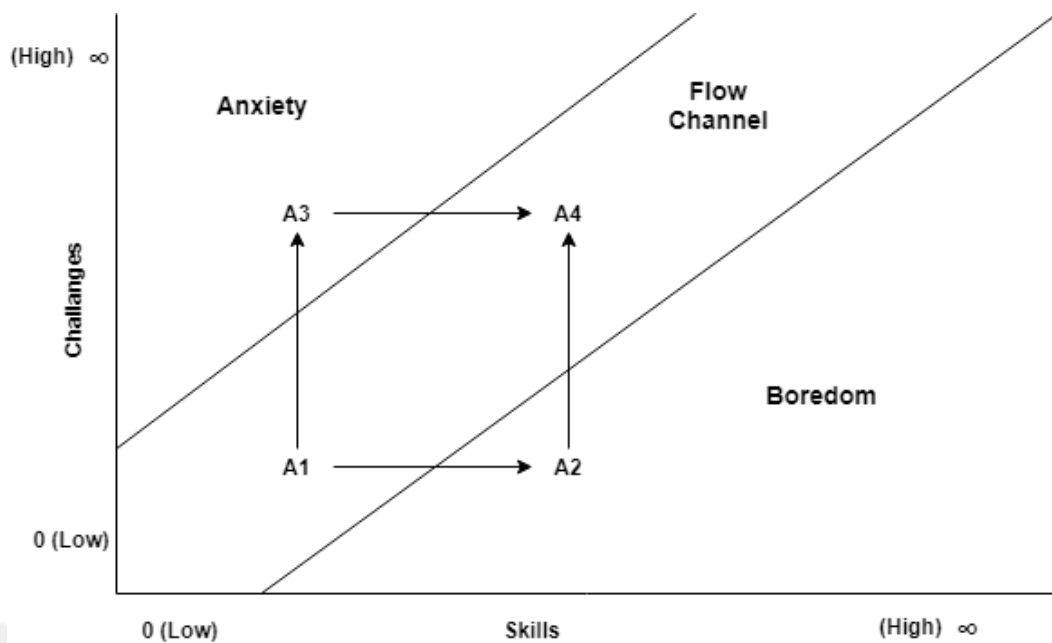


Figure 5: Challenge and Skill Balance, adapted from [37]

Figure 5 represents challenge and skill balance, which can be in a playable game. If a game is so easy according to player skill, the player will be bored from the game. On the contrary, if a game is so difficult to player skills, the player will get anxiety. Therefore, games progression should be arranged regarding player skills. In this way, the player will be in the flow channel as well as this channel will be demonstrated the success of the game. While people are playing a computer game flow items can be observed above the players. Computer games have got different levels according to player progression skills. Games allow trying experiences which people will not come across in real life. For this reason, each player can be experienced his/her dream by games. Flow experiences are researched in computer game that results are indicated strategic decision making like evaluating or analyzing that impacts a positive change of student's cognitive process [12]. While players are playing a game that they are experiencing cognitive flow, their behaviors are also affected.

## 2.6. Advergame in the Literature

“Chipotle’s the Scarecrow” published by Colorado-based Mexican cuisine fast-food restaurant in 2013 [39] [40]. The game gives a secret message of the company that protects food and crops from harmful substances and produces products from healthy

ingredients. In this way, the short video of the game becomes quite popular, and it is displayed 13 million times, and 16.000 comments are written on YouTube [39]. The other advergaming is promoted healthy nutrition and encourages children to choose through what the game is advertised [41]. According to the results, children understand healthy and unhealthy food [41]. Playing a game has a positive effect on brands especially unfamiliar brands, comparing to other brands with no advergaming [42]. A significant relationship was found between flow and advergaming. Advergaming influence buying behaviors of players, and flow experiences provide a connection between them [4]. There is a connection between playing a game and Game-Based Learning (GBL) because players should rapidly make a decision in a limited time, follow game messages or visual targets or think optimal strategies [15]. Results show that players have better conceptual comprehension in GBL when they have in the flow state [15].

## **2.7. Eye-Tracking Technology**

Eye-Tracking technology is used visualization of where people are looking at on the screen with various colors or intensity indicators and their eye movements [43]. Eye-tracking technology is being used to understand human behavior in varied areas [6]. Obtained behavior data from player eye movements can be used to describe usability and other game problems [44]. Survey or interviews are using to evaluate cognition of person; however, these techniques are providing subjective evaluation [14]. Eye-tracking technology is not depending on the person and offers objective evaluation opportunity giving data like eye movements, screen capture, task completion time [14]. Eye-tracking measures (percentage of duration in zone and percentage of fixation count in the zone) association the significant relation is showed between flow and the time distortion [15]. Eye-tracking methods are using to analyze human comprehension activities; mainly, fixation duration reflects problem-solving processes in game-based learning [45]. Fixations represent human comprehension process [46], the high values indicate strong cognitive effort [47]. Additionally; eye-tracking devices, which is adapted to use an input device like a game controller in games, have been found new usage area. [48].

### 4.2.3. Eye-Tracking Metrics

**Fixation:** Gaze points are aggregated specified area and timespan, which is fixation count and fixation duration in milliseconds in a determined area [49].

**Gaze Duration:** Gaze duration includes several fixations and a small amount of time short saccades between these fixations [50].

**Area of Interest (AOIs):** Areas of interest (AOIs) are determined on the visualized area that defines fixations of gaze points within the selected area (AOIs) or not [34].

**Fixation Count:** It measures the number of times the participant fixates on the area (AOIs) [14]. Fixation count also indicates more important areas [50].

**Fixation Duration:** It measures the sum of each fixation within (AOIs) [51] This metric indicates correlated with cognitive function that longer fixation duration increases cognitive function [6].

**Visit Count:** Visit count is started to begin when the first fixation on an active (AOIs) and finished the fixation on something outside of the (AOIs) [52].

**Visit Duration:** It is the sum of the duration of each fixation within a visit [52].

**Heatmap:** Aggregate eye movements are visualized through heatmaps [53]. Heatmaps are much cleaner within the higher fixation area [53].

## CHAPTER 3

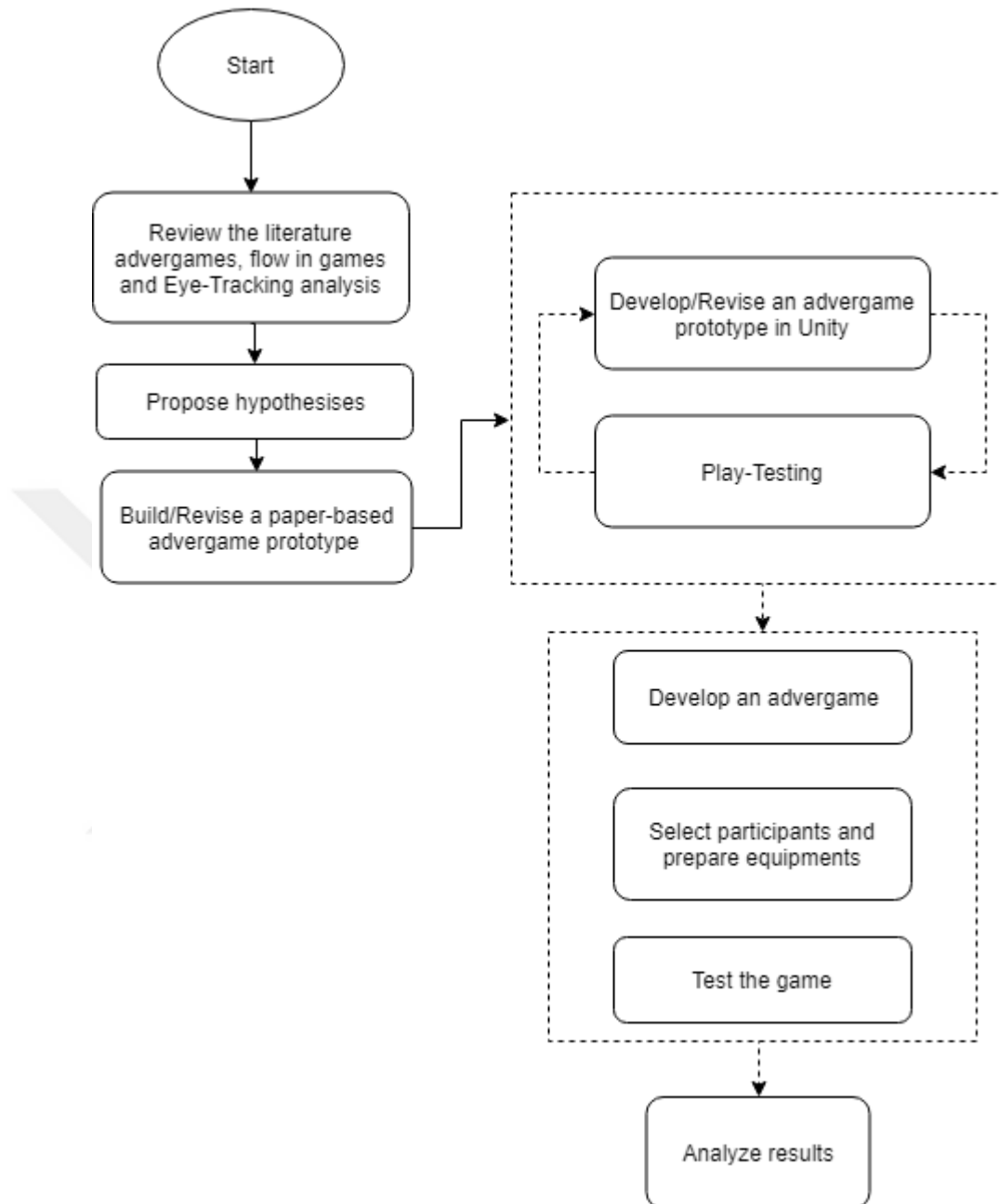
### 3. METHODOLOGY

#### 3.1. Introduction

This section gives information about the methodology of the current study. It starts the brief description of the research and data collection methods in the second section. The third section gives information about the experimental design and technical specifications of the devices. The fourth section offers the instructions of experimental test. The fifth section defines the demographic information of the participant. Dependent and independent variables are determined in the last section.

This study is being conducted as a part of accreditation requirements, and, thus, not considered human subjects research by definition. This study does not constitute a human subject research based-on human subject office at the University of IOWA (<https://hso.research.uiowa.edu/studies-are-not-human-subjects-research>). Firstly, the data is collected from questionnaires about the experience of gameplay and eye-tracking analysis. Secondly, eye-tracker is observed and recorded the eye movements. Tobii eye-tracking device is using near-infrared illumination LED lights, which is tested and approved by IEC/EN 62471 European Standards on light emission that meets this standard, and it is not harmful to the human eye. The light source is used to create reflections on the eyes [54]. Consequently, this study was not found within the scope of the ÇANKAYA University Ethics Committee, and it has not been reviewed by research ethics committee.

### 3.2. Research Design

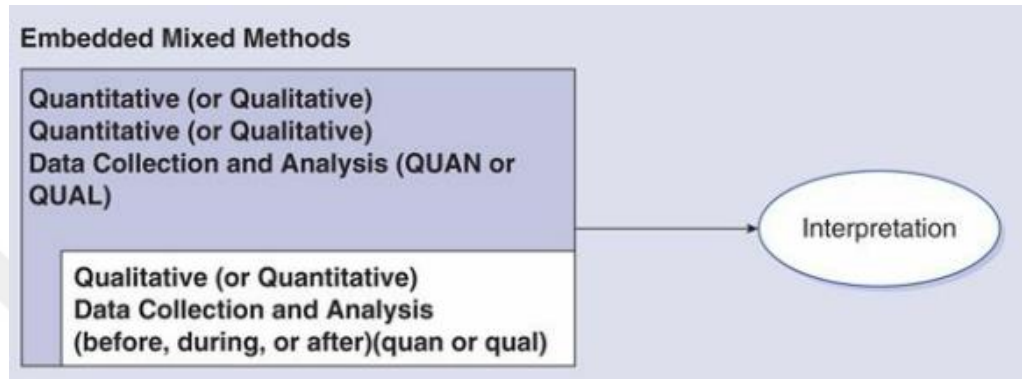


*Figure 6: Research Design Process*

Figure 6 represents the followed steps of this research. This study starts that literature was reviewed about the advergence, flow in games, and eye-tracking analysis. After research questions were determined, three hypotheses are defined. To designed an advergence, paper-based prototypes were built and reviewed. Development processes comprised of the third iteration. After the iterations were completed, advergence was

developed, and participants tested the game. Participants were selected according to their software developer experiences.

This study uses mixed research consist of combining quantitative and qualitative data [55]. The embedded mixed method is a type of mixed method research that one of quantitative and qualitative data is supportive of the other data [55]. Figure 7 represents the usage of the embedded mixed method.



*Figure 7: Embedded Mixed Methods [54]*

Quantitative data is the primary role and qualitative data supportive the quantitative data in this research.

