SHORT-TERM MODIFICATION OF SLEEP-WAKE HABITS BY GAMIFICATION: A USER STUDY

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SHORT-TERM MODIFICATION OF SLEEP-WAKE HABITS BY GAMIFICATION: A USER STUDY

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ABSTRACT

SHORT-TERM MODIFICATION OF SLEEP-WAKE HABITS BY GAMIFICATION: A USER STUDY

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Gamification is used as a tool to persuade and motivate people to achieve hard-to-perform tasks through the use of game mechanics. It can help to change people's habits in a positive direction, thus to get subjective well-being in the long run. Sleep-wake behaviors are important determinants of a day-to-day well-being. Management of sleep-wake habits of individuals is a potential area that can benefit from gamification. This study aimed to find out whether it was possible to modify sleep-wake habits using gamification. To that purpose, a gamified alarm clock app, *Sleepy Bird*, was designed and tested in a user study with 13 number of participants using gamified and 13 number of participants using non-gamified versions for two weeks. The results indicates that the participants of the gamified version were more motivated to start the day at required times than the participants of the non-gamified version. The participants of gamified version also made modifications to their sleep-wake habits becoming closer to optimum values. They also gained an initial awareness on sleep-wake and showed tendency to change behaviors in the long term.

Keywords: Gamification, Well-Being, Sleep-Wake Habits, Behavior Change, Extrinsic and Intrinsic Motivations

ÖZ

OYUNLAŞTIRMA İLE UYUMA-UYANMA ALIŞKANLIKLARININ KISA VADEDE DEĞİŞTİRİLMESİ: BİR KULLANICI ÇALIŞMASI

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Oyunlaştırma, yapılması zor işlerde, insanları oyun mekanikleri kullanımı ile ikna ve motive etmek için kullanılan bir araçtır. Uzun vadede kişisel iyi oluş elde etmek için, alışkanlıkları pozitif bir yönde değiştirmeye yardımcı olabilir. Uyuma-uyanma davranışları iyi oluşun günlük önemli belirleyici faktörlerindendir. Kişilerin uyuma-uyanma alışkanlıklarını yönetmek, oyunlaştırma ile fayda sağlanacak potansiyel bir çalışma alanıdır. Bu çalışma, oyunlaştırma kullanarak, uyuma-uyanma alışkanlıklarını değiştirmenin mümkün olup olmadığını bulmayı amaçlamıştır. Bu sebeple, oyunlaştırılmış bir alarm saati uygulaması olan *Sleepy Bird* tasarlanmış ve 13 katılımcı oyunlaştırılmış, 13 katılımcı ise oyunlaştırılmamış sürümü kullanacak şekilde bir kullanıcı çalışmasında iki hafta süresince test edilmiştir. Kullanıcı çalışması sonuçları, oyunlaştırılmış sürüm kullanan katılımcıların, oyunlaştırılmamış sürüm kullanan katılımcılara göre doğru zamanda güne başlamak için daha çok motive olduklarını göstermiştir. Oyunlaştırılmış alarm uygulaması kullanıcıları, uyuma-uyanma alışkanlıklarını en uygun değerlere yaklaşacak şekilde değiştirmişlerdir. Ayrıca bu kullanıcılar, uyuma-uyanma alışkanlıkları üzerine bir farkındalık kazanmış ve uzun vadede davranış değişikliği eğilimi göstermiştir.

Anahtar Kelimeler: Oyunlaştırma, İyi Oluş, Uyuma-Uyanma Alışkanlıkları, Davranış Değişimi, Dışsal ve İçsel Motivasyon

Dedicated to My Wonderful Family;

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

People like to be physically, psychologically and socially well in their lives. Changing daily routines to get better health conditions, interacting with other people to be socially active or possessing financial power to have economic freedom can be given as examples of wellness. In order to be satisfied with their lives, people not only try to be happy in different aspects of life but also desire to maintain their happiness in the long term. In this perspective, the term 'well-being' gains great importance.

Well-being can be described from various perspectives. For example, Papavlassopulos and Keppler (2010) are of the idea that political, social and economic issues affect happiness. Outer factors of life that make people feel happy or sad can be described as subjective well-being. Subjective well-being is not just about feeling happy, but also about remaining happy for a long time. Although this may differ from person to person or culture to culture, the main goal is to have a continuous life satisfaction. According to Pender and Barkaskas (1992), some activities can have positive results on physical, social and mental health.

Diener (2000) also believes that in everyday life, people give positive and negative reactions according to their emotions. Individuals generally judge their personal well-being with their happiness level. People also determine the level of their subjective well-being and satisfaction of life by considering their positive and negative emotions. Furthermore, amount of pleasant and unpleasant feelings play a significant role in judging well-being. Larsen (2009) indicates that negative emotions stay longer than positive emotions. Because in negative situations, people give stronger reactions than they do in positive situations. As a result of this case, adaptation to good events can be faster than adaptation to bad events. In other words, creating good experiences affects results in a shorter time in positive feelings.

Considering different definitions of well-being, it can be inferred that its importance comes from psychology, feelings and direct relationships with people. It directly concerns positive emotions and pleasurable feelings. The studies to improve well-being not only can influence an individual, but also can affect the society in a favorable way.

On the other hand, while discussing well-being, it should be remembered that it puts 'people' at the center. Feelings, behaviors, ideas, habits, characters and economic status of people are significant factors to analyze well-being. From the perspective of people, they are dissatisfied with their lives in some aspects. They have responsibilities in the control of their behaviors

and habits. Although they believe that they need to change their lives in a healthier, richer, more effective, energetic or powerful way, they sometimes cannot take an action in daily life.

At this point, 'gamification' takes to the stage as a useful strategy that can influence people positively for the activities that they ignore, find boring, tiresome or even difficult to achieve. Deterding et al. (2011a) define gamification as the usage of game design elements in non-game contexts. This can encourage people to get motivated and take place in activities that are not so interesting for them. Gamification…

- ...is used to create desired behaviors by using the power of games (Garris et al., 2002)
- ...has the power to persuade people to take actions about undesired but needed activities (Baranowski et al., 2008)
- ...appeals people creating extrinsic and intrinsic motivations (Zichermann, 2011)

The popularity of gamification strategy derives from the popularity of playing games. Nowadays, millions of people spend many hours in a day to play games (on their computer and other digital devices). Games build an enjoyable and addictive relationship between human and computer. The addiction of games stems from the interactions between human actions and changes in the game. For example, people are also keen on watching movies, however, different from movies, while playing a game, players interact with the game, influence the game, change game characters, and sometimes can even determine the destiny of the game with their actions.

Gamification can be used for various purposes including education, health as well as for well-being in economy and lifestyle of adults by creating engagement in particular activities. Engagement in well-being, health, education, daily routines, finance, sustainability and government can result in positive modification of human behaviors. Games are used as healthcare programs to stop smoking, to decrease obesity or to promote physical activities. Fitbit and Nike Plus can be given as two examples aiming to motive people to adopt a more-active life style. Games can be adapted into mobile systems for training, e-learning and testing purposes by the utilization of reward systems as illustrated in Khan Academy example. Gamified software applications can also organize daily routines as in HabitRPG that can record, track and organize daily tasks of people in an optimum way. Games can also be implemented for controlling finance and sustaining life conditions. Thus, several behaviors can be shaped with gamified tools.

With regard to the game features, Ryan and Deci (2000) suggest to use 'Self Determination Theory' in order to focus on human motivations and psychological needs. Based on this theory, when people are motivated intrinsically during an activity, their interest and long-term success would be higher. In other words, if a gamified tool includes intrinsic value, that would create more interest resulting in deeper engagement and participation of people. Yet, when analyzed from the perspective of psychology, existing gamified examples fall short to provide 'fun', which is quite an important factor in keeping people engaged or motivated. The reason behind this is that the developed gamification examples solve temporary needs and do not take into account game design processes.

Daily activities play an important role in happiness of individuals. However, sometimes the basic and the simplest routines of people are discarded to interpret general well-being. Focusing the components of well-being within daily activities should be the origin to start well-being studies. Daily events can be diversified such as starting the day at the right time, doing physical activities, performing responsibilities, studying or working for needed hours, going to the bed at the right time to have a rest. In order to be efficient in daily activities, people need to relax both physically and psychologically. Therefore, having enough sleep to get energy, waking-up at the right biological hour in the morning and going to bed at the right time at night enable people to have strength the following day.

According to Fredriksen et al., (2004) reduced hours of sleep causes depression and stress besides both physical and cognitive tiredness during the next day. Although, the amount of sleep recommended differs for different age groups, it is possible to assert that people should sleep adequate hours to start the day in a refreshed way. Wolfson and Carskadon (1998) support that if the sleep duration is not long enough, it will deteriorate memory resulting in cognitive performance problems. Thus, sleeping patterns affect well-being in terms of daily emotions and efficiency at work as well.

In addition, the relationship between sleep and well-being is used as a subject of gamified tools. In some software applications, achieving an effective sleep is aimed. For example, Zeo Sleep Manager (Zeo, Inc.) measures duration of sleep stages with headbands, in which its users can control their sleep phases and organize sleep hours accordingly. Other gamified applications with alarm clock try to wake people up by playing games. Examples of such software applications operating on mobile devices will be expanded in the following chapters and will be referred to as ‘app’ throughout the thesis.

As observed in the literature review, people generally have difficulties in waking-up at right hours. Many people also have trouble in regulating their sleep durations. Without knowing that they are not getting enough sleep between optimum time intervals, they suffer from sleep deficiency and its side-effects such as being too tired, demotivated and stressful. If they do not wake-up at right hours, they have cognitive and timing problems, as well.

Existing products and apps either force people to wake-up at optimum hours or use medical accessories instead of using the power of persuasive design, which can be described as the process of creating new technology to change behaviors by psychological, emotional and social factors. (Fogg, 2009). Without using persuasive design and fun factor effectively, the gamified apps remain insufficient to influence sleep-wake habits in a positive way. The design of a new gamified app dedicated to sleep-wake habits may help people to have a motivation while starting a day and to understand sleep dynamics tracking their actions. Moreover, extensive usage of the app may make its users gain awareness on waking-up and even change behaviors in the long run. Therefore, outcomes of the study may be beneficial to see whether that kind of a gamified alarm clock app supplies a demand in these perspectives or not.

1.1 Aim and Scope of the Study

In the present study, the main goal is to understand the effects of gamification usage for one of the hardest daily routines. Waking-up early and sleeping at required hours was determined as one of the hardly-performed daily tasks that is directly related to subjective well-being. The research asks whether it is possible to motivate people, generate awareness and change sleep-wake habits through gamification. The scope neither focuses on gamification and its relevance to physiological and neurological study of sleep stages nor sleep efficiency.

In order to see the effects of gamification in sleep-wake habits, it was required to make observations on waking-up hours and sleep durations. Sleep-wake habits could be collected via gamified and non-gamified versions of a mobile alarm app to ensure that the changes were caused by gamification or not.

1.2 Research Questions

With the perspectives of gamification explained in previous sections, research questions try to find possible answers to three questions. First two questions will be replied via literature review filtered in the topics of well-being, psychology, gamification and sleep-wake habits. Last question will be answered through the fieldwork:

1. What is gamification and its relevance to human well-being?
2. What roles do sleep-wake habits play in people's well-being?
3. What are the possible results of implementing a gamified mobile app to create positive feelings and better awareness of sleep-wake habits?

1.3 Structure of the Thesis

In order to find answers to the proposed research questions, the thesis is classified into five Chapters as follows:

Chapter 1- Introduction.
This current chapter lays the background to the study. It gives a general overview of the topics of well-being, gamification and sleep-wake habits. It introduces the aim and the research questions of the study. It also presents the structure of the thesis.

Chapter 2- Gamification and its relevance to well-being.
The chapter gives literature reviews on well-being, gamification and sleep-wake habits. It also explains well-being, its relationship between gamification and between sleep-wake behaviors. The chapter also mentions gamified apps and sleep-wake apps with the support of literature.

Chapter 3- Research methodology.
The chapter explains the purpose of the fieldwork. It describes gamified alarm app (*Sleepy Bird*) in details. It mentions improvement and steps of the design process. It explains the

methods of the study such as determination of the user group, procedures of studies and collection of data.

Chapter 4- Analyses of the fieldwork.
The chapter presents results and analysis of collected data. It includes qualitative and quantitative analysis according to questionnaires and computer logs. It discusses the results and makes comparisons between experiment and control group of participants.

Chapter 5- Conclusions.
The chapter gives extensive responses to research questions of the study. It covers conclusion and final outcomes of the thesis. It indicates limitations of the study to make future work implications.

CHAPTER 2

GAMIFICATION AND ITS RELEVANCE TO WELL-BEING

This chapter brings the literature reviews on gamification and well-being together, and sets the relevance of the two subject matters. It offers definitions and describes the components of well-being and game-related studies. Sleep-wake habits are also explained to emphasize its importance on subjective well-being. The chapter also introduces gamified examples concerning both personal well-being and for sleep-wake habits.

Literature focuses on multiple areas related-to well-being, gamification and sleep-wake habits. Literature findings help to formulate research questions. The gathered information about subjective well-being, the role of game and gamification for well-being and the importance of daily sleep-wake habits help to make decisions for fieldwork studies. Gamification from the perspective of psychology with motivational affordances and behavioral outcomes help to determine the goals of the fieldwork. Development of the mobile app for the fieldwork is benefited from the knowledge and criticism of existing gamification examples.

2.1 Well-Being

This section will give definitions of well-being and its relevance to sleep and playing games. This knowledge helps to formulate research questions and to give decisions for the development of the app. This section also suggests the possible scales to measure well-being and sleep-wake habits, which is useful for the research methodology.

Well-being is a wide term that refers to positive experiences and happiness of people about different aspects of their lives such as health, wealth, relationships, jobs and communities. It not only affects the moment, but also have an influence on future conditions. Thus, well-being is considered as a long-term study.

Well-being can be detailed under two topics called hedonic and eudaimonic. Ryff and Keyes (1995), Diener and Lucas (2000) and Peterson et al. (2005) assert that life satisfaction and emotional wellness are studied under hedonic perspective. People desire to be satisfied with life and feel good while doing an activity. Diener (1984) states that hedonic well-being is the way of people experience their lives. Having positive feelings by eliminating negative ones could result in pleasurable cognitional and psychological outcomes. Thus, positive feeling and subjective happiness are two main elements of hedonic well-being.

Eudaimonic perspective, on the other hand, defines well-being more than 'subjective happiness'. Ryff et al. (2004) state that eudaimonic well-being includes broader aspects such as self-development and personal growth. In eudaimonic well-being psychological happiness is more significant than subjective happiness. Kraut (2007) defines eudaimonic well-being as physical, cognitive, emotional, social improvement of people with the help of external stimulations. Self-acceptance, positive relationships, autonomy, mastery, life goals and personal growth build six elements of eudaimonic well-being. Csikszentmihalyi (1991) also studies eudaimonic perspective by developing concept of flow. Flow symbolizes the position of engagement and fun, which has a dynamic maintenance in itself. Flow model will be explained in details in the following sections. According to Keyes et al. (2002) although hedonic and eudaimonic types have different perspectives, both are important to interpret the total structure of being well.

Well-being definitions mostly focus on subjective well-being. Diener et al. (2010) justify that subjective well-being is the most widely studied well-being subject since it is a part of total life satisfaction. Pink (2011) defines personal well-being with its three contributors such as autonomy, mastery and purpose. In order to interpret subjective well-being, intrinsic needs of individuals should be satisfied with positive life experiences. These experiences can be obtained by positive emotions.

Figure 2.1 The two-layer model (Retrieved from Van Praag et al., 2003)

Subjective well-being and positive emotions of people are studied with different interpretations and assertions. Van Praag et al. (2003) support that subjective well-being can be modelled according to different aspects of life. Subjective domain satisfactions depend on health, economic power or environmental issues. Two-layer model shows these domains of life which result in short-term or long-term effects on well-being of people as indicated in Figure 2.1. Although they are not totally separated, they all affect general satisfaction.

Kim-Prieto et al. (2005) and Pink (2011) define subjective well-being based on past experiences. Kim-Prieto et al. (2005) also focus on personal evaluations regarding to happiness, hedonic maintenance and stress aspects. Subjective evaluations related to previous experiences play an important role to interpret subjective well-being.

2.1.1 Scales of Well-Being

Diener et al. (2010) elaborate that research and evaluations related to well-being rely on subjective measurements and intentions of individuals. Numbers of tests, scales and questionnaires are used to measure well-being. Personal Well-Being Scale, Happiness Questionnaire, Life Satisfaction Scale, Personal Growth Scale and Subjective Happiness Scale are some examples of them. The scales generally can be effective when behaviors of people are shaped in the long-term. If well-being is needed to be measured in a short-time period, the scales are utilized to evaluate positive emotions generally. For instance, Andrews and Withey (1976) found Delighted-Terrible Scale, which can measure amount of happiness in the short time interval. It has seven categories in which participants choose one to evaluate their subjective well-being considering emotional and cognitive elements.