- The game directly promotes six brands, and twelve brands are placed beside the promoted brands in the game. Players are asked to match products and their brands. Results give qualitative data.
- Players demographic information is asked to analyze the flow experience.
- Jackson and Marsh [56] developed questionnaires to measure Flow of athletes. In this study, the questionnaires are translated to Turkish and asked players after gameplay. Turkish questionnaires are indicated in Appendix B and the original version is indicated in Appendix C. Flow state scale (FSS) survey 5 Likert scale and consists of 36 questions (4 items per dimension) measure the flow experience [56]. Results give qualitative data.
- Eye-tracking data is used qualitative data.
- One question (37. question) that is a description of flow experience [38] was asked to players if they had directly experienced flow in 5 Likert scales. 38. and 39. questions are asked what they are motivated and demotivated them. The Turkish translation is given in the Appendix B and the original version is

placed in Appendix D. Next, if they have experienced the description of flow, they answer the question of which factors are motivated them or if they haven't experienced the description of flow which factors are demotivated them. Players comments give quantitative data.

Table 1 gives the information about data source and analysis method for each hypothesis.

*Table 1: Research Design Matrix Adapted from [14]*

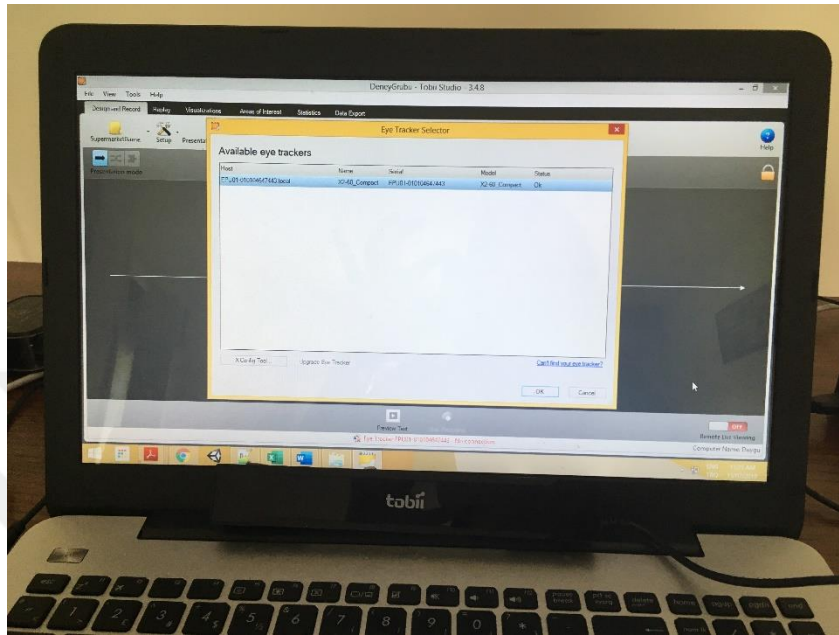
| <b>Hypothesis</b>   | <b>Data Source</b>                    | <b>Method</b>                               |
|---|---------------------------------------|---|
| <b>H1:</b> Players can remember a brand and its product which is promoted by the advergaming. | Matched of brands and products        | Mann Whitney U Test                         |
| <b>H2:</b> Players have an experience of flow when the game elements increase.                | Flow State Scale<br>Player's comments | Mann Whitney U Test<br>Correlation Analysis |
| <b>H3:</b> Players focus more on the positions corresponding to their eye levels.             | Eye-Tracking Data                     | Heatmap analysis<br>AOIs analysis           |

### **3.3. Experimental Design**

**Eye-Tracking Analysis:** Eye-tracking analysis has a great place in human-computer interaction due to digitizing the people eye movements and aggregate data of where they are exactly looking on the screen. Interfaces are designed simple and more useful to provide faster and easier access to a piece of highly significant information by using this analysis. In this study, the eye-tracking analysis uses where players are pay attention and generally looking in the game. Eye-tracking analysis methods that fixation, area of interest, gaze duration, fixation count, fixation duration, visit count, and visit duration are used to analyze.



Tobii X2-60 Compact Eye Tracker was hired from “Bilten Bilişim” for three weeks. Learning the functionalities of the eye-tracker device and using it took approximately one week, collection of eye-tracking data was completed in two weeks. It was used as the main screen for real-time eye movements recording.



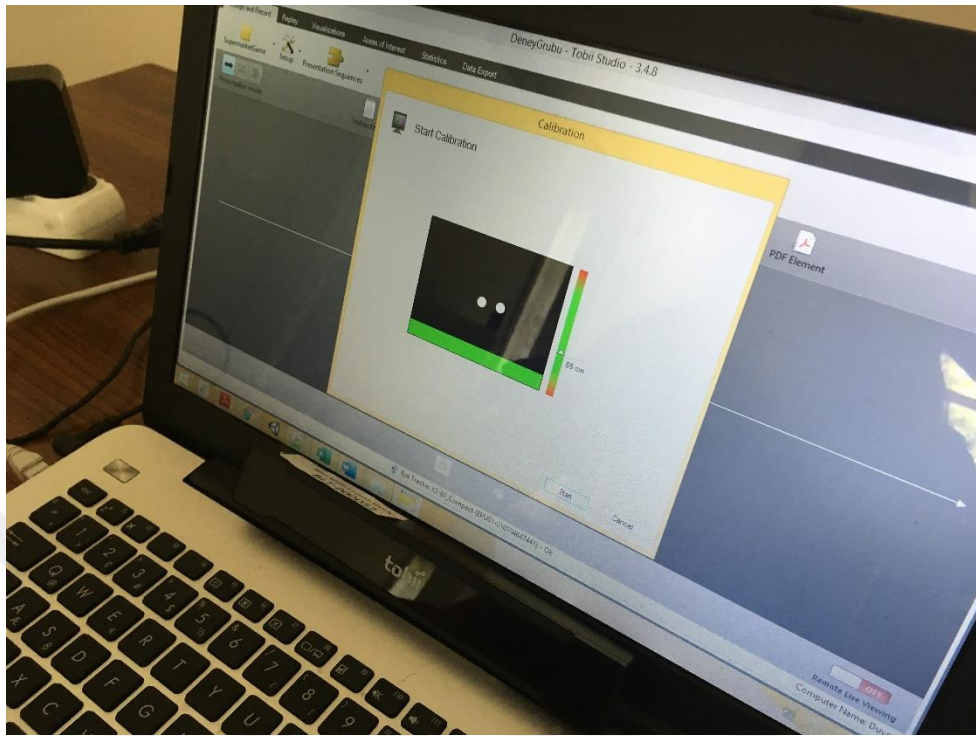
*Figure 8: Tobii is fixed on the magnetic holder*

A magnetic holder is slicked on the frame under the screen. Tobii eye tracker in Figure 8 is fixed on the magnetic holder. This holder avoids changing the eye tracker position. Figure 9 represents the eye-tracker device.



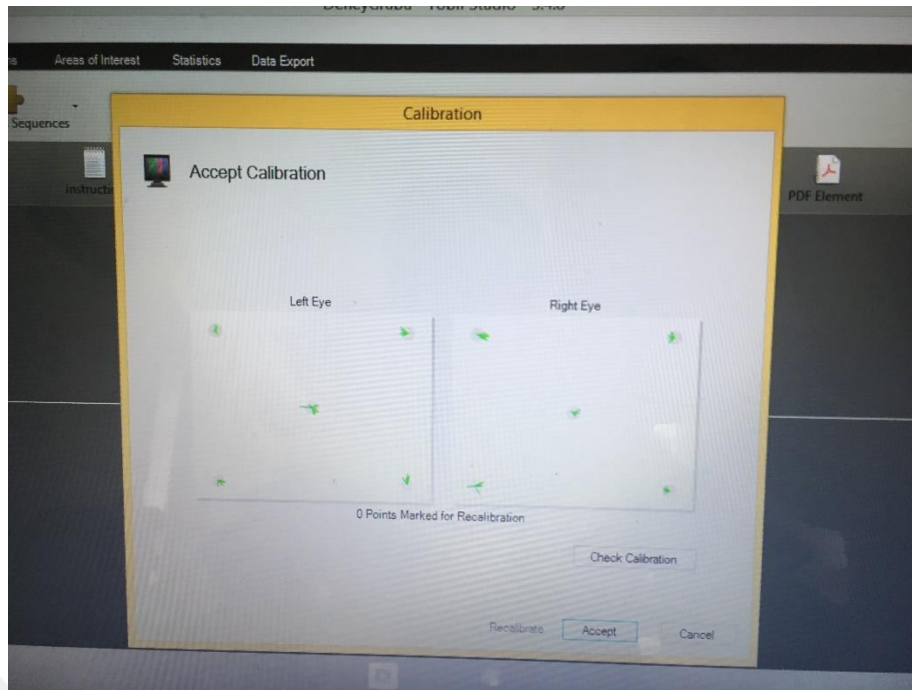
*Figure 9: Tobii Eye Tracker device*

For optimal distance from the participant's eyes to the eye tracker should be approximately 65cm [57]. Figure 10 represents the distance between the participant's eyes and eye-tracker.

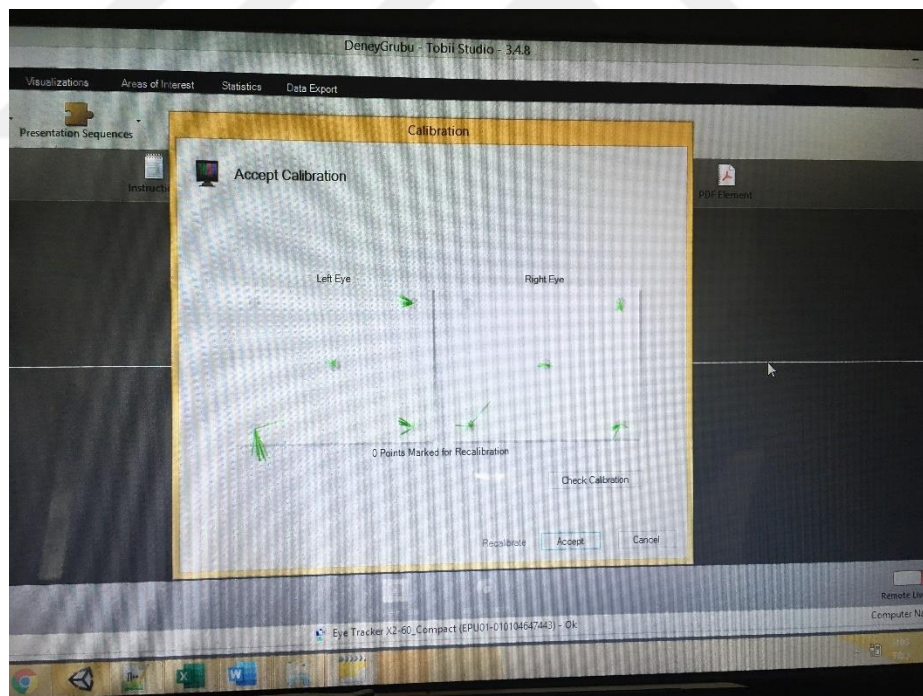


*Figure 10: Distance between participant's eyes and eye-tracker*

Before recording, each participant performs eye calibration process due to the exact location of the fovea varies from participant to participant. The calibration process ensures that eye tracker qualifies characteristics of the participant's eyes and customizes gaze point calculation [51]. Figure 11 represents an accepted calibration and Figure 12 represents an rejected calibration.



*Figure 11: Example of Accepted Calibration*



*Figure 12: Example of Rejected Calibration*

The testing games were running on ASUS 5500U laptop with following specifications:

- Intel Core i7 Processor, 2.40 GHz.
- 1366 x 768 Screen Resolution

- 15.6-inch Display Monitor
- 8 GB Ram 64 bit
- Windows 8.1

### 3.4. Experimental Test

Two games were developed within this research. The first game was designed rich with game elements, and the second game was created with excluded a few game elements. While participants were playing the game; eye tracker records their eye movements. An office was arranged for tests. During the tests, to be ensured office windows blinds were closed, the office door was closed, and mobile phones were asked to be turned off. Each experiment was conducted with one participant and the researcher. Before the game started, that was given the general information about eye-tracker and the game to the participants.



*Figure 13: Participant is playing the game*

### 3.5. Participants

Human-Computer Interaction studies, participant number enough less than 30 [58], getting quantitative results 20 participants are offered [59]. To compare two groups, 13-50 participants for each group are enough in the eye-tracking analysis [60]. In this study, two groups are designed, and each group has got 22 participants. The first group is the experimental group; the second group is the control group. A total of 44 software developers volunteered to participate in the advergaming with an eye-tracker to record their eye movements. Before the test, each participant has filled their demographic information, and they were divided into two groups their video game experiences. They answered a scale between 0 to 100 to the question of video game experience. If any participant was selected “0” video game experience, the participant was not included in the test. Participant’s video game experience should be from a minimum 10 and maximum 100. All participants have experience of software developer and video game playing experiences. Demographic information is given in the Appendix A.

### 3.6. Dependent and Independent Variables

Table 2: Dependent and Independent Variables

| Hypothesis  | Dependent Variables  | Independent Variables                               |
|---|--|---|
| <b>H1:</b> Players can remember a brand and its product which is promoted by the advergaming. | Number of remembered brands and their products after playing an advergaming. | Promoted brands in the advergaming.                 |
| <b>H2:</b> Players have an experience of flow when the game elements increase.                | Players flow measurements.   | Game elements.                                      |
| <b>H3:</b> Players focus more on the positions corresponding to their eye levels.             | The size of player’s gaze points.  | Player’s eye levels on the corresponding positions. |

Table 2 shows that dependent and independent variables for each hypothesis. For the first hypothesis, the number of remembered brands and their products is the dependent variable and promoted brands are independent variables. For the second hypothesis, flow measurement is the dependent variable, and game elements are the independent variable. For the third hypothesis, the aggregate gaze points are dependent variable and player's eye levels on the corresponding position is the independent variable.



## CHAPTER 4

### 4. DESIGN AND IMPLEMENTATION

#### 4.1. Introduction

Chapter 4 covers the game design and implementation process. The second section informs about the general content of the developed game and explains used game elements. The last section gives detail information about tools, components, the structure of the game.

#### 4.2. Game Design

The game is an “illustrative advergame” [27] that player and brands are directly associated between them. The advergame was designed by using supermarket concept. Some products, which were matched with brands given animal names, were placed on shelves of the supermarket. A shopping list was given to players, and they were asked to find the products of this list. Determined brands of products are written on the shopping list. Different brands belonging to the same product but not written in the list were placed on the top or bottom shelf of the desired products. A game demonstration of brands and products are given in Figure 10. Promoted brand (Lion Detergent) is written in the shopping list (the corner of the bottom of the scene), and products are placed on the shelf. Goat Detergent has placed the top of the shelf, Penguin Detergent has placed the middle of the shelf, and Lion Detergent has placed the bottom of the shelf. The game advertises Lion Detergent, but Goat and Penguin detergents are non-promoted brands. When players show the detergent written in the shopping list, they should click the product. If all of brands and products are found in the shopping list, the game is completed. Figure 14 represents the part of the gameplay. A shopping list is given at the bottom of the left corner, Lion Detergent is written in the shopping list.

Player tries to find Lion Detergent from the shelves. Goat and penguin detergents are also placed near the Lion Detergent.



*Figure 14: The Representation of Gameplay Level 1*

#### **4.2.4. Formal Game Elements**

Two games were designed in this research. Both games are the same concepts, but some game elements were excluded from the second game.

**Player Interaction Pattern:** The game is played with one player who has a role a customer.

**Objectives:** Finding all the products of the shopping list in the supermarket.

#### **Rules:**

- Players should include themselves to the game by writing their names in the text box area and click to the add button.
- If players are included themselves before in the game, they can write their names and click to the continue button.
- Each level is opened after the previous level is completed.
- The game consists of 3 levels, and products positions are changed at each level. Each level gets unlocked after successful completion of the previous level.



- First level includes 1 product in the shopping list, and the level completion time is 120 seconds.
- Second level 2 products in the hopping list and completion time are 110 seconds.
- Third level 3 products in the hopping list and completion time are 100 seconds.
- The player can play the same level again when the time is up.



*Figure 15: Overview of Game Scene Level 2*

Figure 15 presents a scene of Level 2. Chick Milk and Zebra Wafer are written in the Shopping List. Players try to find these brands and products in the Supermarket.

**Procedures:** The game is started selecting the first level, and players should be quick to complete the level in a limited time.

**Boundaries:** The supermarket includes 12 shelf groups that various off-brand products are placed. A part of 6 shelves are selected, and promoted products are put on these shelves.

**Controls:** Basically, the game controls are similar to the “first-person” type of games. The player can control his character with using mouse and keyboard. For directional movement, the player can use “w, a, s, d” letters. For looking at different locations, the player uses a mouse. To get products within the shopping list, the player uses the left button of the mouse. A detailed description of keyboard and mouse controls can be seen in Table 3.

Table 3: Keyboard Inputs and Actions

| Controller Device | Input           | Action                   |
|-------------------|-----------------|--------------------------|
| Keyboard          | w               | Move forward             |
| Keyboard          | a               | Strafe left              |
| Keyboard          | s               | Move backward            |
| Keyboard          | d               | Strafe right             |
| Mouse             | Cursor Movement | Look at location         |
| Mouse             | Left click      | Put production to basket |

**Resources:** 1 supermarket and 12 shelf groups, 1 shopping list that is hold by hand on the left side of scene, products, an old woman who helps from players, leaderboard that is listed players scores, 1 timer, background sound, warning sound of remaining time (last 20 seconds), sound of task that “Complete the shopping list on the left side.”

Figure 16 shows the introduction of Game 1. The old woman says that “My dear, I am too tired and old. I have to be bought orders from market. Can you help me?”. Players enter their names, and level 1 is activated to play.



Figure 16: Introduction of Game 1

**Promoted Products:** Leon Detergent, Chick Milk, Rooster Cheese, Zebra Wafer, Deer Tea, Panda Chocolate.

**Non-Promoted Products:** Elephant Cheese, Giraffe Cheese, Goat Detergent, Penguin Detergent, Butterfly Chocolate, Rabbit Chocolate, Bird Wafer, Chicken Wafer, Pelican Milk, Squirrel Milk, Fox Tea, Owl Tea.

#### **4.2.5. Dramatic Elements**

**Premise:** When the game is started, an old and tired woman asks for help from the player to buy his shopping list. To be able to increase dramatization, in addition to visual representation and textual description, the old woman voice acting was also added to the game.

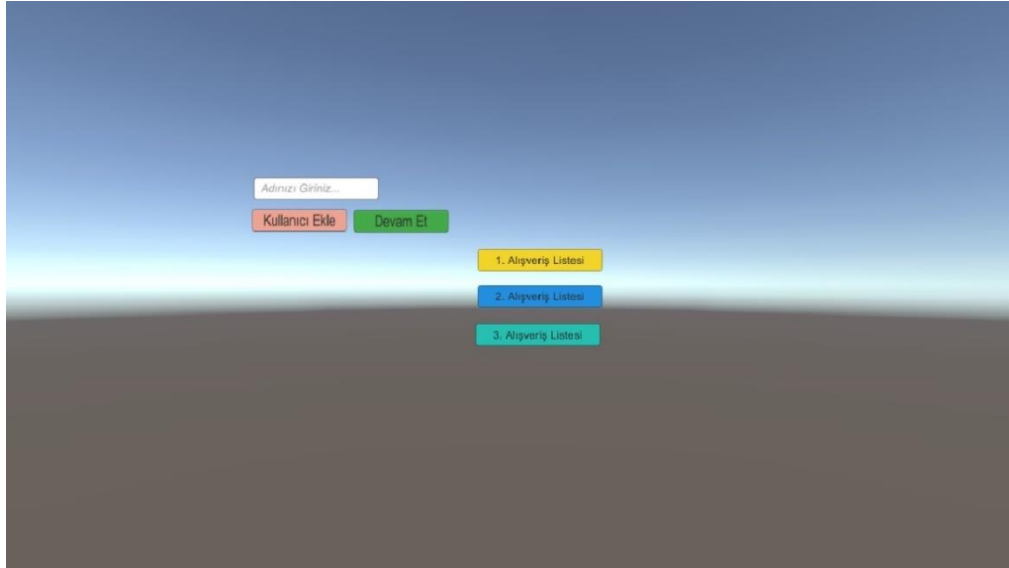
**Character:** The game type of view is First Person [20] that means a graphical perspective rendered the viewpoint of a player's character. Players cannot see anybody of an avatar in the game; they look around their eyes.

#### **4.2.6. Dynamic Elements**

Some challenges are added to ensure balance in the game. The degree of difficulty is increased as the level is increased. One product is found on the first level whereas three products are found on the third level. Besides, the completion time is decreased at each level.

#### **4.2.7. Excluded Game Elements for the Second Game**

A new game is designed after excluding some game elements from the first game. The old woman, leaderboard, and timer are removing directly from the second game. Players are playing the selected level until all products are found. Levels are transformed as shopping list 1, shopping list 2, and shopping list 3. Background sound, warning sound of remaining time (last 20 seconds) and sound of the task that "Complete the shopping list on the left side." are directly excluded in the game. While shopping list that is held by hand in the first game, the shopping list is placed on a box in the second game. Except for these elements, all other features are the same as the first game.



*Figure 17: Introduction of the Second Game*

Figure 17 shows the introduction of the second game. After players entered and saved their names, they choose one of the three tasks.



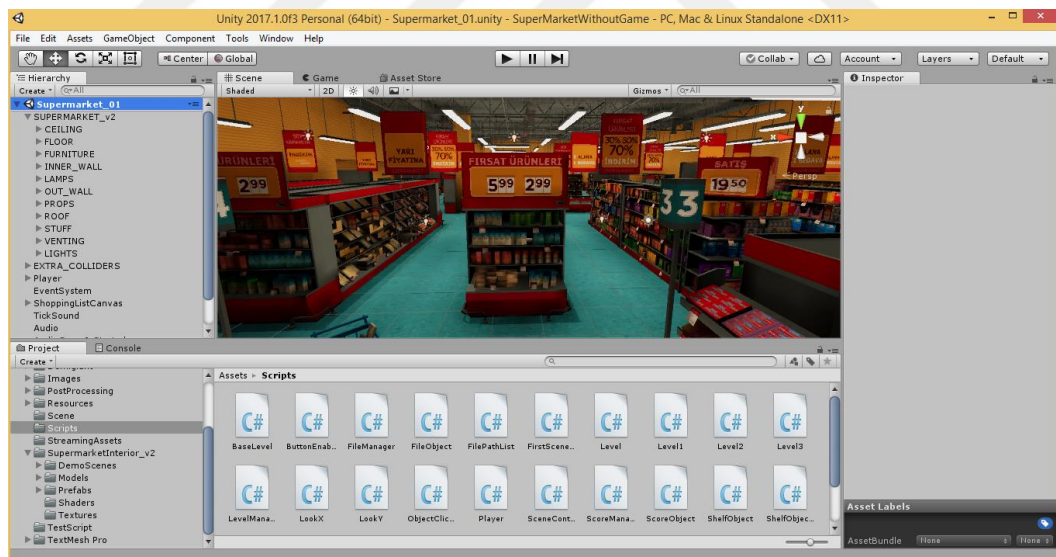
*Figure 18: Overview of Second Game Scene Level 1*

Figure 18 represents the overview of the second game level 1. Players try to find Leon Detergent in the Supermarket.

### 4.3. Implementation

The game development process was completed after the third iterations. In the first iteration, the supermarket model was placed in Unity. Lights and perspective of the supermarket were adjusted. The first-person character was designed, and the character functionalities were arranged. The character was walking with the device inputs (w, a, s, d) and changing perspective with mouse. In the second iteration, brands and their products were designed in Blender. The brand models were placed on the shelves of the supermarket. In the third iteration, game elements were added to the game. To arranged the balance of the game, after each game elements were added to the game, the game was play-testing. The game was revised according to the results of play-testing. This process continued until the game rules were entirely determined. After the play-testing was finished, the adverggame was completed.

The Unity 3D game engine, which is for students and version 2017.1.0f3, was used as the developing platform for both two games using Unity C# game scripts. Figure 19 shows 3D game development platform in Unity.



*Figure 19: 3D Game Development Platform*

Figure 20 represents using classes in Visual Studio solution explorer.



*Figure 20: Classes are using in games*

Figure 21 indicates the class diagram. Game classes were inherited from Unity MonoBehaviour base class to derive interaction between player and UI components. Bitbucket was used to code version control.



The Supermarket 3D model was bought from <https://assetstore.unity.com>. Figure 22 shows the model in the asset store account.

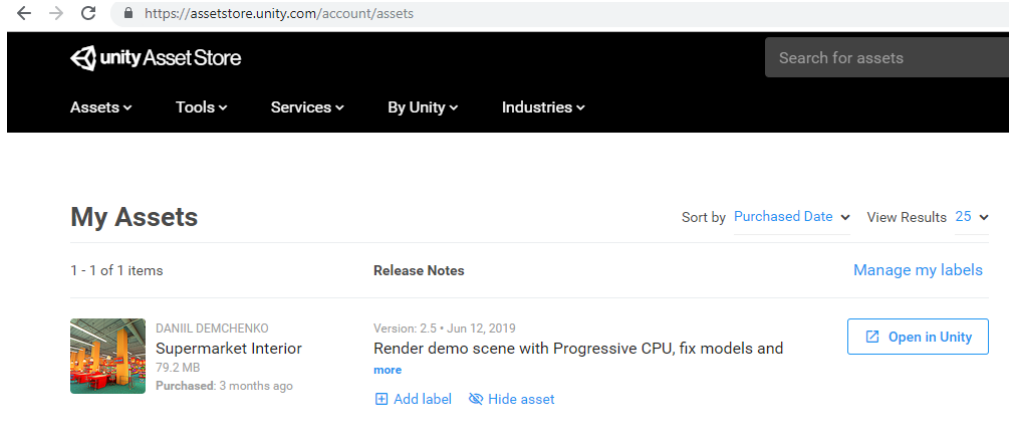


Figure 22: Supermarket Model in Unity Asset Store

3D models of promoted and non-promoted brands are designed on Blender free version 2.79. Pictures were prepared on Gimp version 2.10.10. Brands, which are animal names, were written in Turkish. Animal images were downloaded google as usage rights “free to use or share” type. Figure 23 represents the created brand model in Blender.