2.1.2 Sleep-Wake Habits and Well-Being

In order to have a detailed information about sleep, its definitions, relevance to well-being, and measurement tools will now be explained.

Johns (2009) explains the dictionary meanings of sleepy and sleepiness. Sleepy means possessing problems in staying awake, whereas sleepiness is the condition of sleepy. According to Roth et al. (1989), in the 1980's, researchers defined sleepiness as physiological necessity that causes sleep. Krueger and Obal (2003) define sleep as a repetitive and active behavior that is formed both in the brain and body to enable physical development, healing, cognitive recruitment and memory wellness. Therefore, with good sleep-wake behaviors whole physiological, neurocognitive and emotional systems are affected positively. Zohar et al. (2005) also believe that since sleep provides energy for challenging positions, it is needed for regulating oneself in achieving tasks. Thus, getting enough sleep directly affects the success and psychology.

If sleep is defined with a medical perspective, sleep stages and durations play an important role to measure both its quantity and quality. Smith (2001) explain sleep with its two main phases that affect resting, learning and memory namely REM (rapid eye movement) and NREM (non-rapid eye movement). Robinson (2014) indicates that people start their sleep with NREM stage, which generates 75% of total sleep at a night, which is used for physical relaxation of the body. Each sleep cycle of REM and NREM continues approximately 90 minutes. After NREM sleep, the REM sleep starts to relax the whole body including your brain and mind. REM is the deeper sleep that provides dreams, as well. According to Smith (2001) REM stage is related to procedural memory. On the other hand, Plihal and Born (1997) state that NREM stage is more affective on declarative memory. Additionally, Stickgold et al. (2000) admit that the most suitable sleep behavior to get higher development and learning advantages is related to having slow wave sleep (SWS) during the first quarter and REM during the last quarter of a night. In fact, the order of NREM and REM phases play an important role in an effective sleep.

Bixler et al. (1979) state that minor sleep problems are seen 52% of the population and Hamilton (1989) shows that 60%-90% of depressed people have sleep-wake problems. Adequate levels of sleep bring required physical energy and psychological power to achieve responsibilities and to fight against challenging situations. Furthermore, Kripke et al. (2002) explain that there is a U-shaped relationship between wellness and sleep durations proving that both long and short sleep durations are dangerous for the health. If people sleep more than 8-10 hours or less than 5-6 hours, the risk of mortality increases. Hence, it can be concluded that the same situation is available for the relationship between sleep durations and well-being.

Sleep-wake habits play an important role on both daily happiness and long-term well-being. Keyes (2005) defines well-being in three categories; emotional, psychological and social aspects. Considering this definition, different views are analyzed about sleep-wake habits and well-being relationship. Ryff et al. (2004) believe that psychological well-being is more dependent on medical sleep quality. In other words, it increases when sleep hours and rapid eye movement sleep are higher. In addition to these views, Gray and Watson (2002) defend that the more efficient the subject sleeps, the higher emotional, psychological and social well-being becomes. Bardwell et al. (1999) support that long sleep hours have a positive impact on emotional well-being. On the other hand, Hamilton et al. (2007) are of the idea that if sleep problems are decreased, both emotional and psychological well-being will increase.

According to Hamilton et al. (2006), sleep is related to psychological health. People who sleep between 6 and 8.5 hours have an optimal sleep duration. Optimal sleepers have low levels of depression due to possessing higher amounts of mastery, self-confidence and social relations. Roberts et al. (2001) justify that less sleep causes depression, stress and both physical and cognitive tiredness during the next day. Although, required sleep hours change in different age groups, it is possible to assert that people should sleep adequate hours to start the day in a refreshed way. Moreover, there are some research which prove sleep problems affect characteristics of people. For instance, Mellinger et al. (1985) point that 42% of insomniac people have a very anxious characteristic.

Furthermore, starting the day unrefreshed results in serious health problems related to fatigue. Kobashi-Schoot et al. (1985) explain fatigue in three categories which are physical tiredness as discomfort of arms and legs, mental tiredness as thinking problems and malaise as having no energy. Wolfson and Carskadon (1998) believe that if sleep time is not enough, it will deteriorate studies causing memory and performance problems. Hence, sleep-wake habits affect well-being in terms of daily emotions and efficiency at work.

There are more detailed perspectives that associate sleep with psychological well-being and positive affect. The relationship between quality of sleep and both hedonic and eudaimonic well-being is also analyzed. Moore et al. (2002) show that lower socioeconomic class with less education and lower income has more sleep problems. If people are socially isolated or less satisfied with their lives, they may have more sleep problems. Furthermore, Ryff (1989) interprets that optimum sleep gives needed energy to do activities and brings better feeling in the matters of; self-acceptance, purpose in life and relations with others.

2.1.3 Measurement of Sleep-Wake Habits

In order to analyze sleep-wake habits more, the study focuses on two different aspects. Frankel et al. (1976) define the terms of sleep quantity and sleep quality. Sleep duration, sleep latency and sleep disturbance measure sleep quantity, whereas emotions about sleep and amount of restfulness after sleep introduce sleep quality. Researchers introduced different indexes and questionnaires to measure sleepiness levels of people. These measurements can be done by observations in a medical environment or by personal questionnaires in natural environment of participants. Johns (2009) classifies these tests according to quantitative and qualitative measurements of sleep.

Arand and Bonnet (2008) use Multiple Sleep Latency Test (MSLT) as an example to measure drowsiness of patients. When patients sleep in a laboratory, their EEG (electroencephalography), EOG (electrooculography) and EMG (electromyography) are watched by the help of electrodes. According to Wierwille and Ellsworth (1994), there are similar tests that use technical tools to analyze sleep duration, sleep quality, slow eye movements and eyelid closure such as Maintenance of Wakefulness Test, Changes in the EEG or EOG and Video camera methods. These measures are generally used for insomnia.

Johns (1991) states that subjective evaluation of sleepiness is needed in some situations. Epworth Sleepiness Scale (ESS) is one of the most usable methods to understand dozing of people while doing different activities. It was designed in 1991 as a questionnaire with eight questions and their rating system. Its result gives the subjective degree of dozing behavior. (Smyth, 2012a) There exist other self-reported scales to measure amount of drowsiness and emotions as well. They generally use Likert scale type questions. Karolinska Sleepiness Scale, Stanford Sleepiness Scale, Sleep-Wake Activity Inventory and Profile of Mood States are some examples of these tests.

Smyth (2012b) indicates that Pittsburgh Sleep Quality Index (PSQI) is used to understand sleep-wake patterns and quality, as well. It is divided into seven aspects of sleep such as subjective sleep satisfaction, sleep latency, sleep hours, sleep efficiency, sleep disturbance, utilization of sleep medication and daily problems.

Moreover, according to efficiency at their performance, people can be analyzed under two categories; that are morning and evening types. Horne and Ostberg (1976) developed Morningness-Eveningness Questionnaire (MEQ) with the purpose to group people according to sleep-wake habits considering their biological rhythm. MEQ has 19 questions to determine the characteristics of participants as morning or evening type (Ağargün et al., 2007).

2.1.4 Well-Being and Need for Play

McDowell (2010) thinks that physical and mental health are meaningful elements of well-being. Also, individuals' role in the society, relationship with friends and fighting against challenges play an important role in total well-being. People sometimes need to change their habits in order to reach physical, mental, economical, psychological or social wellness. To

illustrate, people know the danger of fast food but they still continue eating. Since they do not have enough motivation and mental force to stop eating junk food, they do not change their physical actions regarding this behavior. Hence, people may need to be motivated with additional tools to change behaviors in a more positive aspect. Chan (2011) believes that playing has the power to trigger new behaviors against previous habits.

According to Przybylski et al. (2010) when players' psychological needs are satisfied, their well-being increases in that context. Playing games is also beneficial for players' psychological and physical well-being according to Self Determination Theory of Ryan and Deci (2000), which will be explained in the following sections.

Creation of motivation and pleasurable experiences are commented as important goals of games for some of the researchers. Bruner (1979) thinks that playing a game makes people relaxed and calm down in stressful situations. Reeves and Read (2009) asserts that after being successful in a game, the characteristics of people are affected positively in terms of social relations. Moreover, Argenton et al. (2013) believe that human psychology and well-being are affected positively by structures of serious games, which also object to raise happiness and engage players into the game by using social relations.

2.2 From Games to Gamification

In order to understand the topic of gamification better, games are reviewed as an initial point. Games can be powerful in influencing human behaviors and psychology in a positive manner. In Global Games Market Report, Schultte (2013) claims that 1.2 billion people have played games all over the world by 2014. Macchiarella (2012), on the other hand, shows that 135 million people of US spend at least one hour per month playing video games, whereas this number was 56 million in 2008. Thus, the number of video game players increase each year. Entertainment Software Association (2014) shows that the average age of players is 31. These players say that game features satisfied their needs in their 14 year-of play time.

Game features cover both game mechanics and game dynamics. Game mechanics can be classified as points, levels, challenges, virtual goods, leaderboards and gifting items. On the other hand, game dynamics support these mechanics providing reward, status, achievement, self-expression, competition and altruism to satisfy emotional needs of players (Bunchball, 2010).

Considering all these game features and psychological deepness of games, game researchers define games with different perspective. As being one of the important game researcher and designer, McGonigal (2011) is of the idea that games foster positive feelings and increase the quality of life. Games are powerful especially with four important features such as goals, rules, feedback and capacity to generate voluntary participation. Games can create a satisfying virtual world. When games are used to solve real life problems, they can do it successfully if they are designed well. The design should evoke intrinsic motivations to appeal players. Furthermore, Sweetser and Wyeth (2005) divide game design elements into eight parts which

are concentration, challenge, player skills, control, clear goals, feedback, immersion and social interactions that motivate players intrinsically.

Granic et al. (2014) also suggest that a good game should bring psychological advantages in terms of cognitive, motivational, emotional and social benefits. Cognitive benefit provides players using their creativity in the game. Motivational benefit makes players return to the game to achieve their goals. To motivate players, gratifying feedback should be given in order to inform them about their progress. For the emotional benefit, the game should make players feel happy when they take actions during the play. Social benefit empowers the activities related to help, support, communicate, cooperate or compete. Lack of these features makes a game poor-designed. The situation is similar in gamified apps since they use game features. Hence, in order to create motivation and positive experiences in hardly-performed daily tasks, gamification tools use psychological advantages of games.

2.3 Gamification

In the following sections, definitions of gamification, its relationship with psychology, its criticisms and usage area examples including sleep behaviors will be presented to understand the extent of gamification better. This knowledge forms the background of the research questions. Findings are also useful for the development of the gamified app.

Gamification uses power of games to shape daily behaviors in a fun way. Baranowski et al. (2008) believe that the game features like reward mechanism besides interactivity, goals and challenges, controls and feedbacks, appealing presentation and narration affect behaviors and experiences.

Bunchball (2010) is of the idea that game mechanics motivate behaviors, whereas dynamics satisfy needs. Gamification makes use of game elements to provide fun, to let users make their own decisions, to make users play an active role and to engage users to the related non-game activity. Gamification uses these features for different purposes in daily activities such as watching videos, reading articles, writing comments or buying goods. Therefore, gamified apps are used by many people including students, employees or patients. It makes users feel themselves popular, successful or cool in the real life. This sense in gamification brings mystery, mastery, membership and meaning into daily activities. However, to enhance engagement, good gamification tools should include not only game elements but also the sense of game design.

Deterding (2012) indicates the improvement of gamification processes:

- In 1980s Thomas Malone interpreted games as “heuristics for enjoyable interfaces”.
- In 2000s games are used as educating and healing tools as serious games. Moreover, usability and playability started to gain importance with human-computer interaction studies.
- Nowadays, rather than developing a whole game, marketers and organizations make use of game elements to motivate people, which makes gamification popular.

First, the movement of 'Serious Games' was effectively used to influence behavior of people. These games were developed in order to support learning and health care. After 2010, the term of gamification started to gain popularity supporting health, environment, government and educational issues. According to Marczewski (2013), gamification term was firstly used by Nick Pelling in 2002 to increase engagement. When people are engaged to an activity, they can reach their objectives related to that activity easier. Deterding et al. (2011a) define gamification as using game features into non-gaming systems in order to engage users into the activity and to provide better user experience.

Werbach (2012) also considers gamification as a useful tool to provide engagement in daily activities. He divides gamification into four topics namely external gamification, internal gamification, serious games and crowd sourcing. External gamification types are related to point-based marketing and services apps, whereas internal one is more about the individual success and learning programs. The internal gamification needs to motivate and engage users to get its purposes. Serious games, on the other hand, creates a learning platform with simulations about real life activities such as medical or business problems. They do not use the power of playfulness like other gamified tools. Crowdsourcing as the last type of gamification says that social cooperations and teams can bring the success in achieving a goal.

Gartner (2011) thinks that user engagement is increased by usage of gamification processes. In real world situations, given tasks and goals are complex and long. However, with gamification, goals are divided into smaller and short-term to do tasks that can be learned and repeated easily with quick feedback on progress. Achievements can be taken easier and faster in small loops in order to make player stay in the game longer. In addition, Marquis (2013) believes that gamification is beneficial in learning and education. To illustrate, gamified apps encourage students to focus on multiple but small tasks at the same time, which can increase multitasking mentality. Thus, gamification has a positive influence both on individual learning and teamwork success.

It is predicted that gamification will take bigger part of personal and organizational usage in the future studies. Gartner (2011) projects that, 50% of all companies would use gamified systems by 2015. Moreover, more than 70% of largest health, education, civil society and government organizations would gamify their processes. Meloni (2012) indicates the findings of M2 Research claiming that by 2018, gamification tools will have $5.5 billion market share.

Beyond from definitions, gamification has an important role in well-being and psychology of people. Gamified tools are effectively used to motivate people or to change their behaviors in order to get psychological, cognitive and physiological well-being. Therefore, scope of the study presents gamification under a psychology perspective.

2.4 Gamification from the Perspective of Psychology

This knowledge will build the important part of the given decisions in the fieldwork. Gamification is used with regard to its psychological effects in the study.

The main purpose of gamification is supposed to be a behavior modification according to different studies. Huotari and Hamari (2012) emphasize the importance of psychological experiences, whereas Deterding et al. (2011b) focus initial game elements rather than final experiences. Hamari et al. (2014) predict that gamification has two parts; i) "motivational affordances", and ii) "psychological and behavioral outcomes". For the first part, studies generally measure motivation, enjoyment and attitudes, whereas, for the second part studies generally focus to understand human intentions. Huotari and Hamari (2012) believe that behavioral outcomes are more complex and difficult to evaluate.

2.4.1 Motivational Affordances

Przybylski et al. (2012) believe that people want to shape their behaviors to reach their ideal selves by doing daily actions in various spaces such as home, school, work, in a society or even while driving on the road. Motivations play an important role in immersion and changing behaviors for better in order to be more healthy, happy, successful or rich. Motivation types can be studied under two categories namely extrinsic and intrinsic. According to Ryan and Deci (2000), extrinsic motivation satisfies needs with tangible outcomes such as point and reputation systems, titles, money and real rewards. Intrinsic motivation, on the other hand, symbolizes the satisfaction from an interesting and enjoyable activity.

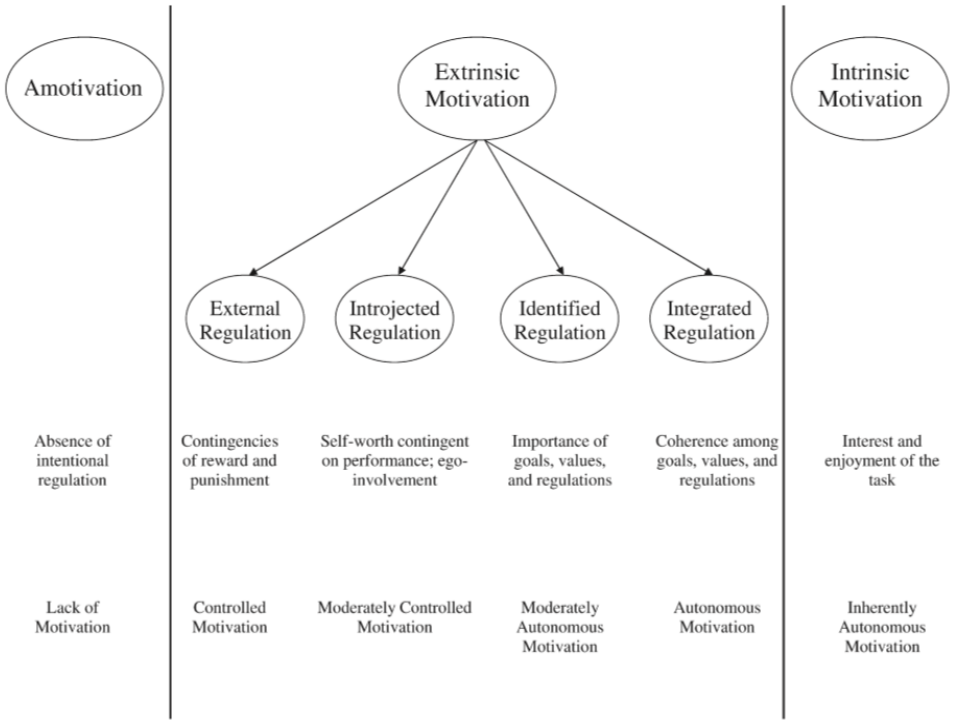

Figure 2.2 A taxonomy of human motivation (Retrieved from http://www.ellisinwonderland.nl/ryan-and-daciintrinsic-and-extrinsic-motivations-classic-definitions-and-new-directions/, 2011)

Regulation types, which guide behaviors of people, are studied under subtopics of extrinsic motivations. As indicated in Figure 2.2, in the external regulation of extrinsic motivation there exist nearly no motivation, but there are some rewards and punishments to persuade people to

do an activity. In the introjected regulation, people want to perform the action a bit because of thinking that it would be beneficial for them. In the identified and integrated regulation types, people are motivated by the result of situations to achieve them. They regulate themselves to reach the goal at the end. In the intrinsic motivation type, on the other hand, people interest in the activity and have fun. Although they have a reasonable goal at the end or not, they continue doing the activity due to its joy. The important aspect of these motivation and regulation types is that the more the user is autonomous about an activity, the more it is possible to engage with it. A gamified experience would be more effective if it reaches to the very right column.

According to Zichermann (2011), the success of gamified tools comes from their satisfaction of intrinsic motivation and goal of players. The game elements are useless unless a gamified tool is successful to create a type of internal motivation. He also believes social aspects play an important role for the success of gamified tools. Providing precious and meaningful intrinsic motivations results in long-term satisfaction and glorified consequences.

Since gamification tries to persuade people to adopt some behaviors or make them get used to some activities, focusing on their needs is very important. Nicholson (2012a) justifies that gamification mainly aims to motivate people in performing an activity. Therefore, individuals take place in the core of gamification studies. User-centered gamified tools should be developed to increase internal motivation considering goals and needs of individuals. In brief, in order to get positive changes in behaviors by persuading people to take some actions, gamification tries to build a motivation. Ryan and Deci (2000) study Self Determination Theory, which carries studies on motivations one step further.

Self Determination Theory (SDT)

Self Determination Theory known as SDT became an important tool of psychology to interpret extrinsic and intrinsic motivations better. This theory proposes that motivation is the mental force of people and can be divided into two subtopics. Intrinsic motivation provides more interest and fun to draw people into an activity voluntarily, whereas extrinsic motivation evoke the hope to win a reward at the end of doing that activity. If people behave with their own desire and satisfaction with the joy of the activity, they are intrinsically motivated. Conversely, if they act to get the end situations and final rewards, they are extrinsically motivated. The more one is taking an action because of its fun factor, the more this action becomes meaningful.

Przybylski et al. (2010) are of the idea that video games are interesting due to their satisfaction of basic psychological needs like autonomy, competence and relatedness. SDT emphasizes that the need for autonomy, competence and relatedness of people should be satisfied to motivate them intrinsically. These now will be explained briefly.

Autonomy: Autonomy is the first intrinsic need of people that should be satisfied. When games and gamified tools are considered, Ryan and Deci (2000) suggest autonomy to provide players with meaningful choices and opportunities for taking actions in the game world. Ryan

et al. (2006) state that the term of autonomy can be described as feeling desire while doing a task. The more one is keen on the activity, the higher level the autonomy is. Enrichment of activities with alternative choices, positive feedback and information increase the autonomy of people on certain activities, which results in higher intrinsic motivations.

Przybylski et al. (2010) also believe that while playing the game, players want their actions to be meaningful in the game world. Thus, the game should include choices and paths to satisfy purpose of players. Gamified apps try to let players to make their decisions about different situations. In the long-term, the satisfaction of choices would lead to the increase in well-being.

Competence: Competence is the second need that is studied under SDT term. Ryan and Deci (2000) are of the idea that competence is to satisfy intrinsic needs for mastery while one is trying to reach their goals and achieving new challenges with continuous feedback.

Moreover, Csikszentmihalyi (1991) asserts that competence is the need of people in the way of success. The success can be obtained as a result of solving problems with possessed abilities. As shown in the Figure 2.3, Flow Model presents the balance between challenges and skills. Players fight against the challenges at the optimum level in the flow zone. If the challenge fit well with one's ability and knowledge, the person feel successful and motivated.

According to Przybylski et al. (2010) this balance is important especially for the engagement of arcade games. Players' abilities to solve problems should grow according to game difficulty and timing of challenges. When players are playing and improving in the game world, they should experience competence, as well.

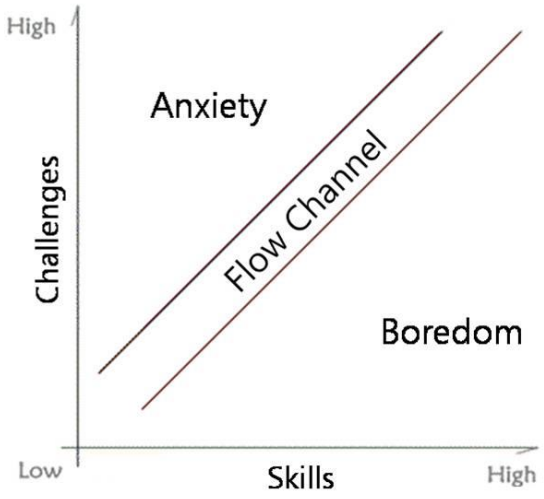

Figure 2.3 Flow model (Retrieved from Csikszentmihalyi, 1991)

Relatedness: Relatedness is the third need of people according to SDT studies. Ryan and Deci (2000) believe that relatedness is obtained by belonging to the society and having meaningful connection to others. Connection with other people empowers the intrinsic motivation of people. Being socially close to others make people feel more valuable and secure.

Przybylski et al. (2010) state that the need of relatedness brings the need of social interactions. Games and gamified tools should include cooperations and competitions in order to connect players to each other. Even if they are physically far away, players feel that they are together in the game world.

2.4.2 Psychological and Behavioral Outcomes

As the aim of gamification is to influence or shape human behaviors, psychological and behavioral outcomes play an important role for this study. This section presents different studies on behavior change and the relevance with gamification. Fieldwork is benefited from that part to form the goals of the study. It is important to analyze behavior change theories, which can be categorized into three subtopics as i) social cognitive theory, ii) theory of planned behavior, and iii) transtheoretical model.

Social Cognitive Theory: Bandura (1986) thinks that people are not only affected by inner factors, but also by outer situations. Personal properties and environmental effects have influence on behaviors of people. Self-efficacy, self-control, expectations and reinforcements are important factors affecting behavior change process. Even if one has self-efficacy, it is important to be rewarded to achieve a behavior change. Regarding to environment reinforcement, social support and interactions are given importance.

Theory of Planned Behavior: This theory argues that behaviors of people are shaped by their own beliefs, attitudes and judgments towards these behaviors. Social pressures and attitudes of other people also have an effect on subjective evaluations related to these behaviors. Glanz and Rimer (2005) assert that behavior change and game design studies can be analyzed together under this theory.

Transtheoretical Model (Stages of Change): This model of Prochaska et al. (1992) divide behavior changes into stages as illustrated in the Figure 2.4. At the first stage, which is called pre-contemplation, people cannot figure out the need for a change since they are unaware of the problem. Next, at contemplation stage, people realize a problematic behavior and start to think about changing it. The first two stages nearly take one year and six months duration in total. At the preparation stage, change plans and preparations are done for the near future. When it comes to fourth stage, people start to take actions such as adopting new habits or leaving old habits. People attempt to continue living with new behaviors, which is called as maintenance stage. People try to stay at the maintenance level to prevent deterioration in behavior again, which is called relapse as a final and initial point of changes.

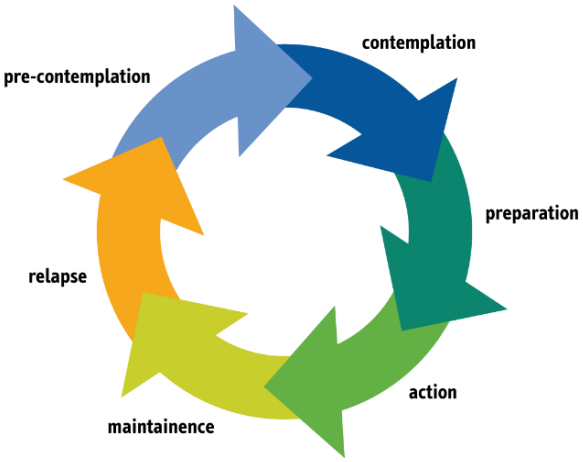

Figure 2.4 Transtheoretical model of change (Retrieved from http://www.nobco.nl/images/eMagazine/TTM_ model.png, 1992)

It can be possible to leave a habit by creating an awareness at the pre-contemplation stage. In order to pass these stages quickly, people should have motivations.

Figure 2.5 A Five-stage model of the behavior change lifecycle (Retrieved from Mehta and Kass, 2012)

On the behavior modification, Mehta and Kass (2012) also offer a similar model, steps of change, called behavior-change lifecycle as shown in Figure 2.5.

Mostly people are not aware of the problem as the case of transtheoretical model of Prochaska et al. (1992) in the first stage. In the second stage people question whether the behavior change is really needed and worth efforts. In the third stage, people try to understand the principles and mechanisms achieve the target behaviors. In the fourth stage, new behaviors are adopted. In the fifth stage, as a final, people practice to get used to new behaviors.

In order to design a powerful persuasive gamification, a game designer should care about the stages of behavior change as well as the challenges and game mechanisms related to these stages. (Mehta and Kass, 2012)

2.4.3 Gamification for Sleep-Wake Habits

Gamified apps are effectively used to influence behaviors of people. Roto (2006) states that with studies of human-computer interaction, mobile apps are designed similar to video games. The main goal is to conceive positive experiences in non-game activities to attract users.

Gamified tools are needed in different sectors to satisfy various needs of companies as seen in Figure 2.6. They have different usage areas such as personal wellness and healthcare, learning and education, social connectivity, financial planning, sustainability and governmental issues. The figure indicates the fields that people wish to see more games applied in the near future. Personal wellness and healthcare field has one of the highest proportions with 72%. (Makhija-Chimnani, 2012).

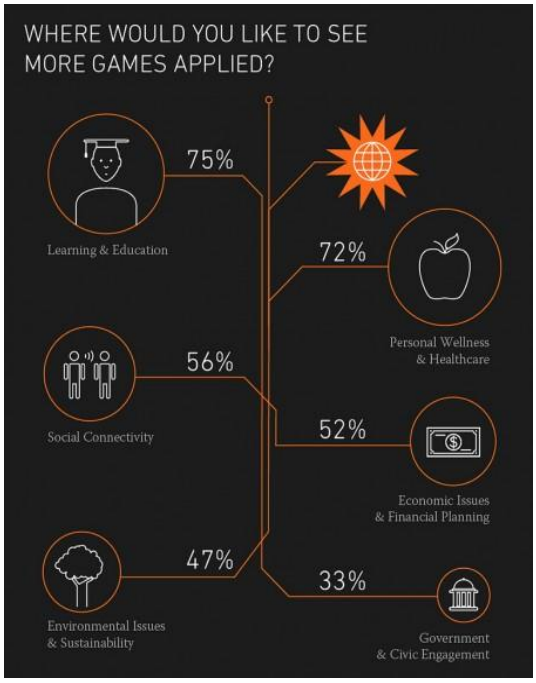

Figure 2.6 Where would you like to see more games applied? (Retrieved from https://www.flickr.com/photos/37527143@N03/6070915415/sizes/l/in/photostream/, 2012)

Young (2012) believes that gamification related to healthcare is gaining more and more importance with developing technology. As considering previous research, the scope of the study is to focus on subjective well-being via using gamified tools on personal wellness and healthcare. Daily routines play an important role for the happiness of individuals. People desire to track their daily health by measuring quantifiable data on special behaviors. If people are satisfied with everyday actions, this situation affects their whole life. Therefore, the initial requirement is to specialize a daily behavior that needs higher motivation. This activity needs to be done every day generally in an unpleasurable way. The literature and observations provide the data that sleep-wake habits are important determinants of daily well-being. Management of sleep-wake habits of people is a potential area that can benefit from gamification. By focusing sleep-wake habits, subjective well-being of people can be affected in a short-term, as well.

There are many examples that use gamification to improve healthcare and to control sleep-wake hours.

2.5 Examples of Gamified Tools

Different examples and usage areas of gamification are analyzed to get more information about this tool. The gamification examples would be beneficial for the design and development of a new gamified mobile app in the fieldwork.

As indicated in the Figure 2.6 gamified tools are used in different fields such as education, social connectivity, finance, personal healthcare and well-being. Chou (2013) gives examples of these apps' usage in the market. Big organizations and brands make use of gamified tools in their companies for different purposes. To illustrate, Google designed a gamified system to organize travel expenses, which resulted in 100% of success. Ford Canada and Deloitte improved gamified apps to improve training programs and to provide long-term engagement. Likewise, Hewlett Packard and Samsung increased their productivity and revenue by giving rewards like holidays and goods. Microsoft and Volkswagen also encouraged employees to produce user-generated content with games which caused creative ideas with less production errors.

Gamified tools can be implemented into daily usage areas in three ways; i) they can be utilized by building spatial structures, ii) they can work as an app with their related product, or iii) they can operate as mobile apps in computers or smart phones.

2.5.1 Spatial Structures

According to Norman (1988), design should explain itself with its visual properties such as form, color, clues, natural mappings for controls and interface. Moreover, it needs to give feedback to actions. By using the power of industrial design, the physical structures can be modified in order to create fun with gamification. The design of piano stairs in front of Armada Mall is shown in the Figure 2.7. It demonstrates a piano stairs that resembles a piano and gives audial information stepping on the stairs. The purpose of the stairs is to gamify climbing to provide a physical activity by changing exhausting activity into fun with playing music. The original version of the product (first applied in Stockholm, Sweden) measured that it increased 66% of people using stairs.

Figure 2.7 Piano stairs, Speed camera lottery (Retrieved from http://www.treehugger.com/cars/speed-camera-lottery-could-save-lives-and-fuel.html, 2010)

2.5.2 Product with Mobile Apps

John and Anderson (2008) believe that conditioning and shaping are important aspects to change behaviors. Behaviors of people are affected depending on the positive/negative reinforces as rewards/punishments. Therefore, in order to achieve complex tasks, rewarding an action for each time can be helpful to shape behaviors. There are studies done to make cars decrease their speed on special places. For instance, second one of Figure 2.7 displays a gamified app that was developed to decrease the speed limit to 25 km/h. When a driver passes in front of the product under that speed, it takes the photo of that car. The app selects one of these drivers to give rewards in regular time periods. Thus, drivers condition themselves to slow down in front of that product. According to the measurements, it is stated that this tool caused 22% reduction in the driving speed.

There exist other gamified tools that are used as mobile apps with their related products. Nike Plus, Zamzee, Fitbit and Withings are other examples of products that gamify well-being and healthcare systems to support physical activities or diet programs. The operating system is similar for these tools. They can measure the data and do calculations with the use of sensorial products. Then they generally connect through internet to their apps and share results on social platforms.

There are also lots of examples that use gamification to shape sleep-wake habits with products and their mobile apps. Sleep-wake habits can be related to either waking-up / going to bed times or sleeping durations.

There are different alarm clocks designed to ease waking-up times and to prevent snoozing clocks. There is an example of app to enhance enjoyment of wake-up process with its cooperative tool. Chou (2012) gives the example of Gun O'Clock, as shown in the Figure 2.8.

Figure 2.8 Gun o'clock (Retrieved from http://www.ubergizmo.com/2008/10/gun-o-clock-aims-for-your-wakefulness/, 2008)

It has a gun to shoot the clock. It aims to wake people up with a game while starting the day. If they do not shoot five times, alarm insist on ringing. Helicopter Alarm Clock is another

example of gamified alarms to motivate people in the morning. Users should catch a flying helicopter to stop the alarm. When users catch and put it on its nest, the alarm is turned off. Thus, these are useful and playful designs to make users get out of the bed without snoozing.