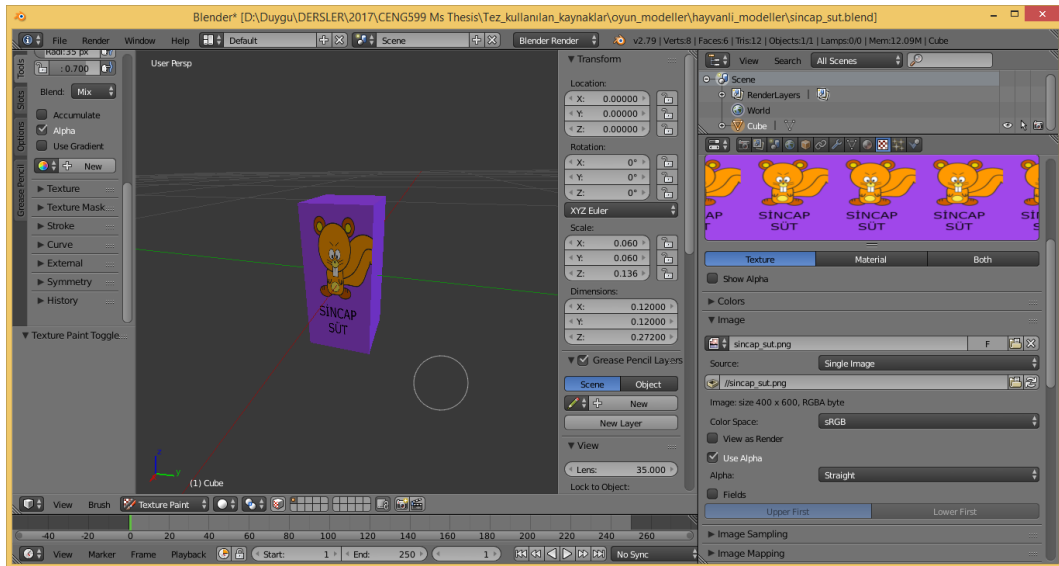


Figure 23: Brands Model Creation in Blender



## **CHAPTER 5**

### **5. TEST RESULTS AND ANALYSIS**

#### **5.1. Introduction**

This section is for gathering the testing results of the described methods mentioned in Chapter 3 and providing analysis based on these results. Experimental and control groups were discussed in the previous chapters. The experimental group played the first game, which has more game elements and the control group played the second game, which is excluded a few game elements. Both of two games had same brands and products also their shelf positions didn't change. While players were playing the game, eye-tracker followed and recorded their eye movements. After gameplay, they filled questionnaires which contain demographic information, flow scale, remembered brands, and their products. The details of the results will be illustrated; analysis and assessments of the results are demonstrated. Descriptive results are prepared in Microsoft Office Professional Excel 2016, and the other statistical analysis is performed in SPSS Statistics Version 22.

#### **5.2. Completion Times of Tasks**

For both groups and games, 6 promoted and 12 non-promoted brands were the same, and also, they have placed the same shelf positions in the supermarket. Players are given the task of finding all products of their shopping lists in a supermarket environment. For first player group and first game, the levels are named as "1. Level", "2. Level" and "3. Level". On the other hand, in the second game, and for the second player group, due to the level names were removed, the naming was changed to "1. shopping list", "2. shopping list" and "3. shopping list". Although both groups played

the game until they become successful at levels; the second group did not see or hear any time limitation warnings. Figure 24 illustrates the definitions of levels.



*Figure 24: The Illustration of level definitions of two groups*

Both two groups finished the three tasks and their completion times in seconds show in Table 4. Totally Group 1 completed 16958 seconds (4.71 hours), and Group 2 completed 17353 seconds (4.82 hours).

Table 4: Results of Task Completion Times from Each Volunteer

|    | Group 1 |       |       |      | Group 2 |       |       |      |
|----|---------|-------|-------|------|---------|-------|-------|------|
| N  | Task1   | Task2 | Task3 | Sum  | Task1   | Task2 | Task3 | Sum  |
| 1  | 116     | 110   | 165   | 391  | 285     | 415   | 140   | 840  |
| 2  | 404     | 384   | 145   | 933  | 202     | 300   | 78    | 580  |
| 3  | 585     | 140   | 502   | 1227 | 78      | 417   | 151   | 646  |
| 4  | 890     | 613   | 696   | 2199 | 374     | 389   | 163   | 926  |
| 5  | 235     | 100   | 138   | 473  | 526     | 218   | 160   | 904  |
| 6  | 157     | 80    | 487   | 724  | 241     | 202   | 464   | 907  |
| 7  | 178     | 97    | 164   | 439  | 189     | 106   | 166   | 461  |
| 8  | 191     | 275   | 242   | 708  | 408     | 401   | 361   | 1170 |
| 9  | 209     | 545   | 703   | 1457 | 85      | 990   | 253   | 1328 |
| 10 | 701     | 173   | 97    | 971  | 88      | 965   | 486   | 1539 |
| 11 | 57      | 209   | 163   | 429  | 61      | 678   | 256   | 995  |
| 12 | 71      | 575   | 127   | 773  | 101     | 246   | 109   | 456  |
| 13 | 30      | 163   | 60    | 253  | 514     | 113   | 103   | 730  |
| 14 | 235     | 88    | 150   | 473  | 37      | 302   | 341   | 680  |
| 15 | 88      | 320   | 237   | 645  | 787     | 430   | 153   | 1370 |
| 16 | 316     | 222   | 144   | 682  | 422     | 138   | 202   | 762  |
| 17 | 76      | 200   | 79    | 355  | 27      | 84    | 239   | 350  |
| 18 | 266     | 431   | 129   | 826  | 287     | 86    | 86    | 459  |
| 19 | 143     | 284   | 258   | 685  | 306     | 426   | 208   | 940  |
| 20 | 307     | 410   | 482   | 1199 | 150     | 90    | 104   | 344  |
| 21 | 71      | 433   | 161   | 665  | 43      | 480   | 201   | 724  |
| 22 | 93      | 197   | 161   | 451  | 53      | 96    | 93    | 242  |

Statistical results are illustrated in Table 5. For group 1, the mean values are task 1 246, task 2 275, task 3 250 seconds, and the sum of all tasks 771 seconds. Standard deviation values are task 1 222, task 2 166, task 3 193 seconds, and the sum of all tasks 442 seconds. Highest values are task 1 890, task 2 613, task 3 703 seconds, and the sum of all tasks 2199 seconds. Lowest values are task 1 30, task 2 80, task 3 60 seconds, and the sum of all tasks 253 seconds. For group 2, the mean values are task 1 239, task

2 344, task 3 205 seconds, and the sum of all tasks 789 seconds. Standard deviation values are task 1 200, task 2 260, task 3 116 seconds, and the sum of all tasks 349 seconds. Highest values are task 1 787, task 2 990, task 3 486 seconds, and the sum of all tasks 1539 seconds. Lowest values are task 1 27, task 2 84, task 3 78 seconds, and the sum of all tasks 242 seconds.

*Table 5: Statistical Calculations and Descriptive Results of Completion Time*

|                | <b>Task</b>  | <b>N</b>  | <b>Min</b> | <b>Max</b>  | <b>Mean</b> | <b>SD</b>  |
|----------------|--------------|-----------|------------|-------------|-------------|------------|
| <b>Group 1</b> | <b>Task1</b> | 22        | 30         | 890         | 246         | 222        |
|                | <b>Task2</b> | 22        | 80         | 613         | 275         | 166        |
|                | <b>Task3</b> | 22        | 60         | 703         | 250         | 193        |
|                | <b>Sum</b>   | <b>22</b> | <b>253</b> | <b>2199</b> | <b>771</b>  | <b>442</b> |
| <b>Group 2</b> | <b>Task1</b> | 22        | 27         | 787         | 239         | 200        |
|                | <b>Task2</b> | 22        | 84         | 990         | 344         | 260        |
|                | <b>Task3</b> | 22        | 78         | 486         | 205         | 116        |
|                | <b>Sum</b>   | <b>22</b> | <b>242</b> | <b>1539</b> | <b>789</b>  | <b>349</b> |

### **5.3. Results of Remembered Brands and Their Products of Two Groups**

Players were asked to match the promoted and non-promoted brands and their products after gameplay. The first hypothesis is tested in this analysis. Remembered products results are given in Table 6.

Table 6: Remembered of Promoted and Non-Promoted Brands Results

| N  | Group 1         |                     | Group 2         |                     |
|----|-----------------|---------------------|-----------------|---------------------|
|    | Promoted Brands | Non-Promoted Brands | Promoted Brands | Non-Promoted Brands |
| 1  | 5               | 1                   | 3               | 0                   |
| 2  | 3               | 0                   | 3               | 0                   |
| 3  | 5               | 4                   | 2               | 0                   |
| 4  | 4               | 2                   | 3               | 0                   |
| 5  | 1               | 1                   | 2               | 1                   |
| 6  | 3               | 1                   | 5               | 0                   |
| 7  | 4               | 0                   | 3               | 3                   |
| 8  | 2               | 0                   | 3               | 1                   |
| 9  | 2               | 0                   | 3               | 0                   |
| 10 | 4               | 0                   | 5               | 0                   |
| 11 | 3               | 0                   | 5               | 2                   |
| 12 | 6               | 0                   | 4               | 0                   |
| 13 | 2               | 0                   | 2               | 0                   |
| 14 | 3               | 1                   | 0               | 1                   |
| 15 | 1               | 0                   | 3               | 0                   |
| 16 | 3               | 0                   | 3               | 0                   |
| 17 | 3               | 0                   | 1               | 0                   |
| 18 | 2               | 0                   | 3               | 0                   |
| 19 | 3               | 0                   | 3               | 1                   |
| 20 | 6               | 0                   | 1               | 0                   |
| 21 | 1               | 0                   | 3               | 0                   |
| 22 | 4               | 1                   | 4               | 0                   |

Remembered promoted and non-promoted brands results carry out normality analysis. The acceptable range is and kurtosis values below +1.5 above -1.5 for normality analysis [61]. After normality analysis of Group 1 skewness for promoted brands skewness 0.350 and kurtosis -0.404 and unpromoted brands skewness 2.634 and kurtosis 8.018. Group 2 skewness for promoted brands skewness -0.276 and kurtosis

0.440 and unpromoted brands skewness 2.193 and kurtosis 4.780. Since both of the two groups remembered non-promoted values are not normally distributed; Mann-Whitney U Test, which is one of the non-parametric tests, is used in this analysis. It is also used when the participant's numbers are small groups [62]. Besides that, Mann-Whitney U Test is used to compare result in game-based learning study [15]. The test is conducted to understand whether there is a significant difference between remembered promoted and non-promoted brands. Test results are given in Table 7.

$H_0$ : There is no significant difference between the two distributions.

$H_1$ : There is a significance difference between two distributions.

*Table 7: Mann-Whitney U Test Results on Remembered Promoted and Non-Promoted Brands*

|           | <b>Brands</b>       | <b>Min</b> | <b>Max</b> | <b>Median</b> | <b>Mean</b> | <b>SD</b> | <b>U</b> | <b>z</b> | <b>p</b> |
|-----------|---------------------|------------|------------|---------------|-------------|-----------|----------|----------|----------|
| <b>G1</b> | Promoted Brands     | 1          | 6          | 3             | 3.18        | 1.47      | 28.50    | -5.15    | 0.00*    |
|           | Non-Promoted Brands | 0          | 4          | 0             | 0.50        | 0.96      |          |          |          |
| <b>G2</b> | Promoted Brands     | 0          | 5          | 3             | 2.91        | 1.27      | 32.00    | -5.14    | 0.00*    |
|           | Non-Promoted Brands | 0          | 3          | 0             | 0.41        | 0.80      |          |          |          |

\* $p < 0.05$

For Group 1, remembered promoted brands statistical results that median 3, mean 3.18, standard deviation 1.47, highest value 6, and lowest value 1 is concluded. Recalled non-promoted brands statistical results that median 0, mean 0.50, standard deviation 0.96, highest value 4, and lowest value 0 are completed. For Group 2 remembered promoted brands statistical results that median 3, mean 2.91, standard deviation 1.27, highest value 5, and lowest value 0 are concluded. Recalled non-promoted brands statistical results that median 0, mean 0.41, standard deviation 0.80, highest value 3, and lowest value 0 are completed.

According to the MWU test results, there is a significant difference between remembered promoted and non-promoted brands ( $U=28.50$ ,  $z=-5.15$ ,  $p=0.00$ ) p value is lower than 0.05 for Group 1. There is a significance difference between recalled promoted and non-promoted brands ( $U=32.00$ ,  $z=-5.14$ ,  $p=0.00$ ) p value is lower than 0.05 for Group 2.  $H_0$  hypothesis is rejected for two groups. Both groups remembered greater numbers of promoted brands and their products than numbers of non-promoted brands and their products in an adverage.

*Table 8: Decision Hypothesis 1*

|  |                         |
|--|-------------------------|
| <b>H1:</b> Players can remember a brand and its product which is promoted by the adverage. | Hypothesis is accepted. |
|--|-------------------------|

The decision of Hypothesis 1 is illustrated in Table 8. The first hypothesis is accepted.

#### **5.4. Results of Flow Measurement**

Flow state scale 36 questions were asked to players after gameplay, and both groups are completed questionnaire. 36 questions were divided into nine flow dimensions [56].

*Table 9: 36 Questions are Divided into 9 Dimensions [56]*

| <b>Dimension</b>               | <b>Questions</b> |     |     |     |
|--------------------------------|------------------|-----|-----|-----|
| Challenge-Skill Balance        | Q1               | Q10 | Q19 | Q28 |
| Clear Goals                    | Q3               | Q12 | Q21 | Q30 |
| Feedback                       | Q4               | Q13 | Q22 | Q31 |
| Control                        | Q6               | Q15 | Q24 | Q33 |
| Action-Awareness Merging       | Q2               | Q11 | Q20 | Q29 |
| Concentration of Task          | Q5               | Q14 | Q23 | Q32 |
| The Loss of Self-Consciousness | Q7               | Q16 | Q25 | Q34 |
| The Transformation of Time     | Q8               | Q17 | Q26 | Q35 |
| Autotelic Experience           | Q9               | Q18 | Q27 | Q36 |

Table 9 represents each dimension owned the question numbers. Each 4 questions represent one flow dimension. Players have been answered to the open-ended question of which factors are motivated or demotivated during the gameplay. Results are analyzed whether there is a significance difference between flow measurement of two groups. Reliability analysis Cronbach's alpha values ( $\alpha$ ) is examined for each of the dimensions. Mann Whitney U test is used to compare groups. The second hypothesis is tested in this analysis.

*Table 10: Statistical Calculations and Descriptive Results of Flow State Scale*

| Q  | N  | Group 1 |     |     |      |      | Group 2 |     |     |      |      |
|----|----|---------|-----|-----|------|------|---------|-----|-----|------|------|
|    |    | Min     | Max | Sum | Mean | SD   | Min     | Max | Sum | Mean | SD   |
| 1  | 22 | 2       | 5   | 83  | 3.77 | 0.92 | 1       | 5   | 83  | 3.77 | 0.92 |
| 2  | 22 | 1       | 5   | 64  | 2.91 | 0.97 | 1       | 5   | 60  | 2.73 | 0.98 |
| 3  | 22 | 1       | 5   | 80  | 3.64 | 1.14 | 2       | 5   | 91  | 4.14 | 0.89 |
| 4  | 22 | 2       | 5   | 78  | 3.55 | 0.80 | 2       | 5   | 79  | 3.59 | 1.05 |
| 5  | 22 | 2       | 5   | 92  | 4.18 | 0.96 | 1       | 5   | 90  | 4.09 | 1.11 |
| 6  | 22 | 3       | 5   | 91  | 4.14 | 0.71 | 2       | 5   | 85  | 3.86 | 0.99 |
| 7  | 22 | 1       | 5   | 86  | 3.91 | 1.31 | 2       | 5   | 85  | 3.91 | 1.02 |
| 8  | 22 | 2       | 5   | 75  | 3.41 | 0.91 | 1       | 5   | 73  | 3.32 | 1.04 |
| 9  | 22 | 3       | 5   | 94  | 4.27 | 0.70 | 1       | 5   | 83  | 3.77 | 1.02 |
| 10 | 22 | 1       | 5   | 77  | 3.50 | 1.06 | 2       | 5   | 77  | 3.50 | 0.91 |
| 11 | 22 | 1       | 5   | 67  | 3.05 | 1.21 | 1       | 5   | 65  | 2.95 | 1.09 |
| 12 | 22 | 1       | 5   | 80  | 3.64 | 1.22 | 2       | 5   | 85  | 3.86 | 0.94 |
| 13 | 22 | 1       | 5   | 62  | 2.82 | 1.05 | 1       | 5   | 68  | 3.09 | 1.15 |
| 14 | 22 | 1       | 5   | 66  | 3.00 | 1.23 | 1       | 5   | 64  | 2.91 | 1.38 |
| 15 | 22 | 2       | 5   | 89  | 4.05 | 0.79 | 3       | 5   | 93  | 4.23 | 0.75 |
| 16 | 22 | 1       | 5   | 75  | 3.41 | 1.14 | 2       | 5   | 79  | 3.59 | 1.10 |
| 17 | 22 | 1       | 5   | 80  | 3.64 | 1.14 | 1       | 5   | 75  | 3.41 | 1.14 |
| 18 | 22 | 2       | 5   | 91  | 4.14 | 0.94 | 2       | 5   | 90  | 4.09 | 0.97 |
| 19 | 22 | 1       | 5   | 74  | 3.36 | 1.26 | 2       | 5   | 82  | 3.77 | 0.97 |
| 20 | 22 | 1       | 5   | 79  | 3.59 | 1.18 | 2       | 5   | 84  | 3.82 | 0.91 |
| 21 | 22 | 2       | 5   | 89  | 4.05 | 0.72 | 2       | 5   | 90  | 4.09 | 0.87 |
| 22 | 22 | 1       | 5   | 66  | 3.00 | 1.27 | 2       | 5   | 71  | 3.18 | 0.96 |



|    |    |   |   |    |      |      |   |   |    |      |      |
|----|----|---|---|----|------|------|---|---|----|------|------|
| 23 | 22 | 2 | 5 | 92 | 4.18 | 0.85 | 1 | 5 | 85 | 3.86 | 1.21 |
| 24 | 22 | 4 | 5 | 96 | 4.36 | 0.49 | 2 | 5 | 88 | 4.00 | 1.02 |
| 25 | 22 | 2 | 5 | 88 | 4.00 | 1.07 | 2 | 5 | 83 | 3.77 | 1.07 |
| 26 | 22 | 1 | 5 | 74 | 3.36 | 1.29 | 1 | 5 | 62 | 2.82 | 1.05 |
| 27 | 22 | 2 | 5 | 88 | 4.00 | 0.82 | 3 | 5 | 86 | 3.91 | 0.68 |
| 28 | 22 | 1 | 5 | 73 | 3.32 | 1.39 | 2 | 5 | 76 | 3.45 | 1.01 |
| 29 | 22 | 1 | 5 | 72 | 3.27 | 1.24 | 1 | 5 | 74 | 3.36 | 1.18 |
| 30 | 22 | 2 | 5 | 94 | 4.27 | 0.88 | 3 | 5 | 97 | 4.41 | 0.67 |
| 31 | 22 | 1 | 5 | 77 | 3.50 | 1.14 | 2 | 5 | 80 | 3.64 | 1.00 |
| 32 | 22 | 2 | 5 | 92 | 4.18 | 0.85 | 2 | 5 | 90 | 4.09 | 1.15 |
| 33 | 22 | 2 | 5 | 87 | 3.95 | 0.84 | 2 | 5 | 89 | 4.05 | 1.09 |
| 34 | 22 | 1 | 5 | 86 | 3.91 | 1.15 | 2 | 5 | 86 | 3.91 | 1.06 |
| 35 | 22 | 1 | 5 | 55 | 2.50 | 1.30 | 1 | 4 | 57 | 2.59 | 1.05 |
| 36 | 22 | 3 | 5 | 95 | 4.32 | 0.72 | 2 | 5 | 93 | 4.23 | 0.87 |

Table 10 gives descriptive information about FSS results. Minimum value 1 and maximum value 5 for each question. Group 1 the highest mean 4.36 is question 24, and lowest mean 2.50 is question 35. Highest standard deviation 1.39 is question 28, and the lowest standard deviation 0.49 is question 24. For group 2 the highest mean 4.41 is question 30, and the lowest mean 2.59 is question 35. Highest standard deviation 1.38 is question 14, and the lowest standard deviation 0.67 is question 30.

Table 11 gives information about flow dimension and reliability analysis. Cronbach's alpha values, which ranges are analyzed for all dimensions. Alpha coefficient and internal consistency are given below [63]:

- $\alpha \geq 0.9$  (Excellent)
- $0.9 > \alpha \geq 0.8$  (Good)
- $0.8 > \alpha \geq 0.7$  (Acceptable)
- $0.7 > \alpha \geq 0.6$  (Questionable)
- $0.6 > \alpha \geq 0.5$  (Poor)
- $0.5 > \alpha$  (Unacceptable)

Reliable alpha is acceptable 0.7 and above in this analysis.

Table 11: Mean, Standard Deviation and Reliability Analysis

| Dimension                      | N  | Group 1 |       |             | Group 2 |       |             |
|--------------------------------|----|---------|-------|-------------|---------|-------|-------------|
|                                |    | Mean    | SD    | a           | Mean    | SD    | a           |
| Challenge-Skill Balance        | 22 | 13.95   | 3.86  | <b>0.84</b> | 14.50   | 2.82  | <b>0.72</b> |
| Clear Goals                    | 22 | 15.59   | 2.67  | 0.57        | 16.50   | 2.54  | <b>0.74</b> |
| Feedback                       | 22 | 12.86   | 3.78  | <b>0.90</b> | 13.50   | 3.57  | <b>0.88</b> |
| Control                        | 22 | 16.50   | 2.26  | <b>0.79</b> | 16.14   | 3.23  | <b>0.85</b> |
| Action-Awareness Merging       | 22 | 12.82   | 3.03  | 0.56        | 12.86   | 2.32  | 0.25        |
| Concentration of Task          | 22 | 15.55   | 2.63  | 0.58        | 14.95   | 3.55  | <b>0.71</b> |
| The Loss of Self-Consciousness | 22 | 15.23   | 3.50  | <b>0.74</b> | 15.18   | 3.51  | <b>0.85</b> |
| The Transformation of Time     | 22 | 12.91   | 2.74  | 0.36        | 12.14   | 2.85  | 0.58        |
| Autotelic Experience           | 22 | 16.73   | 2.51  | <b>0.79</b> | 16.00   | 2.69  | <b>0.74</b> |
| Flow State Scale               | 22 | 132.14  | 17.19 | <b>0.89</b> | 131.73  | 21.22 | <b>0.94</b> |

0.70 ≤ a

Challenge-skill balance is 0.84 good reliability value for Group 1 and 0.7 acceptable reliability value for Group 2. A clear goal is 0.57 poor reliability for Group 1 and 0.74 acceptable reliability for Group 2. Feedback is 0.90 excellent reliability for Group 1 and 0.88 good reliability for Group 2. Control is 0.79 acceptable reliability for Group 1 and 0.85 good reliability for Group 2. Action-awareness merging is 0.56 poor reliability for Group 1 and 0.25 unacceptable reliability for Group 2. The concentration of task is 0.58 poor reliability for Group 1 and 0.71 acceptable reliability for Group 2. The loss of self-consciousness is 0.74 acceptable reliability for Group 1 and 0.84 good reliability for Group 2. The transformation of time is 0.36 unacceptable reliability for Group 1 and 0.58 poor reliability for Group 2. Autotelic experience is 0.79 acceptable

reliability for Group 1 and 0.74 acceptable reliability for Group 2. Flow State Scale reliabilities are 0.84 good for Group 1 and 0.94 is excellent for Group 2.

Group 2 challenge-skill balance is lower than Group 1 Due to the level game elements are excluded. Group 1 clear goals are lower and also not acceptable than Group 2. Group 1 feedback is higher than Group 2. Warning sound of remaining time (last 20 seconds) and sound of a task “Complete the shopping list on the left side.” elements for Group 1 can be affected by the feedback results. Group 1 control is lower than Group 2. Action-Awareness merging is not acceptable for both groups. Group 1 concentration of task is lower and not acceptable than Group 2. Time limitations can be affected by the results. Group 1 the loss of Self-Consciousness is lower than Group 2. The transformation of time is not acceptable for both groups. Group 1 autotelic experience is higher than Group 2. General Flow State Scale result is indicated that both of the two groups have experienced flow apart from some dimensions. Cronbach's alpha values greater than 0.7 flow dimensions are analyzed Pearson correlation analysis in Table 12 and Figure 13.

*Table 12: Pearson Correlation Analysis Between Flow Dimensions for Group 1*

|     | CSB   | F      | C      | LSC  | AE |
|-----|-------|--------|--------|------|----|
| CSB | -     |        |        |      |    |
| F   | .789* | -      |        |      |    |
| C   | .297  | .537** | -      |      |    |
| LSC | .286  | .376   | .399   | -    |    |
| AE  | .490* | .442*  | .654** | .197 | -  |

\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

**CSB:** Challenge-Skill Balance, **F:** Feedback, **C:** Control, **LSC:** The Loss of Self-Consciousness, **AE:** Autotelic Experience

Table 12 represents the correlation analysis for Group 1. Challenge skill balance has a weak relationship with feedback and autotelic experience. Feedback has a strong relationship with control, weak relationship with autotelic experience. Control has a strong relationship with autotelic experience.