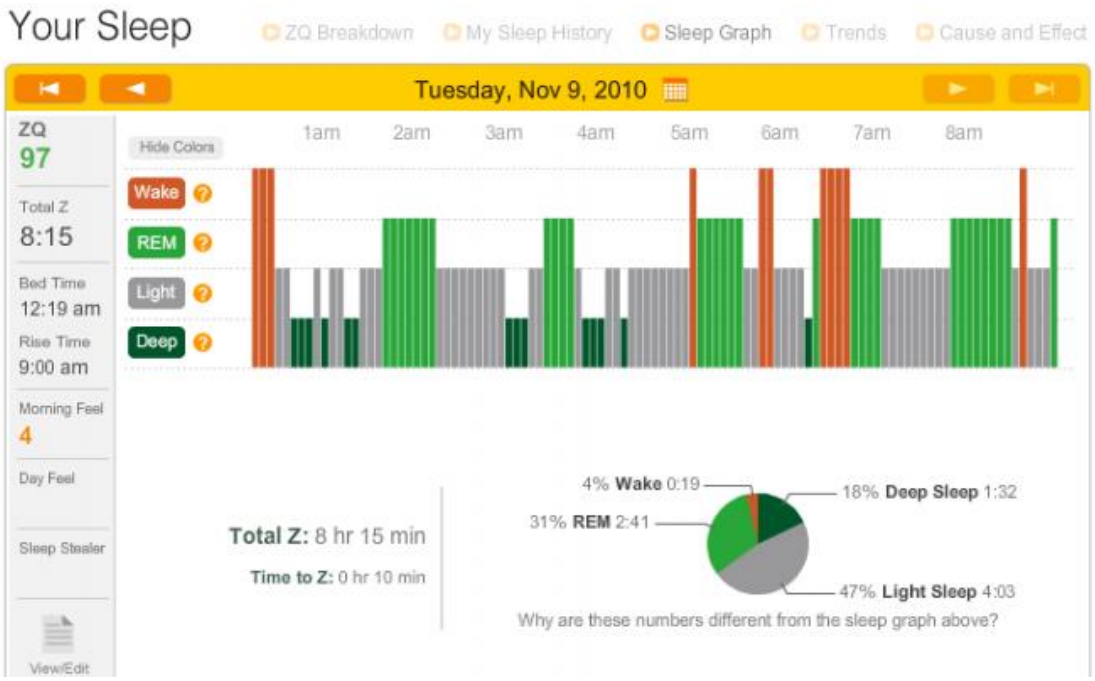

Figure 2.9 Zeo sleep manager (Retrieved from http://dreamstudies.org/2013/07/16/best-sleep-tracking-apps-devices/, 2013)

Zeo Sleep Manager is another example that uses product and its app at the same time. Orlin (2013) explains the product that was introduced in 2011 as tracking sleep cycles in the mobile platform, as indicated in Figure 2.9. It has sensors on its headband in order to measure electrical current during sleep phases. It also can separate NREM with its light and deep sleeps from REM sleep. After measuring these personal duration of cycles, it wirelessly sends the information to the mobile platform to make users aware of their sleep-wake habits and health conditions. According to Chou (2012) Zeo uses game mechanics while trying to wake people up at correct hours. Since the app awakes users when their REM cycle is finished, it provides a qualified sleep without disturbing it in critical hours. Hurd (2013) states that Zeo is a useful product because when sleep is tracked, it would be improved like other things such as diet or working schedule. Controlled sleep would also result in positive effects on psychological and emotional well-being.

Similar to Zeo Sleep Manager, some apps give clues or detailed information about sleep cycles of users such as Sleep Well. Those apps make users aware of their sleep-wake habits, control their long-term sleep behaviors and personalize their app.

2.5.3 Mobile Apps

Przybylski et al. (2012) are of the opinion that people want to get their ideal selves using games as mediators. Gamification motivates people helping them to reach ideal selves. For instance, most of the people want to quit smoking. As shown in Figure 2.10, Goalpost is an app that gives quests to be achieved and rewards to be won as a result of success. Users can follow it on their smart phones every day. With its gamified structures, it aims to make users stop smoking in 12 weeks. The app argues that smoking can only be quitted with the help of other people. Since cooperation and support are considered very significant for that objective, the app gives points when players do a social activity such as sending a message to a friend. It gives feedbacks about the danger of smoking and gives points for the non-smoking days.

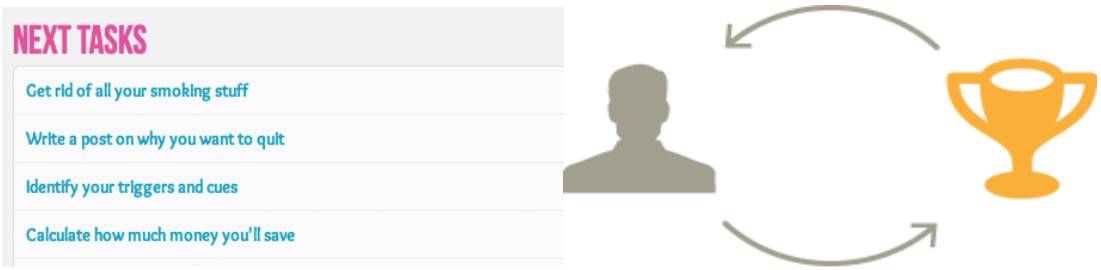

Figure 2.10 Goalpost (Retrieved from http://goalpost.it/how_it_works, 2013)

There are other mobile apps to organize daily life of people. To illustrate, Mindbloom is a game to set priorities in life and indicates how much these priorities are given importance. Habit RPG and Epic Win gamify daily to do lists setting levels and rewards.

There are various gamified apps related to sleep-wake habits, as well. People need to use mobile apps in order to go-to-bed, wake-up on time or have enough sleep. Hildenbrand (2014) believes that healthy sleep-wake habits bring healthy life. Thus, gamified tools aim to change these habits in a healthier way.

Figure 2.11 Early bird for Starbucks (Retrieved from http://www.trendhunter.com/trends/starbucks-early-bird, 2012)

Young (2012) explains the app for Starbucks developed by Berghs School of Communication in Sweden. Figure 2.11 shows that Early Bird tries to persuade people start the day on time with feedback messages and reward system on a social platform. When people use this alarm app without snoozing, it gives achievements to users. The achievement system is implemented with points, stars, social sharing and a cup of coffee, which is available in an hour-time after getting out of the bed. It is a successful example not only making people get out of bed on time, but also buy their coffee for free with their points.

There are other mobile apps focusing on sleep-wake habits. They mostly use the alarm feature of smart phones. Dreeps is a smart phone alarm clock that uses a role playing game. It awakes its game character besides awaking the user in the morning. Carrot is another alarm app that tries to wake users up by talking and rewarding with songs and stories.

2.6 Criticism of Gamification

Studies of gamification have some problems besides its positive effects. Criticism of gamification is analyzed to design a better gamified tool for the study.

Gamification has a difficulty when operating in the real life. Steele (2013) thinks that people want to change some parts of their life with simple apps quickly. However, this process fails unless apps are designed well enough to be successful in changing someone's behavior.
Ferrara (2013) is against the idea of gamification's being a useful tool. Since gamification uses game-like extrinsic reward systems, the meaning of games as being entertaining and precious experiences diminishes. Studies of gamification remain on the reward level, whereas games have much deeper meaning. Games present achievements, points, levels besides their main positive effects on intrinsic needs as motivation. In addition, meaningful choices, balance, usability and aesthetics layers provide outcomes including extrinsic and intrinsic motivations both in the short and long-terms. Gamification only uses extrinsic reward systems ignoring player experiences. Hence, they are not as valuable as games. Power of games originates from their novelty, goals, challenging tactics, interactivity, controls, feedback messages, appealing narration, sound and graphics. Ferrara (2013) also thinks that gamification resembles a newly adopted technology staying at the peak level in these years. Yet, the lack and failures of gamification tools bring it to trough of disillusionment like other technological inventions.

Nicholson (2012b) is of the idea that gamification generally work for the external motivations. Points for being a continuous customer, badges for visiting special locations, levels for completing fitness activities are examples that put forward external reward system. This system enables easy connection between gamified tool and its users. As opposed to Ferrara (2013), Nicholson believes that gamification is a useful tool to increase engagement when there is no desire to take an action in life. Furthermore, external rewards can be useful for some situations although they damage internal motivations. To illustrate, when an individual wants to tie a shoe, gamified tool with only badge, level, leaderboard, achievement and point system will be helpful. However, extrinsic motivations become insufficient in changing behaviors in the long term.

Playful Wingmen (2012) is of the idea that players are not engaged with a game to have trophies, badges, achievements, points, levels or other external rewards. Players only become addictive of a game with intrinsic motivations. Conversely, Ryan and Deci (2000) argue that gamification can be addictive for the competence aspect. Although it generally includes extrinsic factors, it makes player feel that they could reach their goals.

On the other hand, Marquis (2013) states that gamification has some negative aspects in learning and training purposes. For education goals, development of a gamified app can be costly and risky in terms of its results. If they are not well-designed they do not encourage learning. On the contrary, they cause social isolation and short attention span. Moreover, Gartner (2012) claims that 80% of gamified apps will fail to reach their goals because of poor design. The reason behind it is that developers of these apps are not game designers so that they do not give importance to the fun factor to engage players into the app. Thus, the main problems about the future of gamification is the lack of satisfaction of the intrinsic needs and the poor design of gamified apps.

In the literature findings, well-being and gamification are analyzed. It is seen that gamification is used to increase well-being of people in different fields for various purposes. One of the important topics of personal well-being is endorsed as healthcare. Since sleep–wake habits are important daily behaviors, those should be cared more to influence physical and psychological well-being in a positive way. Existing gamified examples are not specially designed with game elements. They generally use a reward system to enable a short-term and temporary motivation. They also do not focus on sleep-wake needs to motivate users in those habits. Thus, the following chapters will explain a new approach for a specially designed gamified app to increase intrinsic motivation and awareness related to sleep-wake habits.

CHAPTER 3

RESEARCH METHODOLOGY

In the literature review, it was endorsed that sleep-wake habits had an impact on well-being in terms of healthcare and personal improvement. Thus, gamification was utilized to motivate participants and to give an awareness about sleep-wake habits. Although there were some gamified examples, they generally created temporary extrinsic motivation. This chapter presents the proposed research methodology. The research focuses on one of the special daily routine, which is waking-up early in the morning; and the tool to ease this routine, which is the gamified alarm clock app.

3.1 Design of the Fieldwork

Deterding et al. (2011a) define gamification as the usage of game design elements in non-game contexts. In addition, Werbach (2012) claims that gamification can provide engagement in daily tasks. This study explored whether an improved motivation and awareness be created by a gamified tool on sleep-wake habits. The literature supported that sleeping and waking-up were important everyday behaviors. It was also believed when sleep-wake routines were influenced positively by gamification, the results would be pleasing for subjective well-being. Accordingly, the scope of fieldwork was to explore whether 'gamification' could help in achieving the following goals.

- To make participants awaken more motivated.
- To create better awareness of sleep-wake habits.
- To create positive attitudes towards sleep-wake at required hours.

To that purposes of the study, it was required to make observations on waking-up hours and sleep durations. Sleep-wake habits of selected participants could be collected via a mobile app. If participants utilized an alarm clock app, it would reveal quantitative data in the usage duration. It was planned to use both gamified and non-gamified versions of the app to ensure the changes were caused by gamification or not. Making comparisons between gamified and non-gamified versions of the app would also allow to do further analyses on sleep-wake behaviors. However, critical topics needed to be clarified.

In order to design a successful alarm app, it was necessary to be informed correctly about sleep-wake habits and then make critical decisions. For this reason, the views of an expert was required in addition to the literature review. A short interview was carried out with a medical doctor, Assoc. Prof. Dr. Bülent Çiftçi, specialized in sleep from the Department of Thoracic Medicine of Atatürk Göğüs Hastalıkları ve Göğüs Cerrahisi Eğitim ve Araştırma Hastanesi.

The interview help to guide the skeleton of the alarm app, accordingly, some topics related to sleep-wake habits will now be explained.

Pre-Fieldwork Interview

The information gathered from the interview can be organized under three topics: i) sleep as a medical term, ii) optimum sleep-wake hours, and iii) snooze actions. Each of these topics will now be presented briefly including the questions covered (in *Italic* text) in the interview.

i) Sleep as a medical term: *Ideal sleep duration.* Çiftçi (2014) defined ideal sleep as sleeping to have enough energy for the next day. Efficiency and sleep-wake times are important to interpret the quality of sleep. In order to understand efficiency of sleep, sleep stages should be detailed. Sleep has two main stages called NREM and REM. People start to sleep in NREM stage which includes slight but longer sleep (50% of total night's sleep). NREM stage is beneficial for daily physical relaxation and physiological healing of the body. After NREM sleep, REM sleep starts to rest people psychologically and mentally (20% of total night's sleep). REM duration increases when people want to learn and memorize new knowledge. Each stage takes approximately 90 minutes and total sleep generally possesses 4-7 cycles in every night. If one has a sleep in such a case, it defines normal sleep, which is efficient sleep.

Outcomes of good sleep-wake habits both in the short and long term. Çiftçi (2014) stated that good sleep is necessary to rest the body physically, psychologically and cognitively. If people do not sleep at sufficient levels, they have fatigue and feel themselves unhappy in the short term. This situation is similar to waking-up in an incorrect hour. Finishing the sleep with a proper waking-up is needed for assessing the quality of sleep. Lack of quality in sleep and awaking brings the term of sleep deprivation, which cause problems in brain operations. Amnesia and concentration disturbance are short term daily complications. Moreover, these challenges affect subjective well-being negatively in the long term by causing failure and depression.

Chronic disorders making it harder to wake-up. Çiftçi (2014) justified that diseases related to sleep such as sleep apnea and insomnia, blood pressure problems, painful illnesses like slipped disc and copd result in serious difficulties to wake-up.

A scale for measuring sleep disorders. Çiftçi (2014) suggested 'Epworth Sleepiness Scale' to know drowsiness of people easily. The score tells if one suffers from sleepiness. This question played an important role to choose a scale for the study to quickly identify the user group having sleep problems on the middle level.

ii) Optimum sleep-wake hours: *Duration of sleep, bed-time and waking-up time.* These were significant questions in order to learn optimum sleep-wake times to design a personal alarm app. According to Çiftçi (2014), required sleep durations decrease with years. Although daily sleep changes from 4.5 to 9.5 hours in different age groups, optimum duration is generally between 6 and 8 hours for adults. Çiftçi (2014) asserted that optimum time for sleeping is after

sunset and for waking-up is after sunrise. Catching the sun is crucial because it makes people release melatonin hormone that calms body with saving health. Hence, people should go to bed at 00.00 am and get out of the bed at 7.00 am to have a normal and qualified sleep.

A time interval required between waking-up time and starting to work. Çiftçi (2014) stated that people certainly need some time after waking-up to be totally awake. This time should be at least 1-2 hours to focus on the studies. If people do brain operating activities or sport in this time, they can start to work with higher concentration.

iii) Snooze actions: *Possible effects of snoozing to waking-up.* Çiftçi (2014) told that alarm snoozing routines have no benefit for people. When people try to sleep five minutes or more they disturb their sleep by finalizing its quality. When the sleep quality is broken, there did not remain any advantages of sleep in terms of health. Therefore, snoozing stops whole efficiency of sleep. Moreover, people miss their working or studying hours while snoozing alarms. Thus, snooze should definitely be avoided.

The knowledge gained from the interview session played an important role on design decisions of the mobile alarm app developed for the study. Data related to waking-up hours, going-to-sleep hours, sleep durations, time interval between waking-up and starting to work and snooze numbers were gathered by the app, *Sleepy Bird*, which will now be explained.

3.2 Development of the Mobile App

Research of eMarketer (2014) demonstrates that 1.75 billion of people use smart phones in total of 4.55 billion of mobile phone participants in 2014. It was obvious that many participants utilized alarm clock function of their phones rather than using additional alarm clocks. For these reasons, a mobile software, which was an alarm clock app, was decided to be an appropriate tool to make observations about sleep-wake habits of participants. The app was designed specifically for the present research.

A gamified app could be obtained in three ways to reach the goals of the study. First way was to design and develop a totally new program. Second way was to utilize an existing gamified software. Third way was to implement sleep-wake elements into an existing game. For the first alternative, developing a new app was considered to be time costly and risky. If the gamified app had totally different features, it would possibly be disliked by participants. The risk could be sparing a long time for an unsuccessful product. For the second alternative, the literature and present examples were reviewed. In the already existing apps, motivation to wake-up was provided with compulsive methods. They also remained inadequate to motivate and aware participants. Gamified tools were neither specially designed with fun factor nor included sleep-focused needs according to the Literature Chapter. Therefore, third alternative was chosen as the most appropriate solution for the study objectives, which was modifying an existing successful game with alarm features. Quick popularity and simplicity made one game more remarkable than others.

3.2.1 Selection of the Game to be implemented in the Fieldwork

The selection of the game was done according to the following criteria: the popularity of the game, simplicity of gameplay and quick progression in the game world.

First of all, the decision was made by focusing on game genres that could be implemented in the time duration of this study. It should offer fun, as well as being easy to learn and play. It should support the main goal of using an alarm clock. In other words, the app should not take all attraction to its game. Thus, the game was a supporter to help the main goal, which was an alarm clock to influence sleep-wake habits. The genres were reduced to puzzle or platform game that could be implemented with an alarm clock and played on the smart phone easily. Once the genre was chosen as a platform game, the success of *Flappy Bird* was recalled.