Table 13: Pearson Correlation Analysis Between Flow Dimensions for Group 2

|     | CSB    | CG     | F      | C      | CT     | LSC    | AE |
|-----|--------|--------|--------|--------|--------|--------|----|
| CSB | -      |        |        |        |        |        |    |
| CG  | .787** | -      |        |        |        |        |    |
| F   | .782** | .838** | -      |        |        |        |    |
| C   | .828** | .909** | .862** | -      |        |        |    |
| CT  | .515*  | .683** | .682** | .682** | -      |        |    |
| LSC | .806** | .864** | .847** | .825** | .687** | -      |    |
| AE  | .639** | .732** | .630** | .686** | .528*  | .635** | -  |

\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

**CSB:** Challenge-Skill Balance, **CG:** Clear Goals, **F:** Feedback, **C:** Control, **CT:** Concentration of Task, **LSC:** The Loss of Self-Consciousness, **AE:** Autotelic Experience

Table 13 represents the correlation analysis for Group 2. Challenge-skill balance has a strong relationship with clear goals, feedback, control, loss of self-consciousness, and autotelic experience; it has a weak relationship with the concentration of task. Clear goals have a strong relationship with feedback, control, the concentration of task, loss of self-consciousness, and autotelic experience. Feedback has a strong relationship with control, concentration of task, loss of self-consciousness, and autotelic experience. Control has a strong relationship with the concentration of task, loss of self-consciousness, and autotelic experience. Concentration of task has a strong relationship with loss of self-consciousness and weak relationship with autotelic experience. Loss of self-consciousness has a strong relationship with autotelic experience.

Both groups have been found a strong relationship with between control and feedback, control and autotelic experience.

Mann Whitney U test is conducted FSS results to analyze a significance difference between two groups.

$H_0$ : There is no significant difference between the two distributions.

$H_1$ : There is a significance difference between two distributions.

Table 14: Mann Whitney U test on Flow State Scale

| Dimension        | Group | Min | Max | Median | Mean   | SD    | U     | z      | p     |
|------------------|-------|-----|-----|--------|--------|-------|-------|--------|-------|
| Flow State Scale | G1    | 96  | 165 | 132.5  | 132.14 | 17.19 | 236.5 | -0.129 | 0.897 |
|                  | G2    | 95  | 164 | 131.5  | 131.73 | 21.22 |       |        |       |

\*p<0.05

Table 14 represents the results of the test. According to MWU test results, there is no significant difference between two groups flow scale due to the p value higher than 0.05.  $H_0$  hypothesis is accepted. Both of two groups have experienced flow, but flow dimension correlations are different. The second hypothesis is rejected.

Table 15: Decision of Hypothesis 2

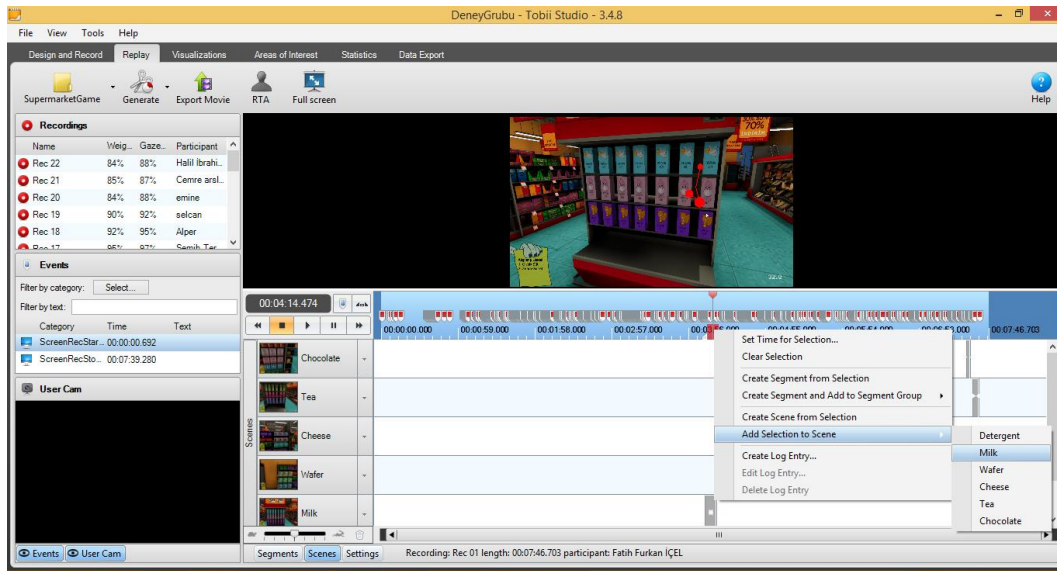
|  |                         |
|--|-------------------------|
| <b>H2:</b> Players have an experience of flow when the game elements increase. | Hypothesis is rejected. |
|--|-------------------------|

Hypothesis 2 decision is given in the Table 15. The second hypothesis is rejected.

According to players recommendations; for Group 1, time limitation, visual elements, sounds, finding a product are motivated them. For Group 2, searching for a product, feeling like in the market, visual elements, the main character is player are motivated them. One player is demotivated due to the lack of sounds.

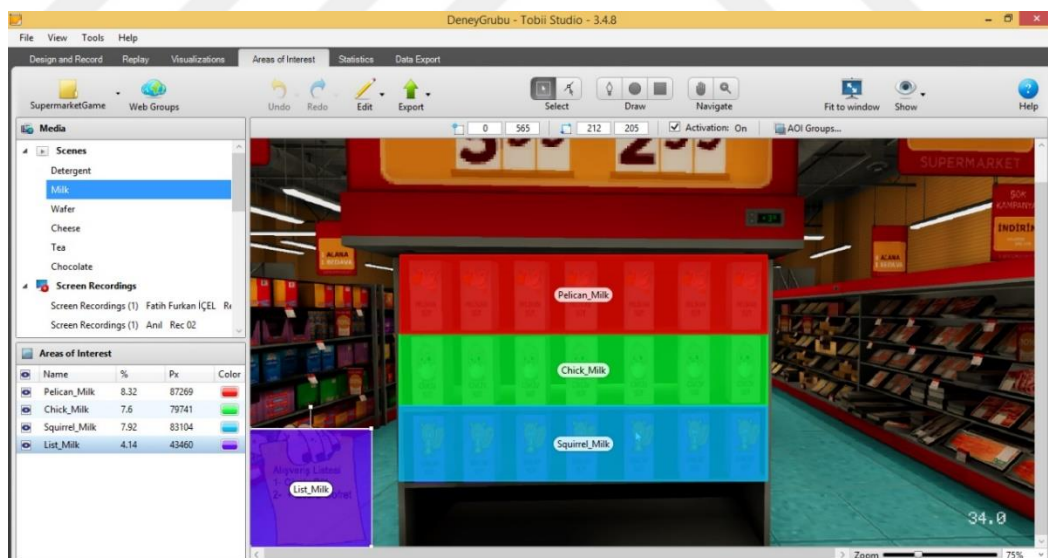
## 5.5. Results of Eye-Tracking Analysis

Eye-tracking results are analyzed in Tobii Studio version 3.4.8 1348. Two projects are created as an experimental group and control group. 22 volunteers of the experimental group are played the first game and 22 volunteers of control group played the second game. Eye movements are visualized as points on a video recording. A product scene is splinted from a scene of recordings and all eye movements data, which is a part from the first fixation on the area to first fixation on outside of the area, are added to the selected scene. 6 areas are determined and products are detergent, milk, cheese, wafer, tea, chocolate. Figure 25 represents the selection of a part on recordings.



*Figure 25: Scene Selection of Milk Product*

After selection of the scene, each brand is sprinted and defined as area (AOIs). Figure 26 indicates the defined area of interests for Pelican Milk, Chick Milk and Squirrel Milk. Fixation count is an eye-tracking metrics that aggregate eye movements of players. In this study, fixation count and heatmap analysis is used the analyze where players are focused on the screen.



*Figure 26: Area of Interests are Defined for Milk Brands*

Area of interests of all brands are demonstrated in Figure 27 and Figure 28.



Figure 27: Area of Interests of Group 1



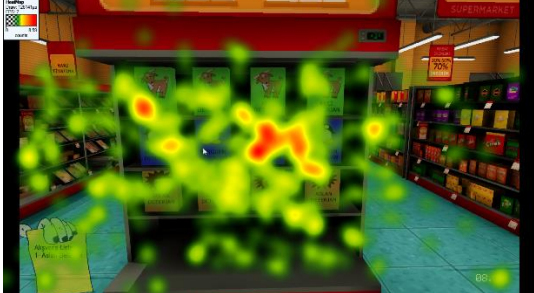
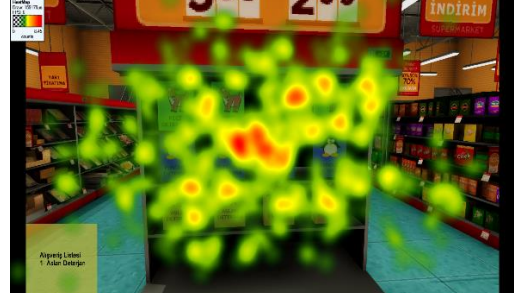




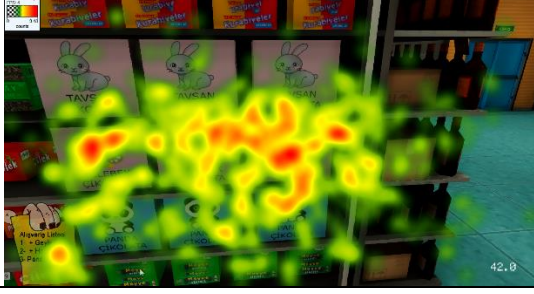

Figure 28: Area of Interests of Group 2

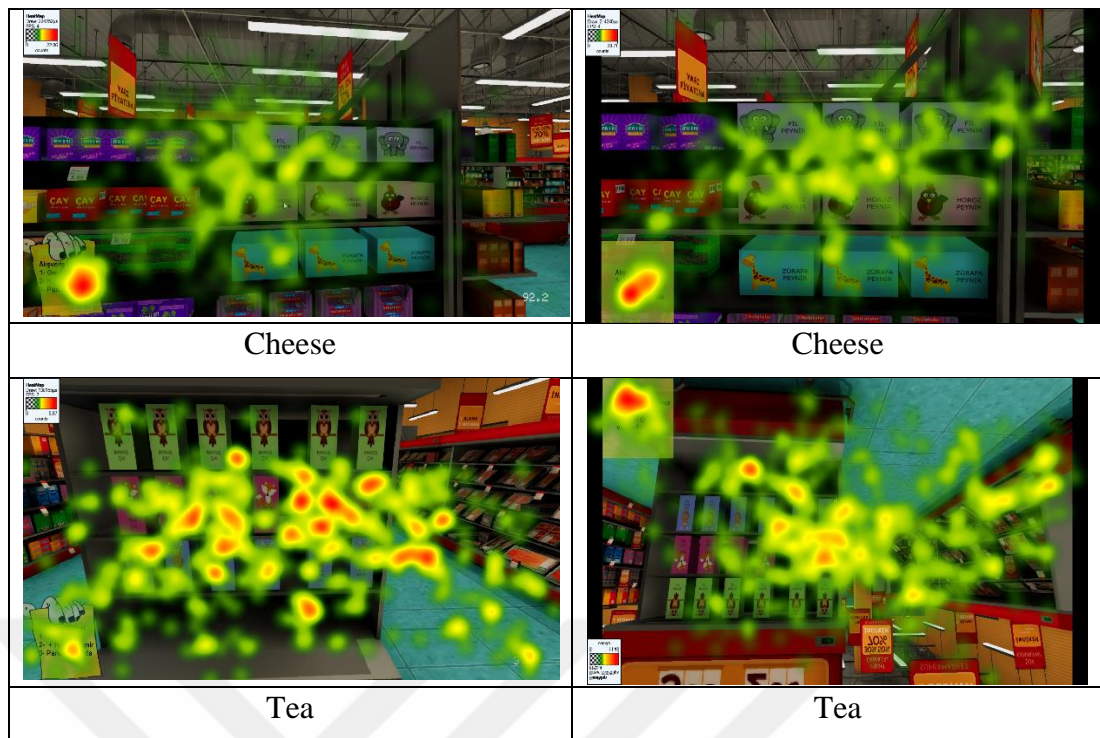
#### 4.2.8. Heatmap Analysis

Heatmap results extract according to aggregated gaze point in determined areas. 6 heatmaps are extracted from the analysis. Heatmaps setting is selected radius 87px for color representation; an analysis data type counts, the zoom level is %44. From intensive to sparse points, color is selected red, yellow and green. Table 16 represents the heatmap results for both groups. Shelves are divided into 4 and 5 groups. Brands are placed randomly on the positions.