Flappy Bird was a side-scrolling platform game, in which a bird was flying from the left to the right side of the screen. In the game, participants controlled the bird to fly without touching the green pipes by tapping on the screen. When bird flied between these pipes, the game gave one point for each pipe. Warren (2014) states that early visual studies of the game were designed in April, 2013 by Dong Nguyen. After the game published on the mobile platform in May, 2013, it became a global phenomenon in a short time. With its Nintendo style retro graphics and easy gameplay, it became popular in firstly in App Store and later in Google Play. According to data of December 2013, the game occurred in the top 250 for free apps and best 14 for family apps in the U.S. These numbers increased to most downloaded eighth free app and sixth free game in the U.S in January, 2014. App Annie statistics showed family, games and overall charts. The number of downloads increased 136% day by day. As a result of this, it became number-one free app in the U.S. besides 53 countries including China and UK on the second half of January (Warren, 2014).

In brief, since *Flappy Bird* was considered to be popular, simple, addictive and progressive game, it was selected to be implemented into the alarm clock app.

3.2.2 Technical Development

Technical assistance of a computer engineer was needed to code the software. For the development of the app, Java programming language was used. Entire *Flappy Bird* game was rewritten from scratch with embedded alarm functions, feedbacks and calculations for the study. Target platform was Android with minimum Android version 2.3. Java was the native language for Android development so any other tool was not needed. Libgdx graphics library was used to ease the graphics development. Libgdx also provided a base for separating game code from platform specific code. Thus, the entire app could be ported to other platforms such as IOS with a little effort. Alarm function depended so much on the target platform that only Android version was implemented for the study. Android API needed to wake-up the phone from sleep state to function the alarm. For data collection, online service Parse.com was used. It provided a Java API that was used for communicating with provider's servers and the game software. Communication was established over standard http. Parse.com was also used for the high score feature of the app.

3.2.3 Development of the Gamified and Non-Gamified App Versions

Sleepy Bird was designed as a tool to achieve the main goal, which was creating a motivation and awareness about correct waking-up hours, sleeping durations and snoozing actions. *Sleepy Bird* was developed in two versions: with a gamified, and non-gamified alarm clock function. In the former, gamification and alarm clock function were implemented together into the app to feed each other, whereas in the latter a non-gamified form of the alarm was designed. The aim of two versions was to analyze the data of gamified version for experimental group, and non-gamified version for the control group. The differences between the two versions can be seen in Table 3.1.

Table 3.1 Differences between gamified and non-gamified versions of the app

Gamified Version	**Non-Gamified Version**
Alarm time and sound	Alarm time and sound
Going to bed hour and sleep duration	Going to bed hour and sleep duration
Feedback about wake/sleep actions	Feedback about wake/sleep actions
Revised *Flappy Bird* game	NA
Game elements (e.g. lives, points, challenges, feedbacks, visual elements and leader board)	NA

According to Table 3.1, setting alarm and indicating sleep hours were functionally used in both versions. Since gratifying feedback had been suggested to motivate participants intrinsically, the app used feedback messages (see Appendix A for the detailed feedback messages for each condition) in both of the versions. Thus, non-gamified version also had an additional feature in comparison with existing alarm apps. By using feedback messages, it gave insights about wake-up times, snooze actions, and sleep durations. Gamified and non-gamified versions of the app will be compared to analyze the results in the next chapter.

3.2.4 Visual Design

As *Sleepy Bird* aimed to create positive feelings while starting the day, color choices and selection of images were made carefully to support this mood. *Sleepy Bird* character was designed to have a big red eye to emphasize its level of drowsiness. The game also used light to set the ambience telling the participants that sun rose in the morning. At the top of the game screen, user interface was used to show score and lives left as indicated in the Figure 3.1.

For the gamified version, *Sleepy Bird* was designed to have four buttons on the main screen, which were grouped in two with color coding. ‘Play’ (oyna) and ‘leader board’ (en iyiler) buttons were related to the game; and ‘alarm set’ (alarm kur) and ‘sleep’ (uykuya dal) buttons were related to sleep-wake actions (see Figure 3.1).

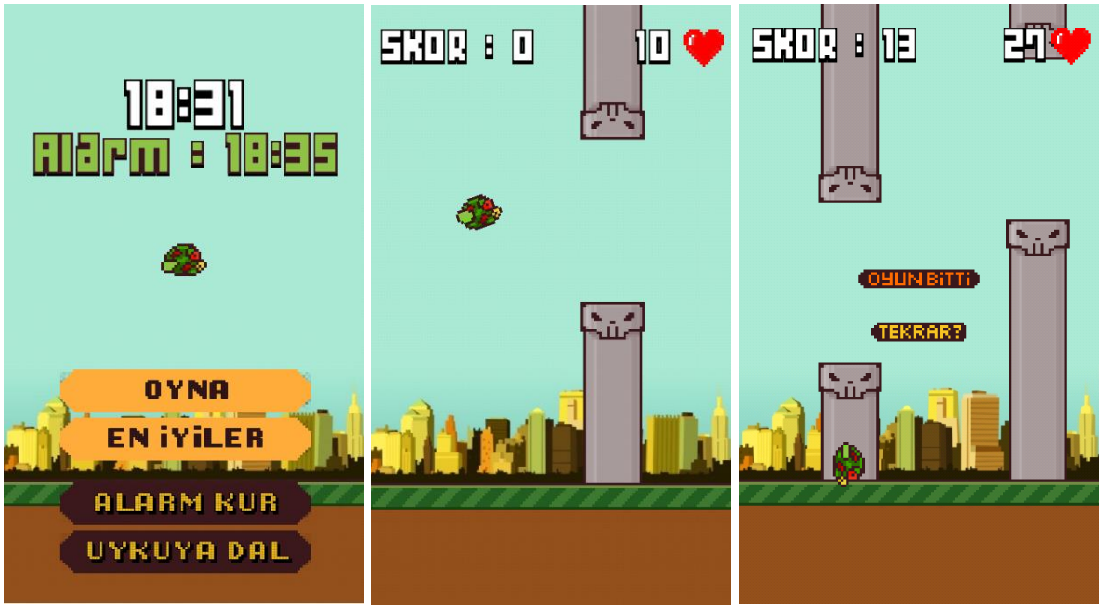

Figure 3.1 Example screenshots from *Sleepy Bird*

Once the buttons were tapped, they leaded to different screens as exemplified in Figure 3.2. The game also provided personal feedback messages (Appendix A) when for example, the participants set the alarm or wanted to go to bed. Feedbacks aimed to provide awareness about sleep-wake habits. This feedback messages were shown in red color to draw attention of players. If the feedback message was relatively longer, a pop-up screen opened just as *Sleepy Bird* spoke to participants about their action.

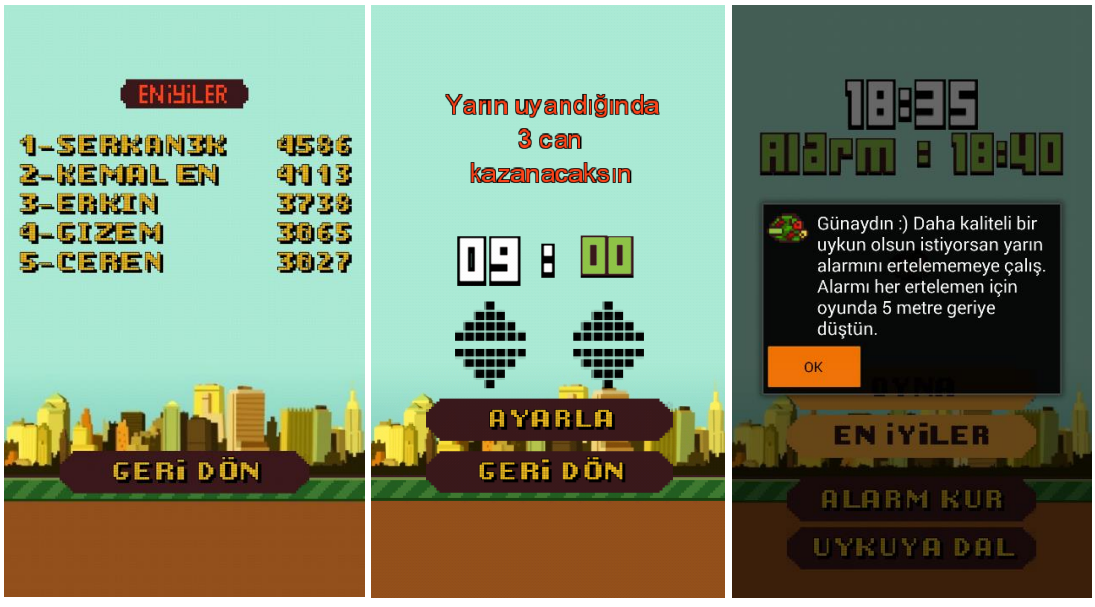

Figure 3.2 Example screenshots from gamified version of *Sleepy Bird*

For the non-gamified version, the app had two buttons on the main screen to set the alarm and sleep times. Participants could only use ‘alarm set’ (alarm kur) and ‘sleep’ (uykuya dal) buttons related to sleep-wake actions in this version. As a response to participants’ actions, *Sleepy Bird* sent feedback messages to them about sleep and wake-up hours. These notifications were shown with pop-ups (see Figure 3.3).

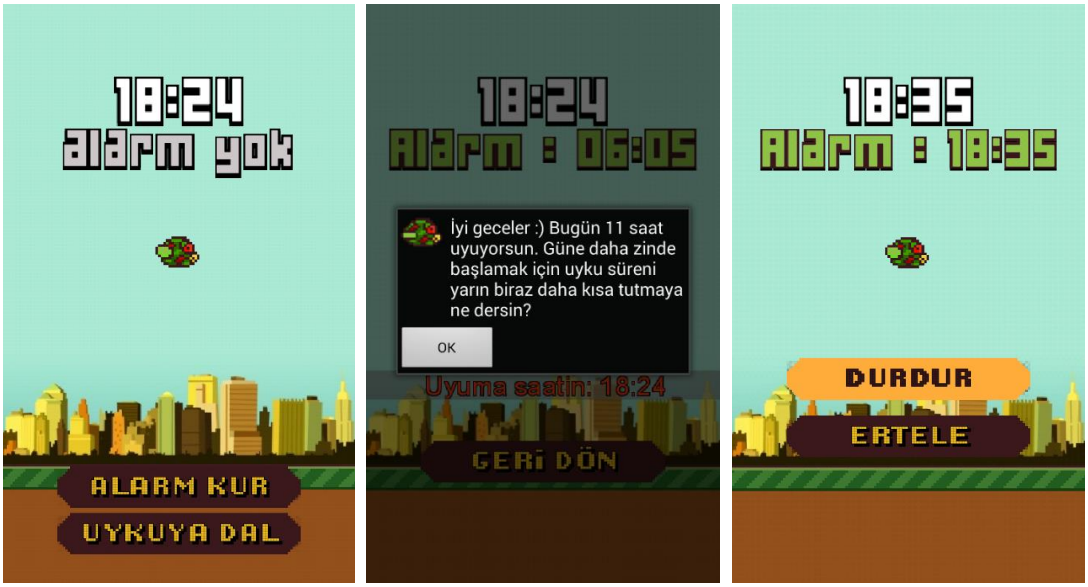

Figure 3.3 Example screenshots from non-gamified version of *Sleepy Bird*

In both versions, the app sent a notification to participants at 10.00 pm every evening. Bird of the app took place on the main screen of smart phones to remind participants to sleep not too late in order to wake-up easily in the morning. Additionally, it reminded to set alarms for the following day and informed participants about their sleep hours.

3.2.5 Decisions Behind the Running of the ‘Sleepy Bird’ App

In the development process of the gamified and non-gamified versions of the app, following considerations were taken into account:

Decisions supported by the literature and interview findings:

- Ideal waking-up time was set to be between 6.00-8.00 am and at least 1.5-2 hours before the work time (B. Çiftçi, personal communication, February 24, 2014).
- Adequate sleep duration was determined as 7 hours for the target group of participants (Zohar et al., 2005).
- Game elements such as points, lives and leader boards were used to motivate participants (Montola et al., 2009).
- The app was designed with continuous feedback messages (Ryan and Deci, 2000).
- The game was redesigned to decrease the challenge level.
- The app did not force participants to play a game while waking-up.

Game rules:

- The game started with 10 lives in order to make participants start playing when they meet the app at the first time.
- When participants woke-up at their optimum hours they won the maximum number of lives. Since the amount of given daily lives directly affected the gameplay, it was significant for the study. This decision was made as a result of findings of Beta and Pilot Study. According to studies, participants desired to play the game whenever they wanted. If they won maximum lives, they needed to prove their success against rivals. There was a dilemma to decide the number of lives:
  - If participants were successful in their sleep behaviors, they wanted to be greeted by game elements. Thus, waking-up at correct hours rewarded more than waking-up at wrong hours. In fact, the difference should not be so small.
  - If participants were given 100 lives in a day, for example, the difference of right and wrong sleep behaviors could be focused better. Yet, for this condition, the game would lose its attraction. When the lives were more than required, they would be spent without thinking and enjoying into the game, which made game lives valueless at the end.

    As a result, reward with 30 lives was found an appropriate solution to enhance this dilemma to enhance fun and value for the gameplay.

- Work/school time was important for the background maths of the app. It gave maximum game lives depending on the 1-2 hour time gap between wake-up and work start hours. If participants did not wake-up at appropriate hours they lost one live from the daily game for each 5 minutes. This calculation was done twice considering wake-up hours and the time interval between awake and work time.
- The worst condition of wake-hour rewarded the participant with 3 lives.
- Snooze time was assigned as 5 minutes in the game. If participants snoozed the alarm, they fell 25 meters back of score for each time. In other words, snoozing action negatively affected participants in the competition with rivals.
- If participants went to bed too early or too late, the speed of *Sleepy Bird* increased to make the game more difficult.
- Daily success or failure in the game stayed only one day to encourage people set the alarm clock for the next day. To illustrate, if participants won 30 lives but did not play throughout the day, their lives decreased to 3 at the end of the day. Game elements like cumulative score and the leaderboard were saved throughout the app usage. It was believed that the stronger the relationship between alarm and the game was, the more awareness the app would create on sleep-wake habits.

3.3 Selection and Distribution of the Participants

The call for recruiting participants was made through the word of mouth, e-mail and social media shares as well as notice board poster print-outs at METU. Some of the volunteers were eliminated at the start, due to having chronic health problems or not being used to wake-up with an alarm clock. Whilst selecting the participants from the volunteered ones, a

combination of people who were interested / and not interested in playing games was sought. Other selection criteria included the people, who:

- used an alarm to wake-up,
- were within the age group of 18-35 (with an assumption that they need similar sleep durations and wake hours),
- possessed average awaking difficulty (not too little or not too high),
- had a mobile phone running on Android platform,
- liked *Flappy Bird* game (for gamified version).

The volunteers qualifying these criteria were first contacted via e-mail to give further explanation about the study. However, for the volunteers to be qualified as participants a last final step was required. A questionnaire (see Appendix C for the pre-use questionnaire) was sent to them, containing three parts of questions to understand; i) whether they had any sleep or waking-up problems; ii) their sleep-wake habits; iii) morning attitudes concerning sleep-wake habits. Then, their answers to questionnaires were evaluated. Part 1 of the questionnaire was used to determine participants of the app. Thus, it will be detailed in this section. Part 2 and Part 3 will be explained in section 3.5.1.

In the first section of Part 1, user profile was inferred with sleep interaction, behaviors and preferences about games. According to these data, participants were eliminated if they had serious health problems. Moreover, selected participants were divided into groups of gamified or non-gamified versions according to responses to this part. In the second section of Part 1, as Johns (1991) developed, ESS was used to have a quick idea on subjective evaluations of sleepiness levels. Once the total point was at a medium score, the participants were considered to have sleep problems to incorporate in the study. If they pointed a very low score, this situation indicated that they did not have any sleep problems. Conversely, if the result was high, it could imply a sleep-related disease. In other words, participants who did not have any problems about sleep or who had serious medical problems were excluded from the study.

Participants were divided into two as participants of gamified and non-gamified versions due to their scores resulted in the Part 1 of pre-use questionnaires. Since the game in the app was a modified form of *Flappy Bird,* participants' approach to the game played a significant role to decide about the two groups. If they had positive attitudes towards *Flappy Bird* game, they were attached to experimental group. If participants did not so much interested in *Flappy Bird* game, they were given non-gamified version. The same number of participants were aimed to for experimental and control groups, therefore in total, 30 number of participants were secured for final studies. The data of those groups will be compared with each other and discussed as a result of computer logs and questionnaires in the next chapter.

During the stages of the study, 3 participants for Beta Study, 9 participants (one is excluded due to lack of data) for Pilot Study, and 30 participants (four is excluded because of system clash and data loss) for Final Study were selected. Taking into account the lost or damaged data, 26 participants attended in the Final Study at the end. In total 15 females and 11 males involved in the study. Mean age of participants was 27 ranged from18 to 35 years.