Table 16: Heatmap Analysis of Area of Interests

| Group 1  | Group 2   |
|--|---|
|  <p>Heatmap showing high interest (red/yellow) in the detergent aisle for Group 1. The aisle is well-lit with shelves on both sides. A small '66' is visible in the bottom right corner.</p>          |  <p>Heatmap showing high interest (red/yellow) in the detergent aisle for Group 2. The aisle is well-lit with shelves on both sides. A small '66' is visible in the bottom right corner.</p>          |
| Detergent  | Detergent   |
|  <p>Heatmap showing high interest (red/yellow) in the milk aisle for Group 1. Price tags for '599' and '299' are visible above the shelves. A small '34.0' is visible in the bottom right corner.</p> |  <p>Heatmap showing high interest (red/yellow) in the milk aisle for Group 2. Price tags for '599' and '299' are visible above the shelves. A small '34.0' is visible in the bottom right corner.</p> |
| Milk   | Milk  |
|  <p>Heatmap showing high interest (red/yellow) in the wafer aisle for Group 1. Shelves are filled with various wafer products. A small '73.0' is visible in the bottom right corner.</p>            |  <p>Heatmap showing high interest (red/yellow) in the wafer aisle for Group 2. Shelves are filled with various wafer products. A small '73.0' is visible in the bottom right corner.</p>            |
| Wafer  | Wafer   |
|  <p>Heatmap showing high interest (red/yellow) in the chocolate aisle for Group 1. Shelves are filled with various chocolate products. A small '42.0' is visible in the bottom right corner.</p>    |  <p>Heatmap showing high interest (red/yellow) in the chocolate aisle for Group 2. Shelves are filled with various chocolate products. A small '42.0' is visible in the bottom right corner.</p>    |
| Chocolate  | Chocolate   |



The red color refers that players are looking more focused on the area. According to heatmap analysis, players are generally looking at the direction of eye level even if the products are searching the bottom of shelf position. Lion detergent and panda chocolate are written in the shopping list, and their positions are bottom of the shelf. Players are focused on penguin detergent and butterfly chocolate.

#### 4.2.9. Area of Interests (AOIs) Fixation Count Analysis

Players are looking to the place all of the products while they are trying to find a product written in the shopping list. Fixation counts are aggregated data numbers which are extracted from an area of interest's scenes. The descriptive results are given in Table 17 and Table 18.

Table 17: Fixation Count to Products and Their Brand for Group 1

| Brands and Products | N  | Group 1 |     |     |       |       |
|---------------------|----|---------|-----|-----|-------|-------|
|                     |    | Min     | Max | Sum | Mean  | SD    |
| Goat Detergent      | 22 | 0       | 11  | 67  | 3.05  | 3.03  |
| Penguin Detergent   | 22 | 0       | 13  | 106 | 4.82  | 3.97  |
| Lion Detergent      | 22 | 0       | 8   | 75  | 3.41  | 2.46  |
| Pelican Milk        | 22 | 0       | 31  | 170 | 7.73  | 8.02  |
| Chick Milk          | 22 | 0       | 25  | 143 | 6.50  | 5.64  |
| Squirrel Milk       | 22 | 0       | 10  | 32  | 1.45  | 2.56  |
| Zebra Wafer         | 22 | 1       | 18  | 131 | 5.95  | 4.41  |
| Chicken Wafer       | 22 | 0       | 12  | 81  | 3.68  | 2.68  |
| Bird Wafer          | 22 | 0       | 7   | 31  | 1.41  | 1.89  |
| Rabbit Chocolate    | 22 | 0       | 18  | 97  | 4.41  | 4.70  |
| Butterfly Chocolate | 22 | 0       | 50  | 293 | 13.32 | 14.27 |
| Panda Chocolate     | 22 | 0       | 19  | 118 | 5.36  | 5.69  |
| Elephant Cheese     | 22 | 0       | 13  | 130 | 5.91  | 4.29  |
| Rooster Cheese      | 22 | 0       | 15  | 115 | 5.23  | 3.78  |
| Giraffe Cheese      | 22 | 0       | 15  | 62  | 2.82  | 3.58  |
| Owl Tea             | 22 | 0       | 6   | 26  | 1.18  | 1.68  |
| Fox Tea             | 22 | 0       | 14  | 127 | 5.77  | 3.98  |
| Deer Tea            | 22 | 0       | 9   | 84  | 3.82  | 2.74  |

Table 18: Fixation Count to Products and Their Brand for Group 2

| Brands and Products | N  | Group 2 |     |     |       |      |
|---------------------|----|---------|-----|-----|-------|------|
|                     |    | Min     | Max | Sum | Mean  | SD   |
| Goat Detergent      | 22 | 0       | 28  | 108 | 4.909 | 6.19 |
| Penguin Detergent   | 22 | 1       | 8   | 98  | 4.455 | 2.11 |
| Lion Detergent      | 22 | 0       | 12  | 92  | 4.182 | 3.43 |
| Pelican Milk        | 22 | 0       | 27  | 178 | 8.091 | 6.30 |
| Chick Milk          | 22 | 0       | 17  | 157 | 7.136 | 5.20 |
| Squirrel Milk       | 22 | 0       | 7   | 22  | 1.00  | 1.63 |
| Zebra Wafer         | 22 | 0       | 17  | 100 | 4.545 | 3.53 |
| Chicken Wafer       | 22 | 0       | 16  | 134 | 6.091 | 4.83 |
| Bird Wafer          | 22 | 0       | 11  | 47  | 2.136 | 2.87 |
| Rabbit Chocolate    | 22 | 0       | 21  | 80  | 3.636 | 5.02 |
| Butterfly Chocolate | 22 | 0       | 21  | 166 | 7.545 | 5.48 |
| Panda Chocolate     | 22 | 0       | 13  | 70  | 3.182 | 3.02 |
| Elephant Cheese     | 22 | 0       | 28  | 189 | 8.591 | 7.64 |
| Rooster Cheese      | 22 | 0       | 28  | 211 | 9.591 | 7.48 |
| Giraffe Cheese      | 22 | 0       | 13  | 87  | 3.955 | 4.86 |
| Owl Tea             | 22 | 0       | 9   | 35  | 1.591 | 2.22 |
| Fox Tea             | 22 | 0       | 9   | 74  | 3.364 | 2.66 |
| Deer Tea            | 22 | 0       | 11  | 51  | 2.318 | 2.73 |

According to Table 17 and 18; products are placed in the middle and top of the shelf, players are more focused on the positions. The heatmaps support aggregated points.

Table 19: Decision of Hypothesis 3

|   |                         |
|---|-------------------------|
| <b>H3:</b> Players focus more on the positions corresponding to their eye levels. | Hypothesis is accepted. |
|---|-------------------------|

Hypothesis 3 decision is given in the Table 19. The third hypothesis is accepted.

## **CHAPTER 6**

### **6. CONCLUSION AND FUTURE WORK**

The purpose of the current study was to determine the achievement of advergames, flow experience, and players visual attention. This study has identified that players can recall promoted brand or product in an advergame, but they don't recall non-promoted brand or product after gameplay. An advergame, advertisement brand or product should interact with players. On the other hand, players are not interested in the visualized brand or product anywhere in the game. This study also supports the opinion that players have not remembered the brands placed on billboards [16].

The second significant finding is some game elements can be excluded to experience a flow in advergames. Both groups have experienced flow based on different dimensions. On the other hand, feedback and control have a strong relationship for both groups; which means, the providing that a game returns unambiguous feedbacks, players have felt what they want to do within the game. Control and autotelic experience also have a strong relationship; which means, as long as individuals can do anything in an activity, they have performed the activity with intrinsic motivation. The other dimensions are changing according to using the game elements. Challenge-skill balance generally represents the level difficulty, and the dimension is more motivated players. However, a level of difficulty may affect the players in a negative way of experiencing other dimensions.

The last finding is that players are generally looking at their eye level in the advergame. An advertisement brand or product can be placed in the middle or slightly above the middle on the game content. In this way, advertisement content can be more remarkable according to the other positions.

These findings provide the following insights for future research. According to the study, advergames can be used to advertise any brand, product or message of

companies. Action awareness merging and the transformation of time dimension are not reliable for both groups. Questions of these dimensions may be reviewed, and they can be changed the question forms in computer games. To analyze the transformation of time dimension, players' perception of time can be measured by asking "How long did you play the game?" to the players and comparing the real time that they spent on the game. If products are placed on the middle and top of the shelf, their visibilities are increased. This method can be used in real life. The relationship between eye-tracking fixation duration and the number of remembered brands can be discovered in the 2D games. Because aggregate eye movements data can be collected in 2D games more than 3D games. Thus, aggregated eye movements data in this study was not enough to establish a relationship with recalled brands.



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## APPENDICES

### APPENDIX A

*Group 1 Frequency and Percentage of Demographic Information*

|                                      | F  | %    |  | f  | %   |
|--------------------------------------|----|------|--|----|-----|
| <b>Gender</b>                        |    |      | <b>Experience of Software Developer (year)</b> |    |     |
| Woman                                | 5  | 23%  | 1-2  | 12 | 55% |
| Man                                  | 17 | 77%  | 3-5  | 5  | 23% |
| <b>Age</b>                           |    |      | 6-10   | 5  | 23% |
| 24-35                                | 22 | 100% | <b>Level of Video Game Experience</b>          |    |     |
| <b>Education</b>                     |    |      | 10   | 2  | 9%  |
| Bachelor's Degree                    | 18 | 82%  | 20   | 2  | 9%  |
| Master Degree                        | 4  | 18%  | 30   | 2  | 9%  |
| <b>Playing Game in a Week (hour)</b> |    |      | 40   | 1  | 5%  |
| 0                                    | 4  | 18%  | 50   | 4  | 18% |
| 1-2                                  | 5  | 23%  | 60   | 1  | 5%  |
| 3-5                                  | 5  | 23%  | 70   | 6  | 27% |
| 6-11                                 | 3  | 14%  | 80   | 1  | 5%  |
| 11-20                                | 4  | 18%  | 90   | 1  | 5%  |
| 20+                                  | 1  | 5%   | 100  | 2  | 9%  |

*Group 2 Frequency and Percentage of Demographic Information*

|                                      | F  | %    |  | f  | %   |
|--------------------------------------|----|------|--|----|-----|
| <b>Gender</b>                        |    |      | <b>Experience of Software Developer (year)</b> |    |     |
| Woman                                | 6  | 27%  | 1-2  | 12 | 55% |
| Man                                  | 16 | 73%  | 3-5  | 8  | 36% |
| <b>Age</b>                           |    |      | 6-10   | 2  | 9%  |
| 21-36                                | 22 | 100% | <b>Level of Video Game Experience</b>          |    |     |
| <b>Education</b>                     |    |      | 10   | 2  | 9%  |
| Bachelor's Degree                    | 18 | 82%  | 20   | 1  | 5%  |
| Two-year Degree                      | 1  | 5%   | 30   | 2  | 9%  |
| Master Degree                        | 3  | 14%  | 40   | 3  | 14% |
| <b>Playing Game in a Week (hour)</b> |    |      | 50   | 3  | 14% |
| 0                                    | 2  | 9%   | 60   | 3  | 14% |
| 1-2                                  | 10 | 45%  | 70   | 1  | 5%  |
| 3-5                                  | 5  | 23%  | 80   | 5  | 23% |
| 6-11                                 | 3  | 14%  | 90   | 1  | 5%  |
| 11-20                                | 1  | 5%   | 100  | 1  | 5%  |
| 20+                                  | 1  | 5%   |  |    |     |

## APPENDIX B

### Questionnaires

#### Demografik Özellikler ve Oyun Deneyim Anketi

Bu çalışma, yazılım geliştirme alanında çalışan kişilerin oyun deneyimlerini ölçmek amacıyla yapılmaktadır. Toplanan kişisel bilgiler kimseyle paylaşılmayacak, yalnızca araştırma amacıyla kullanılacaktır. Cevaplar doğru ya da yanlış olarak değerlendirilmeyecektir.

Çalışmaya katıldığınız ve vakit ayırdığınız için teşekkür ederim.