Setting: Making observations of sleep-wake habits could be done when participants utilized the app in their natural environment. Thus, the study was held at the participants' houses using their own smart phones. Selected participants downloaded *Sleepy Bird* onto their smart phones. Although participants were generally from Ankara, insistence of some volunteers made them involved into the study from İstanbul and Bursa, as well.

3.4 Fieldwork Protocol

The study was carried out in a flow system from the beginning of pre-usage phases till the end of post-usage phases of the app. Detailed pre-usage, usage and post-usage phases of fieldwork protocol is represented in Figure 3.4. In the figure, the initial day of studies is symbolized by 'S' as 'Day 0'. Pre-use phases are illustrated with 'x days minus start', whereas use and post-use phases are illustrated with 'x days plus start'. Study protocol is detailed in three main phases which are; i) pre-use, ii) use and, iii) post-use (see Figure 3.4).

i) Pre-use phase:

- Volunteers to participate in the study were informed about the general goals and time schedule of the study via word of mouth or email.
- Participants were sent or given pre-use questionnaires (see Appendix C) for the selection. Chosen participants signed the consent form of the study.
- Participants were divided into groups as gamified and non-gamified version users.
- Participants were sent either gamified or non-gamified version of the app just before its usage time.

ii) Use phase:

- Participants were explained about installation and usage of *Sleepy Bird*. Since it was important to collect unbiased and objective data, all of the participants had been unaware of the app before they installed it to their smart phones.
- After installed on their mobile phones, the app posed two questions (i.e. their name and work time) at the start up screen to be personalized for each participant.
- Participants were made to set the alarm in order to test the app to ensure its performance.
- Participants were asked about positive and negative approach towards the app after a couple of usage days. Occurred technical and practical problems were tried to overcome.
- Participants used the app at least one week.

iii) Post-use phase:

- After using the app, participants were visited or emailed to conduct post-use questionnaires (see Appendix D for the post-use questionnaire). They were also thanked for participating in the study.
- Participants were given feedback about their results if they had wished to be informed about their sleep-wake habits.

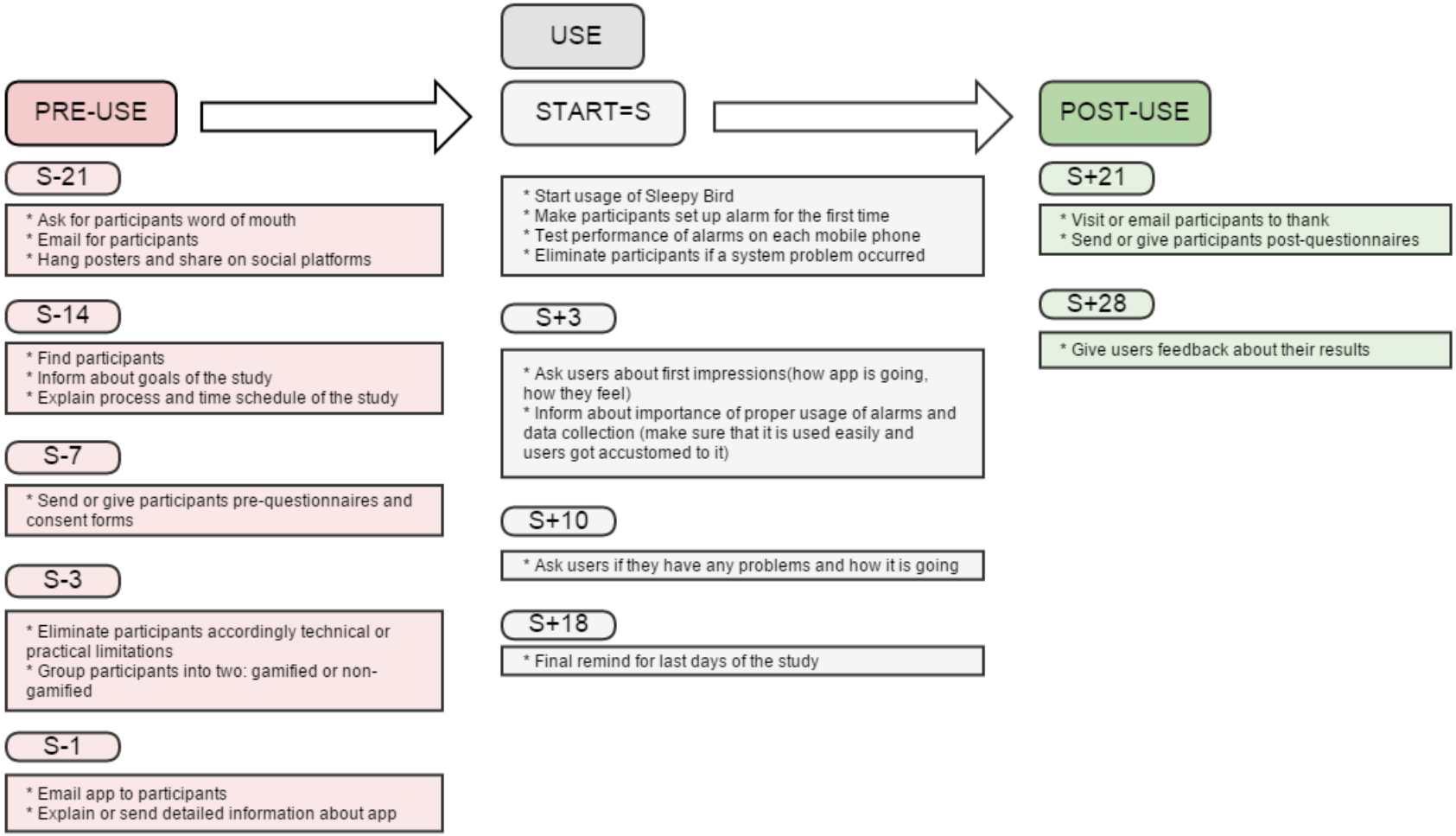

Figure 3.4 Flow of the fieldwork protocol

3.4.1 Arrangement and Duration of Three Fieldwork Studies

Fieldwork protocol shown in Figure 3.4 was followed for the three *Sleepy Bird* studies, which were Beta Study, Pilot Study and Final Study. The participants were arranged to use the app at least for 7 days. However, if they wished to, they were encouraged to continue using the app as long as four weeks. At the end of final studies, quantitative and qualitative data of four-weeks-period were collected. For each studies, pre-use phase lasted approximately 20 days for selecting and preparing participants and post-use phase lasted about 7 days to get the results. The fieldwork was improved in three consecutive studies including different time intervals for different purposes.

1) Beta Study: This study was carried out during in May-June of 2014 with three participants, with 2 using gamified and the 1 using non-gamified alarm clock. The aims of the Beta Study were: to reveal the first impressions related to the app; to detect and correct possible errors/bugs; and to develop the app's performance.

2) Pilot Study: Once the identified bugs/errors were fixed and the app was improved, pilot studies were carried out in September-October. In total, eight participants took part: 4 participants used gamified alarm clock and 4 used the non-gamified version. The aims of the Pilot Study were: to observe usage behaviors before final studies; to narrow down the focus and to choose appropriate statistical analysis methods; and to decide the number of participants that would be recruited for the Final Study.

3) Final Study: After final corrections and improvements of *Sleepy Bird* were completed, Final Study was carried out during in November of 2014. Of the twenty-six participants, 13 were given gamified and 13 were given non-gamified versions of the app to evaluate. The aims of the Final Study were: to collect the relevant quantitative and qualitative data with the final versions of the app.

3.4.2 Ethical Considerations

Before starting the studies with participants, necessary ethical approvals were taken from the Middle East Technical University (METU) - Human Subjects Ethics Committee (see Appendix B for the approval of METU Human Subjects Ethics Committee).

3.5 Data Collection Tools

During the fieldwork data were collected through the questionnaires and the computer logs. Two questionnaires were designed: pre-use questionnaire to be delivered prior to the use of the app (see Appendix C), post-use questionnaire to be delivered on the completion of the app usage period (see Appendix D).

The first questionnaire aimed to eliminate and group the participants according to their scores. The second questionnaire aimed to collect usage related information. The questionnaires also helped comparing relevant data between the gamified and non-gamified versions of the app.

The difference between experimental and control groups respectively participants of gamified and non-gamified version were measured. Sleep-wake habits, feelings and awareness levels were asked to have detailed information about participants. Moreover, reaction towards the app and intention to change their awareness about sleep into behaviors were obtained. Four scales supported questionnaires to collect personal evaluations. These were Epworth Sleepiness Scale (ESS), Pittsburgh Sleep Quality Index (PSQI) Morningness-Eveningness Questionnaire (MEQ) and Delighted-Terrible Scale, which will be detailed in the following sections.

Computer logs were used to collect relevant data for each of the participants. After the installation of *Sleepy Bird* on to the participants' phones, the usage data were automatically gathered via computer database, and all the actions taken in the app were recorded in the system. The background procedure for recording computer logs enabled the quantitative data.

As summarized in Figure 3.5 with flow and purpose of the data collection tools, the process was divided into three; i) pre-use of *Sleepy Bird*, ii) use of *Sleepy Bird* and iii) post-use of *Sleepy Bird*.

3.5.1 Pre-Use Questionnaire

In the pre-use questionnaire three parts were used to select/reject and get general information about participants (see Appendix C).

In Part 1, participants were chosen due to their sleep-wake habits as described in Section 3.3.

In Part 2, sleeping, working and snoozing behaviors of participants were asked. First three questions were adapted from first, third and fourth questions of 'PSQI' to get information and distributions about subjective sleep-wake evaluations. (Smyth, 2012b). Since, the scope of the study did not cover sleep quality and medical aspects of sleep, the remained questions were not involved in the questionnaire. Moreover, start of work hours were asked to calculate the appropriate wake-up hours for an individual. In that part, snooze habits and numbers were also gathered from subjective evaluations. This part would be compared with recorded actions of participants as computer logs.

In Part 3, morning motivations and attitudes concerning game and sleep-wake habits were asked to participants. The questions regarding to sleep-wake habits were obtained from 'MEQ' by Horne and Ostberg (1976). This part of questionnaire would be compared with post-use questionnaire in order to see whether attitudes had been affected in a positive manner or not.

In the questions on questionnaires, 5-point Likert scale system was used except for 'ESS'. 'ESS' was kept as its original form to evaluate sleepiness levels without any interference. Other questions were modified to become 5-point Likert scale to make participants decide on the answer behaving most honest and natural way even if they were unstable or negative for an item.

3.5.2 Computer Logs (Usage Data)

Usage data of participants were collected automatically to the system during the use of mobile app. After participants downloaded *Sleepy Bird* to their smart phones, the app started to record all of the actions. These actions included all of the interventions of participants such as opening the app, setting the alarm, touching a button, playing a game, losing a game live, visiting the leaderboard pages and etc. Those actions were recorded and kept for every participant in queries. The queries would give the most detailed results of participants. The information that had been collected from computer logs were:

1) Wake-up hour: alarm time (the app calculated wake-up time by using alarm time with snooze numbers), and time between wake-up and start to work/school
2) Sleep hour and sleep duration (the app calculated sleep duration by using sleep time with wake-up time)
3) Number of snooze

1) Wake-up hour (Alarm time and its relevance to work hour):
The app aimed to draw attraction to starting the day in an appropriate hour for emotional and cognitive well-being. Since time interval between starting the day and starting to work played an important role on concentration as Çiftçi (2014) explained, this interval was given importance besides wake-up time. Personalization of optimum wake and sleep hours were defined considering work/school start hours of participants.

Game Elements: Daily lives of *Sleepy Bird* were given according to alarm time. Maximum benefit of game was happened between 6.00 and 8.00 am. However, participants needed to wake-up at least 1.5 hours before their work to be awake enough. Each participant had personally optimum waking-up hour designed with work time.

For example, if a participant started to work at 8.30 am, this user required to wake-up latest at 7.00 am. When s/he started the day between 6.00 and 7.00 am, s/he obtained daily maximum lives. Yet, if s/he woke-up early at 5.00 am, s/he won less game lives because of awaking before optimum hours of 6.00-8.00 am. Adversely, when s/he awoke late at 8.15 am, s/he lost more lives due to both being out of optimum 6.00-8.00 am interval and having less time than 1.5 hours to work. Since most of the participants did not work at the weekends, they were calculated only according to optimum awake hours. In other words, they were not penalized for work hours by losing game lives on holidays.

2) Sleep hour and sleep duration:
Hamilton et al. (2006) and Kripke et al. (2002) claim that sleep duration between 6 and 8 hours is beneficial for physiological and psychological health besides cognition and social relations. Furthermore, sleeping less than 6 hours and more than 8 hours and similarly, going to bed too late and too early are harmful for the health. Hence, the app used sleep hour and duration as a secondary objective.

Game Elements: Speed of the game was designed according to sleep duration of participants. To illustrate, if a participant slept from 6 to 8 hours in a day, s/he played the game in its normal

speed. Because having less or more sleep had the same danger, for both of the conditions the game speed increased to make it more difficult to play. Thus, when the challenge increased, participants tried to organize sleep hours to have a better game for the next day.

3) Number of snooze:
As Çiftçi (2014) focuses the harmful effects of delaying awake activity again and again, snooze is considered to be undesired wake-up habit. It not only breaks down the quality of sleep, but also affects daily mood negatively at the beginning of the day. The app tried to minimize snooze numbers.

Game Elements: Snooze numbers made participants go back in the game. When tapped on snooze button, they lost distance and may fell behind their rivals. Social interaction with competition was supported by leaderboard in the game. To enhance intrinsic motivations, participants could motivate themselves with their success. Yet, when they snoozed the alarm, they deteriorated their success symbolized by scores.

3.5.3 Post-Use Questionnaire

In the post-use questionnaire, four parts appeared both to figure out feelings related to app versions and to compare participants with their initial conditions (see Appendix D).

In Part 1, 'Delighted-Terrible Scale' of Andrews and Withey (1976) measured short term subjective well-being caused by the usage of *Sleepy Bird*. This part also enabled data comparisons between control and experimental groups to understand whether a gamified alarm created positive feelings or not.

In Part 2, four main goals of *Sleepy Bird* were given as to ask whether it was beneficial to create an awareness on sleep-wake habits. The score of gamified and non-gamified participants were compared.

In Part 3, the counterpart of judgments in Part 3 of pre-use questionnaire took place. Experiences and motivations related to wake-up activity were asked before and after using *Sleepy Bird*. Change in the score of morning wake-up attitudes and motivations were evaluated. Moreover, the similarities and differences between participants of gamified and non-gamified versions were discussed.

In Part 4, open-ended questions were used to recruit comments on positive and negative aspects of *Sleepy Bird*. Participants' awareness about sleep behaviors and long-term expectations regarding to behavior change played also significant role to understand the success of the app.

As a brief summary, the flow and purpose of data collection is shown in Figure 3.5. It indicates three main stages of data collection besides giving their details divided into parts. The figure also demonstrates if there was any comparative analyzes within some sub-headings. To illustrate, the results of Part 2 of pre-use questionnaire were compared with the results of

computer logs. Additionally, outcomes of Part 3 of pre-use questionnaire were compared with Part 3 of post-use questionnaire. The remained collected data were analyzed to make comparisons between experimental and control groups, which included participants of gamified and non-gamified versions.