Duygu Akcan, Çankaya Üniversitesi, Bilgisayar Mühendisliği Bölümü

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#### Bölüm 1: Demografik Özellikler (Demographic Informations)

1. Adınız: \_\_\_\_\_
2. Cinsiyet:
  - Kadın
  - Erkek
3. Yaş: \_\_\_\_\_
4. Eğitim durumunuz:
  - Ön Lisans
  - Lisans
  - Yüksek Lisans
  - Doktora
  - Diğer \_\_\_\_\_
5. Kaç yıldır yazılım geliştirici olarak çalışıyorsunuz?
  - 1-2
  - 3-5
  - 6-10
  - 11-20
  - 21+

6. Eğer video oyun deneyiminiz varsa:

0 10 20 30 40 50 60 70 80 90 100

Çok Az

Orta

Çok Fazla

Video oyun deneyimi seviyem: \_\_\_\_\_

7. Haftada ortalama kaç saat oyun oynuyorsunuz?

- 0
- 1-2
- 3-5
- 6-10
- 11-20
- 21+

## Bölüm 2: Flow Deneyimi (Flow State Scale)

|   |  | Kesinlikle<br>Katılmıyorum | Katılmıyorum | Kararsızım | Katılıyorum | Kesinlikle<br>Katılıyorum |
|---|--|----------------------------|--------------|------------|-------------|---------------------------|
| 1 | Zorlandım fakat yeteneklerim sayesinde bu zorluklarla başa çıkabileceğime inanıyordum. | 1                          | 2            | 3          | 4           | 5                         |
| 2 | Doğru hamleleri bu hamleyi yapacağımı düşünmeden yaptım.                               | 1                          | 2            | 3          | 4           | 5                         |
| 3 | Ne yapacağımı ve hedefimi açıkça biliyordum.   | 1                          | 2            | 3          | 4           | 5                         |
| 4 | Yaptığım hamlenin doğru olduğunun farkındaydım.  | 1                          | 2            | 3          | 4           | 5                         |
| 5 | Dikkatim tamamen yaptığım işe odaklanmıştı.  | 1                          | 2            | 3          | 4           | 5                         |
| 6 | Yapmak istediğim şeyin tamamen kontrolümde olduğunu hissettim.                         | 1                          | 2            | 3          | 4           | 5                         |

|    |   |   |   |   |   |   |
|----|---|---|---|---|---|---|
| 7  | Diğerlerinin benim hakkımda ne düşündükleriyle ilgilenmedim.                  | 1 | 2 | 3 | 4 | 5 |
| 8  | Zaman algım deęiřti (Çok yavaş ya da hızlı).                                  | 1 | 2 | 3 | 4 | 5 |
| 9  | Bu deneyim sırasında oldukça eğlendim.  | 1 | 2 | 3 | 4 | 5 |
| 10 | Yeteneklerim bu durumun yüksek zorluklarıyla eşleřti.                         | 1 | 2 | 3 | 4 | 5 |
| 11 | İřler otomatik olarak gerçekleşiyor gibiydi.                                  | 1 | 2 | 3 | 4 | 5 |
| 12 | Ne yapmak istediđime dair güçlü bir hisse sahiptim.                           | 1 | 2 | 3 | 4 | 5 |
| 13 | Ne kadar iyi performans gösterdiğimin farkındaydım.                           | 1 | 2 | 3 | 4 | 5 |
| 14 | Geçmiş olayları aklımda tutmak için efor sarf etmedim.                        | 1 | 2 | 3 | 4 | 5 |
| 15 | Hareketlerimin kontrolümde olduğunu hissettim.                                | 1 | 2 | 3 | 4 | 5 |
| 16 | Etkinlik sırasındaki performansım için endişelenmedim.                        | 1 | 2 | 3 | 4 | 5 |
| 17 | Geçen zaman normal zamandan farklı geçmiş gibi geldi.                         | 1 | 2 | 3 | 4 | 5 |
| 18 | Bu performans duygusunu sevdim ve aynı duyguyu tekrar deneyimlemek istiyorum. | 1 | 2 | 3 | 4 | 5 |
| 19 | Durumun yüksek talebini karşılayacak kadar yetkin olduğumu hissettim.         | 1 | 2 | 3 | 4 | 5 |
| 20 | Verilen görevleri otomatik olarak yaptım.                                     | 1 | 2 | 3 | 4 | 5 |
| 21 | Neyi başardığımı biliyordum.  | 1 | 2 | 3 | 4 | 5 |



|    |   |   |   |   |   |   |
|----|---|---|---|---|---|---|
| 22 | Performansı gerçekleştirirken ne kadar iyi yaptığım hakkında iyi bir fikre sahiptim.          | 1 | 2 | 3 | 4 | 5 |
| 23 | Yaptığım işe tamamen konsantreydim.   | 1 | 2 | 3 | 4 | 5 |
| 24 | Tüm kontrolün bende olduğu hissine kapıldım.  | 1 | 2 | 3 | 4 | 5 |
| 25 | Kendimi nasıl sunduğumla ilgilenmedim.  | 1 | 2 | 3 | 4 | 5 |
| 26 | Performansı gerçekleştirirken zamanı durmuş gibi hissettim.                                   | 1 | 2 | 3 | 4 | 5 |
| 27 | Bu deneyim bende harika bir his bıraktı.  | 1 | 2 | 3 | 4 | 5 |
| 28 | Aktivitenin zorluğu ve benim yeteneklerim eşit derecede yüksekti.                             | 1 | 2 | 3 | 4 | 5 |
| 29 | Her şeyi otomatik ve spontane bir şekilde düşünmeden yaptım.                                  | 1 | 2 | 3 | 4 | 5 |
| 30 | Hedeflerim açıkça belirtilmişti.  | 1 | 2 | 3 | 4 | 5 |
| 31 | Görevleri ne kadar iyi yaptığıma bakarak ne kadar iyi performans gösterdiğimi söyleyebilirim. | 1 | 2 | 3 | 4 | 5 |
| 32 | Elimdeki göreve tamamen odaklandım.   | 1 | 2 | 3 | 4 | 5 |
| 33 | Bedenimin tamamen kontrolümde olduğunu hissettim.   | 1 | 2 | 3 | 4 | 5 |
| 34 | Diğerlerinin benim hakkımda ne düşündüğü ile ilgili endişelenmedim.                           | 1 | 2 | 3 | 4 | 5 |
| 35 | Bazen, bir şeylerin yavaş hareket ettiğini neredeyse görür gibi oldum.                        | 1 | 2 | 3 | 4 | 5 |

|    |                                  |   |   |   |   |   |
|----|----------------------------------|---|---|---|---|---|
| 36 | Deneyimi oldukça faydalı buldum. | 1 | 2 | 3 | 4 | 5 |
|----|----------------------------------|---|---|---|---|---|

|    |  |   |   |   |   |   |
|----|--|---|---|---|---|---|
| 37 | Flow deneyimini okuyunuz ve cevap veriniz:<br>Açık bir şekilde flow deneyimini aktivite boyunca deneyimledim.  | 1 | 2 | 3 | 4 | 5 |
|    | <b>Flow Deneyimi:</b> İnsanların bir aktiviteye derinlemesine odaklanmaları ve onunla bütünüyle meşgul olması sonucu deneyimledikleri bir beyin durumu olarak tanımlanır. Örneğin bir futbol oyuncusu flowu deneyimlediğine oyunun kendisinden başka hiçbir şeyi önemsemez. İnsanlar aktiviteye kendilerini tamamen kaptırdıklarında zaman hızla geçmiş gibi olur. Flow bir aktiviteyi gerçekleştirirken kişinin mutlu olması halidir. |   |   |   |   |   |
| 38 | Eğer flowu deneyimlediyseniz hangi faktörler sizi motive etti?   |   |   |   |   |   |
| 39 | Eğer flowu deneyimlemediyseniz hangi faktörler sizin bu deneyime ulaşmanıza engel oldu.  |   |   |   |   |   |

### **Bölüm 3: Marka Deneyimi (Remembered Promoted and Non-Promoted Brands)**

Aşağıdaki markaları ürünleriyle eşleştiriniz.

#### Markalar

1. Aslan\_\_\_\_\_
2. Baykuş\_\_\_\_\_
3. Cıvcıv\_\_\_\_\_
4. Fil\_\_\_\_\_
5. Geyik\_\_\_\_\_
6. Horoz\_\_\_\_\_
7. Keçi\_\_\_\_\_
8. Kelebek\_\_\_\_\_
9. Kuş\_\_\_\_\_
10. Panda\_\_\_\_\_
11. Pelikan\_\_\_\_\_
12. Penguen\_\_\_\_\_
13. Sincap\_\_\_\_\_
14. Tavşan\_\_\_\_\_
15. Tavuk\_\_\_\_\_
16. Tilki\_\_\_\_\_
17. Zebra\_\_\_\_\_
18. Zürafa\_\_\_\_\_

#### Ürünler

1. Çay
2. Peynir
3. Süt
4. Gofret
5. Çikolata
6. Deterjan

## APPENDIX C

### Flow State Scale Questionnaires.

36 Questions were translated in Turkish.

|    |  | Strongly<br>Disagree | Disagree | Neither agree<br>nor Disagree | Agree | Strongly<br>Agree |
|----|--|----------------------|----------|-------------------------------|-------|-------------------|
| 1  | I was challenged, but I believed my skills would allow me to meet the challenge. | 1                    | 2        | 3                             | 4     | 5                 |
| 2  | I made the correct movements without thinking about trying to do so.             | 1                    | 2        | 3                             | 4     | 5                 |
| 3  | I knew clearly what I wanted to do   | 1                    | 2        | 3                             | 4     | 5                 |
| 4  | It was clear to me that I was doing well.  | 1                    | 2        | 3                             | 4     | 5                 |
| 5  | My attention was focused entirely on what I was doing.                           | 1                    | 2        | 3                             | 4     | 5                 |
| 6  | I felt in total control of what I was doing                                      | 1                    | 2        | 3                             | 4     | 5                 |
| 7  | I was not concerned with what others may have been thinking of me.               | 1                    | 2        | 3                             | 4     | 5                 |
| 8  | Time seemed to alter (either slowed down or speeded up)                          | 1                    | 2        | 3                             | 4     | 5                 |
| 9  | I really enjoyed the experience.   | 1                    | 2        | 3                             | 4     | 5                 |
| 10 | My abilities matched the high challenge of the situation.                        | 1                    | 2        | 3                             | 4     | 5                 |

|    |  |   |   |   |   |   |
|----|--|---|---|---|---|---|
| 11 | Things just seemed to be happening automatically.                        | 1 | 2 | 3 | 4 | 5 |
| 12 | I had a strong sense of what I wanted to do.                             | 1 | 2 | 3 | 4 | 5 |
| 13 | I was aware of how well I was performing.                                | 1 | 2 | 3 | 4 | 5 |
| 14 | It was no effort to keep my mind on what was happening.                  | 1 | 2 | 3 | 4 | 5 |
| 15 | I felt like I could control what I was doing.                            | 1 | 2 | 3 | 4 | 5 |
| 16 | I was not worried about my performance during the event.                 | 1 | 2 | 3 | 4 | 5 |
| 17 | The way time passed seemed to be different from normal.                  | 1 | 2 | 3 | 4 | 5 |
| 18 | I loved the feeling of that performance and want to capture it again.    | 1 | 2 | 3 | 4 | 5 |
| 19 | I felt I was competent enough to meet the high demands of the situation. | 1 | 2 | 3 | 4 | 5 |
| 20 | I performed automatically.   | 1 | 2 | 3 | 4 | 5 |
| 21 | I knew what I wanted to achieve.   | 1 | 2 | 3 | 4 | 5 |
| 22 | I had a good idea while I was performing about how well I was doing.     | 1 | 2 | 3 | 4 | 5 |
| 23 | I had total concentration.   | 1 | 2 | 3 | 4 | 5 |
| 24 | I had a feeling of total control.  | 1 | 2 | 3 | 4 | 5 |
| 25 | I was not concerned with how I was presenting myself.                    | 1 | 2 | 3 | 4 | 5 |
| 26 | It felt like time stopped while I was performing.                        | 1 | 2 | 3 | 4 | 5 |

|    |   |   |   |   |   |   |
|----|---|---|---|---|---|---|
| 27 | The experience left me feeling great.                                 | 1 | 2 | 3 | 4 | 5 |
| 28 | The challenge and my skills were at an equally high level.            | 1 | 2 | 3 | 4 | 5 |
| 29 | I did things spontaneously and automatically without having to think. | 1 | 2 | 3 | 4 | 5 |
| 30 | My goals were clearly defined.  | 1 | 2 | 3 | 4 | 5 |
| 31 | I could tell by the way I was performing how well I was doing.        | 1 | 2 | 3 | 4 | 5 |
| 32 | I was completely focused on the task at hand.                         | 1 | 2 | 3 | 4 | 5 |
| 33 | I felt in total control of my body.                                   | 1 | 2 | 3 | 4 | 5 |
| 34 | I was not worried about what others may have been thinking of me.     | 1 | 2 | 3 | 4 | 5 |
| 35 | At times, it almost seemed like things were happening in slow motion. | 1 | 2 | 3 | 4 | 5 |
| 36 | I found the experience extremely rewarding.                           | 1 | 2 | 3 | 4 | 5 |

## APPENDIX D

**Flow is directly asked to players in the 37. question. Motivation and Demotivation factors are asked in 38. and 39. questions. 3 Questions were translated in Turkish.**

|    |  | Strongly<br>Disagree | Disagree | Neither agree | Agree | Strongly<br>Agree |
|----|--|----------------------|----------|---------------|-------|-------------------|
| 37 | <p>Read the description of flow experience and answer to the following statement:<br/>I experienced a clear flow experience during playing.</p>  | 1                    | 2        | 3             | 4     | 5                 |
|    | <p>Description of flow: The word flow is used to describe a state of mind sometimes experienced by people who are deeply involved in some activity. For example, a football player may experience flow when nothing else matters but the game itself and it is going very well. Activity that induces flow totally captivates a person for some period of time, in which case time seems to distort and nothing else but the activity seems to matter. Flow may not last for a long time on any particular occasion, but it may come and go over time. Flow has been described as being an intrinsically enjoyable experience.</p> |                      |          |               |       |                   |
| 38 | <p>If you experienced flow, what factors in the game contributed</p>   |                      |          |               |       |                   |

|    |   |  |
|----|---|--|
|    | to flow experience?   |  |
| 39 | If you did not experience flow, what factors in the game disturbed achieving a flow experience? |  |