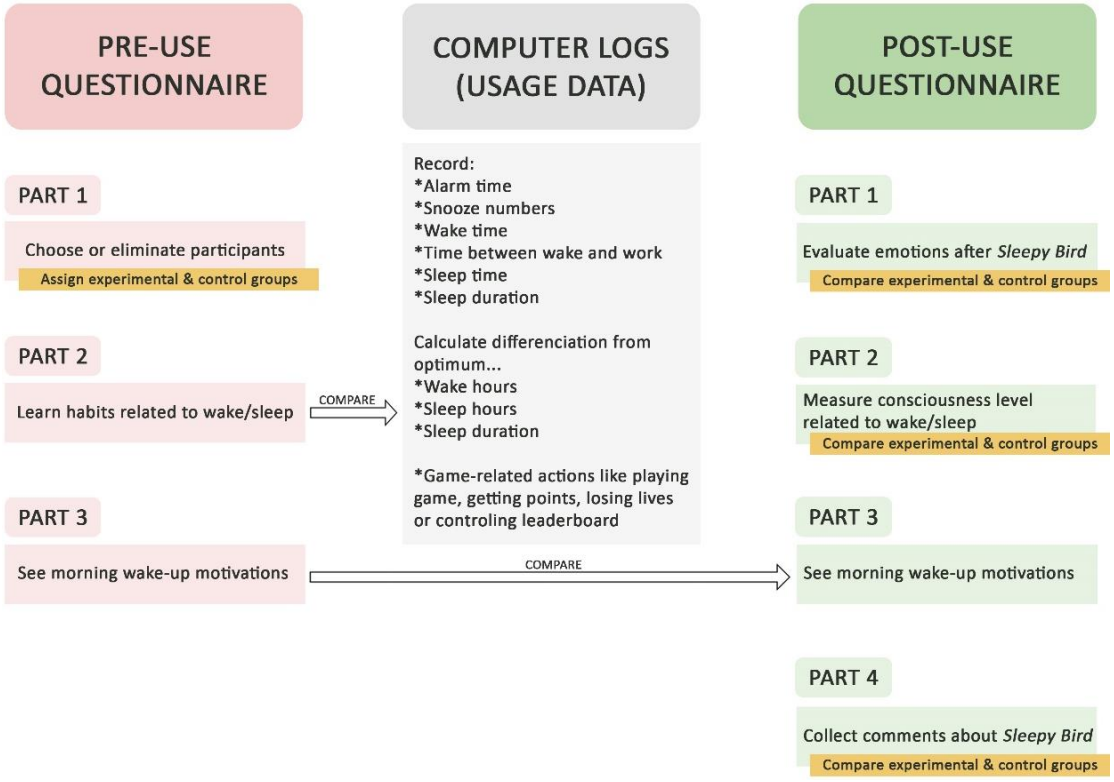

Figure 3.5 Flow and purpose of data collection tools

3.5.4 Approach towards Qualitative and Quantitative Data

Qualitative data were acquired generally from open-ended and category measurement questions in the questionnaires. To analyze this data, the answers were written into excel sheets. They were grouped and narrowed accordingly meaningful keywords to show a distribution on attitudes, feelings and comments of participants.

For the quantitative data, on the other hand, computer logs were used generally. According to computer data; wake-up hours, sleep hours, sleep durations, snooze times; and positive and negative deviations from optimum wake-up hours, sleep hours and sleep durations of participants were obtained. All of the data were transferred into excel sheets for each participants. The participants were divided into two as users of gamified and non-gamified versions and shown different parts on the excel sheet. Once the lost data were eliminated for each participant, the remained data was put into SPSS to make statistical analysis.

In SPSS, mean, frequency and range of variables were found to make analysis on different actions. Independent tests were implemented using SPSS. Means and frequencies of dependent factors were defined to compare experimental and control groups. Moreover, in order to

evaluate statistically significant values, full factorial ANOVA models including univariate and multivariate models and One-Way ANOVA and T-Test were applied to the required data respectively. ANOVA and t-test were used to control if the difference of data between experimental and control groups is statistically significant or not.

Both for showing quantitative and qualitative data, figures, charts and tables were used as supportive elements.

In the next chapter, results, analyzes and discussions of collected qualitative and quantitative data will be explained in details with the order of pre-use questionnaires, computer logs and post-use questionnaires.

CHAPTER 4

ANALYSES OF THE FIELDWORK

Gamification was endorsed as commonly used tool to motivate people in waking-up early. Thus, a gamified mobile alarm app, called *Sleepy Bird,* was designed and developed to be tested in the fieldwork.

Accordingly, the chapter presents the main results of the Beta Study and Pilot Study described in the previous chapter, then a more detailed account is given to the Final Study. The presentation of data analysis will be made in the following order: pre-use questionnaire, computer logs, and post-use questionnaire.

4.1 Overview of the Fieldwork Analysis

The analysis of the fieldwork was performed with the objective to answer the following questions:

- What is the usage ratio of gamified and non-gamified versions of *Sleepy Bird*?
- Does gamified version of *Sleepy Bird*…
  - … affect wake-up hours positively compared to non-gamified version?
  - … affect sleep duration positively compared to non-gamified version?
  - … affect go-to-sleep hours positively compared to non-gamified version?
  - … affect snooze numbers positively compared to non-gamified version?
  - … create a positive feeling compared to non-gamified version?
  - … create an awareness on sleep-wake habits compared to non-gamified version?

In order to answer these questions, the results of the pre-use questionnaire, computer logs, and post-use questionnaire were analyzed. Depending on the recorded data; quantitative changes of participants were analyzed. The actions related to alarm time, sleep time, work/school time and snooze numbers were set by the participants. Statistical results and analysis were obtained by using SPSS program. Depending on the questionnaire data, subjective evaluations, awareness, intentions and comments of individuals related to sleep-wake habits of participants were analyzed.

Before explaining qualitative and quantitative analysis of the fieldwork, usage scenario of the app should be presented. An exemplary plot of a participant's usage days of the app is illustrated in the Figure 4.1.

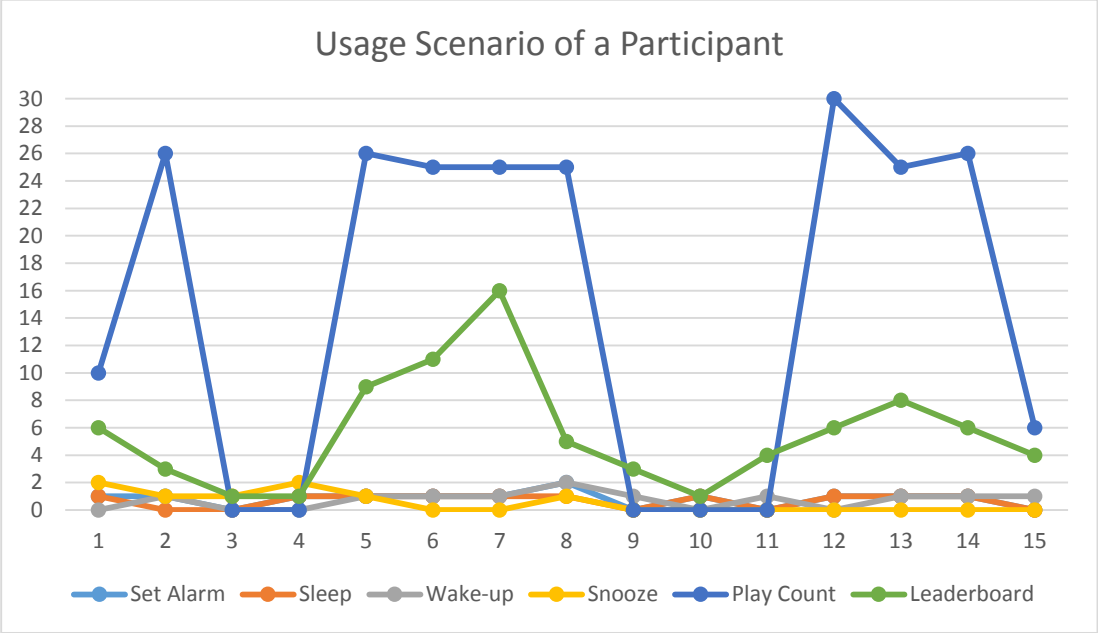

Figure 4.1 Usage scenario of a participant of experimental group

Figure 4.1 shows that a participant of experimental group used the app during 15 days. Vertical column shows the frequency of actions, whereas horizontal column shows the usage days. Starting from day 1 to day 15, the participant set the alarm clock nearly every day, except for the weekends. Some of the participants chose not to set their alarms at the weekends. This participant mostly played the game until losing all the game lives that were won for the day. The participant generally played the game in the week and controlled the leaderboard while playing the game. High score was generally controlled by participants most of the time. This figure gives an idea about general usage scenario for the gamified version of the app.

Usage scenario was given for only participants of experimental group. On the other hand, the usage scenario for participants of control group was simpler. Since they used the non-gamified app as an alarm app, they only set their alarms and informed their sleeping hours.

4.2 Results and Analyses of the Beta and Pilot Study

The participants of the Beta Study utilized the app to reveal the possible bugs and deficiencies. Three participants used *Sleepy Bird* for two weeks. The comments made by the participants were used to improve the app, which was then further evaluated during the Pilot Study.

The Pilot Study started the tests with 9 participants. As one of the participants used the app only once, relevant data was excluded from the study. Consequently, 4 participants used gamified version, whereas the other 4 used non-gamified version. 102 wake-up data of 8 participants were collected over 24 days.

On the completion of the Pilot Study, it was observed that *Sleepy Bird* was used minimum for 9 days by 8 participants, and maximum for 16 days by 3 participants (gamified version). The

tests were performed in September/October months which included four-days-religious holiday. Therefore, the participants generally did not need to set their alarms on holidays and weekend days. All of the participants stated that they did not set their alarms on holidays. Thus, this situation was taken into account for timing of the Final Study.

Usage ratio of gamified *Sleepy Bird*, 58.8%, revealed that the app with gamification was used more than the app without gamification during that time interval. The data collected from the Pilot Study allowed the measurements of mean, range, minimum and maximum values for wake and sleep hours, sleep durations, snooze numbers, and differences from optimum cases. Since optimum hours were calculated for each of the participants, values of difference from optimum wake hour, difference from optimum sleep hour and difference from optimum sleep duration increased the reliability of analysis. For this reason, analysis and discussions of the Final Study would be generally done with positive and negative differences from optimum hours rather than wake hours, sleep hours and sleep durations.

In order to achieve more reliable outcomes, the Pilot Study results were evaluated only as a part of an improvement process, and were not combined with the Final Study analysis. As a result of Pilot Study, it was decided to increase the number of participants up to 30 at the Final Study. The usage duration of the app was another important decision to make. The app was envisaged to be used for four weeks rather than a week. Having no holiday interruptions, November was considered to be the best month to conduct the Final Study.

4.3 Results and Analyses of the Final Study

The results and the analysis of the Final Study will be presented in the following order: i) pre-use questionnaire, ii) computer logs, iii) and, post-use questionnaire.

4.3.1 Results and Analysis of Pre-Use Questionnaire

The Pre-Use Questionnaire (see Appendix C) included three parts serving for different purposes. Each of the parts now will be explained.

i) Part 1:
This part of the questionnaire (see Appendix C) was used for selecting and assigning the participants for gamified and non-gamified app versions. Volunteered participants, who used alarm clocks to wake-up and did not have any serious health problems, were evaluated by their Epworth Sleepiness Scale (ESS) scores. The scale (see Appendix C) was used to find out the sleepiness level of the participants from their perspectives. The evaluation of the scores was made as follows. A total score between 4 and 9: *average sleep problems*; between 10 and 14: *sleep problems*; over 15: *requiring a professional medical help* (and the volunteers were kept outside the scope of the fieldwork). In ESS results, the minimum total score was 4, and the maximum score was 13 with an average score of 7.76 within the selected group of participants. Of the volunteers, six received ESS scores less than 4, and were not included in the tests as they presented no sleep problems.

As a result of Part 1 answers, 30 participants were secured for the Final Study. Distribution of the gamified and non-gamified versions of the app was made carefully between the participants (as experimental and control groups) to obtain consistent and meaningful analysis. After a few days, 4 participants were left out of the study due to technical problems with their smart phones and their reluctance to set the alarm. Then, 6 additional participants were included in the study. In the Final Study, 32 participants used the app in a time interval of 30 days. Yet, sleep-wake data of 26 participants were used because the remaining 6 users had a shorter usage under 7 days: they had a routine of alarm usage to wake-up with a percentage of 100 % and did not have any serious health problems. Within the group of 26 participants, 13 participants were using gamified version and the other 13 were using non-gamified version.

ii) Part 2:

This part of the questionnaire (see Appendix C) was used to assess pre-use sleep patterns of the participants.

Table 4.1 Mean value of wake and sleep hours according to pre-use questionnaire by 26 participants

		Sleep_hour_ Weekdays	Sleep_hour_ Weekends	Wake_hour_ Weekdays	Wake_hour_ Weekends	Sleep_ Duration
Mean	Experimental Group	00:36	01:51	07:49	10:18	7.07
	Control Group	00:08	00:57	07:35	09:27	7.38
	Total	00:22	01:24	07:42	09:53	7.23

Mean values of wake and sleep hours were classified according to versions. The obtained self-report data is summarized in Table 4.1. This pre-use data was not compared between groups. However, that data was used to make comparisons with usage sleep patterns of computer logs to see the changes from their initial conditions.

Table 4.2 Distribution of work/school time according to pre-use questionnaire by 26 participants

	7:00-8:00	8:00-9:00	9:00-10:00	10:00-11:00	Later
Number of Participants	2	13	11	0	0

As represented in Table 4.2, the participants' work or school start times were mostly between 8.00–9.00 am and 9.00–10.00 am with a total percentage of 92%. Only 2 participants had a work time between 7.00-8.00 am. This data was important to calculate optimal wake-up and sleep hours in the app.

Table 4.3 Distribution of alarm snooze numbers according to pre-use questionnaire by 26 participants

	1	2	3	4	5
Number of Participants	9	5	5	2	3

Regarding to snooze habits, 24 participants (92%) mentioned that they generally use this feature. As illustrated in Table 4.3; 9 participants (37%) told that they generally snoozed their

alarm once, 5 participants (21%) twice, 5 participants (21%) three times, 2 participants (8%) four times and 3 participants (13%) five times.

iii) Part 3:
This part of the questionnaire (see Appendix C) was used for the participants' personal assessments about their wake-up attitudes and motivations. This was the only section that provided data for comparisons with the same part of post-use questionnaire. The participants assigned scores ranging from 1 to 5 (1 meaning strongly disagree and 5 meaning strongly agree) to each of the six questions, the sum of the scores were then calculated.

Table 4.4 Score of morning attitudes and motivations according to pre-use questionnaire by 26 participants

	Q1	Q2	Q3	Q4	Q5	Q6	SCORE
Experimental Group	27	45	31	37	53	49	242
Control Group	27	36	32	37	46	38	216
Total	54	81	63	74	99	87	458

Table 4.4 summarizes that gamified version users got the score of 242, whereas non-gamified version got 216. The scores of the pre and usage stages were also compared. Hence, experimental group and control groups were evaluated with their progress.

Six questions were also discussed according to their scores as shown in Table 4.4. In pre-use questionnaire, Q1 got the lowest score in total. It was asking whether participants believed it was easy to wake-up in the morning. Participants gave 81 points to Q2 indicating that an alarm app would make them wake-up easier. Q3 and Q4 were asking being wakeful or tired after waking-up. These questions got low points showing that participants did not feel wakeful in the morning before using the app. Q5, on the other hand, got the highest score with 99 points by asking whether the participants had positive feelings when they started the day at a correct time. Q6 had a high score to emphasize that a gamified alarm app would motivate participants to start a day. Therefore, most of the participants were at a similar situation; they desired to start the day at a correct time but had difficulties and little motivation to achieve it.

Total scores and statistically significant changes of the experimental and control groups will be discussed in section 4.4.3 in comparison to the results of post-use questionnaire.

4.3.2 Results and Analysis of Computer Logs

Computer logs included the participants' sleep-wake action logs. After downloading *Sleepy Bird* to the smart phones, all of the sleep-wake habits of 26 participants were recorded during usage period. The app sends all usage data of participants to the developer's computer and system keeps the data as computer logs.

At the end of the study, totally 325 samples were gathered from the participants. To analyze the data, comparisons were made based on the app version (gamified or non-gamified), usage

period, first and second half of the usage period, week days of usage (weekend or weekdays), in terms of:

- number of snoozes,
- difference from optimum wake-up hours (plus or minus minutes of deviations from subjective optimum time),
- difference from optimum go to sleep hours (plus or minus minutes of deviations from subjective optimum time),
- difference from optimum sleep durations (plus or minus minutes of deviations from subjective optimum duration).

As a general assessment of tests, *Sleepy Bird* was used at least 8 days by 26 participants and continued up to 22 days by 2 participants. One of the mostly-using participants had the gamified version whereas the other one had the non-gamified version.

Table 4.5 Statistics of action frequencies of 26 participants

		Wake	Sleep	Snooze	Sleep_ duration	Difference_ optimum_wake	Difference_ optimum_sleep	Difference_ optimum_duration
N	Valid	324	319	324	318	324	319	318
	Missing	1	6	1	7	1	6	7
Mean		7:41	00:07	,95	7:34	11,56	-23,55	34,64
Range		6:30	10:24	7	10:34	385	624	634
Minimum		5:55	19:25	0	2:12	-120	-305	-288
Maximum		12:25	05:49	7	12:46	265	319	346

The mean, range, minimum and maximum values of wake and sleep times, snooze actions and difference from optimum cases were calculated. Table 4.5 summarizes the overall results obtained from the participants throughout the course of the Final Study.

Usage frequency between gamified and non-gamified versions had a small difference in the Final Study. Gamified alarm was set with a percentage of 52.3 with a total usage data of 170. Non-gamified alarm was used with a percentage of 47.7 with total 155 data. Hence, there was not a big difference in the usage ratio of *Sleepy Bird* between two versions.

Defining the Model

In order to analyze the computer logs in a more structural way, a model was identified. This model was obtained by multivariate methods of general linear model in SPSS. The full factorial ANOVA model included all sleep-wake data according to version, user, usage period, first and second half of the usage period, weekend or weekdays of usage. At the end, one model calculated the most reasonable regression as following:
a.R Squared = ,574 (Adjusted R Squared = ,403) ; snooze
b.R Squared = ,449 (Adjusted R Squared = ,227) ; difference from optimum wake time
c.R Squared = ,440 (Adjusted R Squared = ,214) ; difference from optimum sleep time
d.R Squared = ,450 (Adjusted R Squared = ,228) ; difference from optimum sleep duration

As a result, the most meaningful model was determined as follows:
Design: Intercept + Version + User + First and Second Half of Usage + Weekend vs. Weekdays. The model also included different combinations of these interactions.

Making Comparisons in the Model

According to the identified full factorial model of the study; i) Version (analyzed together with the user), ii) First and Second Half of Usage and iii) Weekend vs. Weekdays filtered as three significant interactions. Each will now be detailed.

i) Version: Most important goal of the study was to find effects of gamification. In fact, the model showed significant differences between gamified and non-gamified versions in terms of wake, sleep and snooze topics. Since users did not reflect important changes inside the same version in terms of snooze numbers and differences from optimum hours to wake-up, go to bed and have sleep durations, 'User' data were also addressed under the heading 'Version'.

Table 4.6 Group statistics of actions by "version" of 26 participants

	Version	N	Mean	Std. Deviation	Std. Error Mean
Snooze	Gamified	170	,74	1,373	,105
	Non-Gamified	154	1,19	1,604	,129
Difference_optimum_wake	Gamified	170	13,18	56,324	4,320
	Non-Gamified	154	9,77	59,607	4,803
Difference_optimum_sleep	Gamified	169	-11,75	84,303	6,485
	Non-Gamified	150	-36,85	76,252	6,226
Difference_optimum_duration	Gamified	169	24,33	88,391	6,799
	Non-Gamified	149	46,33	84,928	6,958

Table 4.6 summarizes a general view of mean values of snooze numbers, difference from optimum wake/sleep hours and difference from sleep durations were calculated for two versions. Mean of snooze numbers (0.74) and difference from optimum sleep duration (24.33 minutes) of gamified version was lower than mean values of non-gamified version. Moreover, the difference from optimum go-to-sleep times was better in gamified version with a deviation of -11.75 minutes.

Change in Sleep Patterns: Computer logs were compared with the Part 2 of pre-use questionnaire, as shown in Table 4.1 in order to see whether sleep patterns of participants had changed in a positive way with the app usage.

Participants had evaluated their wake-up hours at the average of 8:47 (average of weekdays as 7:42 and weekends as 9:53). The results of recorded computer data analysis gave mean of wake-up hours as 7:41. Subjective evaluations and results of collected data were almost one hour different from each other. When analyzed by versions, participants of gamified version had answered that they wake-up at 9:03 (average of weekdays as 7:49 and weekends as 10:18), whereas participants of non-gamified version wake-up at 8:31 (average of weekdays as 7:35

and weekends as 9:27) in the average. Computer logs indicated that users of gamified version woke-up at 7:42 and the users of non-gamified version woke-up at 7:40 in the mean value. In brief, the experimental group changed their wake-up hours from 9:03 to 7:42 and the control group changed their wake-up hours from 8:31 to 7:40.

Before the usage, participants had told that they have a 7.23 hours of sleep duration averagely. According to computer logs, the mean value of sleep duration was found as 7.34 hours at the end of the study. According to versions, subjective evaluations of sleep durations were 7.07 and 7. 38 hours for gamified and non-gamified groups respectively. When computer data was analyzed, users of gamified version had 7:24 hours of sleep duration, whereas users of non-gamified version had 7:46 hours of sleep.

Participants had stated their go-to-bed times as 00:53 (average of weekdays as 00:22 and weekends as 01:24). Computer data recorded the sleep hours at 00:07 in the average of all users. According to versions, users of gamified version had evaluated their sleep times at the mean of 01:13 (average of weekdays as 00:36 and weekends as 01:51), whereas users of non-gamified version had measured that they sleep at the average of 00:32 (average of weekdays as 00:08 and weekends as 00:57). Computer logs showed these values at 00:19 and 23:53 for the experimental and control groups respectively. In brief, the experimental group changed their go-to-sleep hours from 01:13 to 00:19 and the control group changed their go-to-sleep hours from 00:32 to 23:53.

In order to analyze significant changes in sleep-wake habits between versions, One-Way ANOVA about snooze, difference from optimum wake time, difference from optimum sleep time and difference from optimum sleep duration was conducted. “Between groups” analysis showed whether there was a statistically significant result or not. All the tests were designed with 95% confidence interval to have a margin of error less than 5% so as to be more reliable.

Table 4.7 One-Way ANOVA by “version” of 26 participants

		Sum of Squares	df	Mean Square	F	Sig.
Snooze	Between Groups	16,155	1	16,155	7,304	,007
	Within Groups	712,151	322	2,212		
	Total	728,306	323			
Difference_optimum_wake	Between Groups	936,134	1	936,134	,279	,598
	Within Groups	1079751,751	322	3353,266		
	Total	1080687,886	323			
Difference_optimum_sleep	Between Groups	50072,455	1	50072,455	7,704	,006
	Within Groups	2060306,335	317	6499,389		
	Total	2110378,790	318			
Difference_optimum_duration	Between Groups	38337,699	1	38337,699	5,090	,025
	Within Groups	2380055,986	316	7531,823		
	Total	2418393,686	317			

As a result of queries as demonstrated in Table 4.7, the difference between experimental and control groups was at significance level for three actions; snooze [F (1, 322)= 7.304, p=0.007], difference from optimum sleep times [F (1, 317)= 7.704, p=0.006] and difference from optimum sleep durations [F (1, 316)= 5.090, p=0.025] at the p<.05 level. Gamified version affected these three actions to become closer to optimum cases during the usage.

For the values that were analyzed at the significant level by ANOVA, independent-samples t-test was applied. According to t-test results, *Sleepy Bird* caused significant results in terms of:

- Snooze action between gamified (M= 0.74, SD=1.373) and non-gamified (M= 1.19, SD=1.604); t (322) = -2.703, p = 0.007 versions.
- Difference from optimum go-to-sleep hours between gamified (M=-11.75, SD=84.303) and non-gamified (M= -36.85, SD=76.252); t (317) =2,776, p =0.006 versions.
- Difference from optimum sleep durations between gamified (M=24.33, SD=88.391) and non-gamified (M=46.33, SD=84.928); t (316) =-2.256, p =0.025 versions.

ii) First and Second Half of Usage: According to the fixed model, meaningful second interaction data was calculated as 'First and Second Half of Usage'.

The app was used between 8-22 days by participants. It was not rational to change sleep-wake behaviors in this short period of time. However, it could be possible to gain an awareness about sleep-wake habits as a starting point. For that reason, average values of first half of usage was compared to average values of second half of usage.

Table 4.8 One-Way ANOVA by "first & second half of usage" of 26 participants

		Sum of Squares	df	Mean Square	F	Sig.
Snooze	Between Groups	9,988	1	9,988	4,478	,035
	Within Groups	718,317	322	2,231		
	Total	728,306	323			
Difference_optimum_wake	Between Groups	582,430	1	582,430	,174	,677
	Within Groups	1080105,456	322	3354,365		
	Total	1080687,886	323			
Difference_optimum_sleep	Between Groups	40,239	1	40,239	,006	,938
	Within Groups	2110338,551	317	6657,219		
	Total	2110378,790	318			
Difference_optimum_duration	Between Groups	3580,755	1	3580,755	,469	,494
	Within Groups	2414812,931	316	7641,813		
	Total	2418393,686	317			

Table 4.8 includes One-Way ANOVA by first and second half of usage. There was a significant effect of the snooze action [F (1, 322) = 4.478, p = 0.035] at the p<.05 level. This situation proved an improvement in snoozing habit gained by the app usage.

Table 4.9 Group statistics of actions by "first & second half of usage" of 26 participants

	First_Second_Section	N	Mean	Std. Deviation	Std. Error Mean
Snooze	First Half	179	1,11	1,525	,114
	Second Half	145	,76	1,454	,121
Difference_optimum_wake	First Half	179	12,77	56,698	4,238
	Second Half	145	10,07	59,389	4,932
Difference_optimum_sleep	First Half	176	-23,88	84,729	6,387
	Second Half	143	-23,16	77,551	6,485
Difference_optimum_duration	First Half	175	37,67	91,242	6,897
	Second Half	143	30,92	82,489	6,898

In order to analyze first and second half of usage, t-test was applied to data. It was analyzed that on the second half of usage, mean values approached zero, as given in Table 4.9. Thus, all of the actions had a positive progression in the duration of the study. According to t-test results, *Sleepy Bird* caused statistically significant results in terms of:

- Snooze action between first half (M= 1.11, SD=1.525) and second half (M= 0.76, SD=1.454); t (322) = 2.116, p = 0.035 of usage.

The model suggested some paired comparisons to make further analysis. T-test was applied to analyze 'version * first & second half of usage'.

Table 4.10 Group statistics of actions in gamified version by "first & second half of usage" of 26 participants

	First_Second_Section	N	Mean	Std. Deviation	Std. Error Mean
Snooze	First Half	95	,99	1,498	,154
	Second Half	75	,43	1,129	,130
Difference_optimum_wake	First Half	95	17,00	57,001	5,848
	Second Half	75	8,33	55,455	6,403
Difference_optimum_sleep	First Half	95	-15,49	87,321	8,959
	Second Half	74	-6,95	80,595	9,369
Difference_optimum_duration	First Half	95	32,86	93,042	9,546
	Second Half	74	13,36	81,343	9,456

For experimental group, all the mean values became closer to zero in the second half, which indicated the optimal case as revealed in Table 4.10. At the beginning of tests, participants snoozed the alarms more (0.99 times in average), woke–up later (17 minutes later than their optimum hours), slept earlier (15.49 minutes earlier than optimum hours) and slept more (32.86 minutes more than optimum durations). According to t-test results, *Sleepy Bird* caused statistically significant results in terms of:

- Snooze action between first half usage of gamified (M= 0.99, SD=1.498) and second half usage of gamified (M= 0.43, SD=1.129); t (168) = 2.703, p = 0.008 versions.

Table 4.11 Group statistics of actions in non-gamified version by "first & second half of usage" of 26 participants

	First_Second_Section	N	Mean	Std. Deviation	Std. Error Mean
Snooze	First Half	84	1,25	1,551	,169
	Second Half	70	1,11	1,673	,200
Difference_optimum_wake	First Half	84	7,98	56,308	6,144
	Second Half	70	11,93	63,687	7,612
Difference_optimum_sleep	First Half	81	-33,70	81,016	9,002
	Second Half	69	-40,55	70,659	8,506
Difference_optimum_duration	First Half	80	43,38	89,304	9,984
	Second Half	69	49,75	80,068	9,639

According to Table 4.11, for control group, the average value of snooze numbers decreased in the second half of use, which indicated a positive improvement. Yet, there were not any statistically significant results in these four actions from the first half to second half of usage according to t-test results.

iii) Weekend vs. Weekdays: According to the fixed model, meaningful third interaction data was defined as 'Weekend and Weekdays of Usage'.

The study also observed whether there was a difference in the alarm usage related to week days. Participants used *Sleepy Bird* at most on Tuesdays and Wednesdays (18%) and at least on Saturdays (9.5%). Alarm was set 70 times (21.8%) at the weekends, whereas it was set 250 times (78.2%) in school/work days.

Table 4.12 One-Way ANOVA by "weekend vs. weekdays" of 26 participants

		Sum of Squares	df	Mean Square	F	Sig.
Snooze	Between Groups	7,738	1	7,738	3,458	,064
	Within Groups	720,567	322	2,238		
	Total	728,306	323			
Difference_optimum_wake	Between Groups	18375,452	1	18375,452	5,570	,019
	Within Groups	1062312,434	322	3299,107		
	Total	1080687,886	323			
Difference_optimum_sleep	Between Groups	51051,603	1	51051,603	7,859	,005
	Within Groups	2059327,187	317	6496,300		
	Total	2110378,790	318			
Difference_optimum_duration	Between Groups	21229,188	1	21229,188	2,798	,095
	Within Groups	2397164,498	316	7585,964		
	Total	2418393,686	317			

Table 4.12 represents One-Way ANOVA by weekend and weekday usage. Difference from optimum wake [F (1, 322) = 5,570, p = 0.019] and difference from optimum go-to bed hours [F (1, 317) = 7,859, p = 0.005] had a significant result at the $p<.05$.

Table 4.13 Group statistics of actions by "weekend vs. weekdays" of 26 participants

	W_end_wdays	N	Mean	Std. Deviation	Std. Error Mean
Snooze	Weekdays	253	1,04	1,579	,099
	Weekend	71	,66	1,146	,136
Difference_optimum_wake	Weekdays	253	7,57	51,570	3,242
	Weekend	71	25,77	74,846	8,883
Difference_optimum_sleep	Weekdays	249	-47,41	82,028	9,804
	Weekend	70	-16,85	80,198	5,082
Difference_optimum_duration	Weekdays	248	30,29	84,352	5,356
	Weekend	70	50,01	96,286	11,508

Sleepy Bird evaluated wake/sleep patterns of participants in a week as summarized in Table 4.13. Users generally woke up and slept later with longer sleep duration at weekends. They woke up with a deviation of 25.77 minutes more than their optimum hours at the weekend. In addition, they slept 16.85 minutes earlier than optimum times having 50.01 minutes more sleep on Saturday and Sunday.

After ANOVA comparisons, t-test was carried out to have details on usage related to days of the week. According to t-test results, *Sleepy Bird* caused statistically significant results in terms of:

- Difference from optimum wake hours between weekdays (M=7.57, SD= 51.570) and weekend (M= 25.77, SD= 74.846); t (322) = -2.360, p =0.019 usage.
- Difference from optimum go-to-sleep hours between weekdays (M= -47.41, SD=82.028) and weekend (M= -16.85, SD=80.198); t (317) =2.803, p =0.005 usage.

The model suggested another paired comparison to analyze 'version * weekend vs. weekdays'

Table 4.14 Group statistics of actions in gamified version by "weekend vs. weekdays" of 26 participants

	W_end_wdays	N	Mean	Std. Deviation	Std. Error Mean
Snooze	Weekdays	133	,86	1,478	,128
	Weekend	37	,32	,784	,129
Difference_optimum_wake	Weekdays	133	9,51	52,472	4,550
	Weekend	37	26,35	67,594	11,112
Difference_optimum_sleep	Weekdays	132	-34,81	75,556	12,421
	Weekend	37	-5,29	85,751	7,464
Difference_optimum_duration	Weekdays	132	21,45	89,963	7,830
	Weekend	37	34,59	82,891	13,627

For the experimental group, 133 action data in weekdays and 37 action data at the weekends were collected as shown in Table 4.14. Participants woke-up later, went to bed later and slept more at the weekends when compared to week days. According to t-test results, *Sleepy Bird* caused statistically significant results in terms of:

- Snooze action between weekdays usage of gamified (M=0.86, SD= 1.478) and weekend usage of gamified (M= 0.32, SD= 0.784); t (168) = 2.109, p =0.036 versions.

Table 4.15 Group statistics of actions in non-gamified version by "weekend vs. weekdays" of 26 participants

	W_end_wdays	N	Mean	Std. Deviation	Std. Error Mean
Snooze	Weekdays	120	1,23	1,669	,152
	Weekend	34	1,03	1,359	,233
Difference_optimum_wake	Weekdays	120	5,42	50,683	4,627
	Weekend	34	25,15	83,052	14,243
Difference_optimum_sleep	Weekdays	117	-61,55	87,730	15,272
	Weekend	33	-29,89	71,574	6,617
Difference_optimum_duration	Weekdays	116	40,36	76,621	7,114
	Weekend	33	67,30	108,063	18,811

Table 4.15 indicates that for control group, 120 data in weekdays and 34 data at the weekends were gathered. In contrast to gamified version, mean values were higher and far away from zero in the non-gamified version. In other words, differences from optimum hours were higher. According to t-test results, *Sleepy Bird* caused statistically significant results in terms of:

- Difference from optimum go-to-sleep hours between weekdays usage of non-gamified (M=-61.55, SD=87.730) and weekend usage of non-gamified (M=-29.89, SD=71.574); t (148) = 2.131, p =0.035 versions.

4.3.3 Results and Analysis of Post-Use Questionnaire

The Post-Use Questionnaire (see Appendix D) included four parts serving for different purposes. The results also were compared for the gamified and non-gamified versions of the app. Each of the parts now will be explained.

i) Part 1:
This part of the questionnaire used Delighted-Terrible Scale (see Appendix D) to measure the participants' feelings about *Sleepy Bird* after its usage.

According to Figure 4.2, 1 participant (4%) felt very delighted due to *Sleepy Bird*, as a best result. 4 participants (15%) felt neither happy nor sad about the usage, as a worst result. Although there were other negative smileys worse than medium level, they were not selected by the participants. 6 participants (23%) felt delighted during usage and 15 participants (58%) pointed that they felt happy due to this special alarm design, as well.

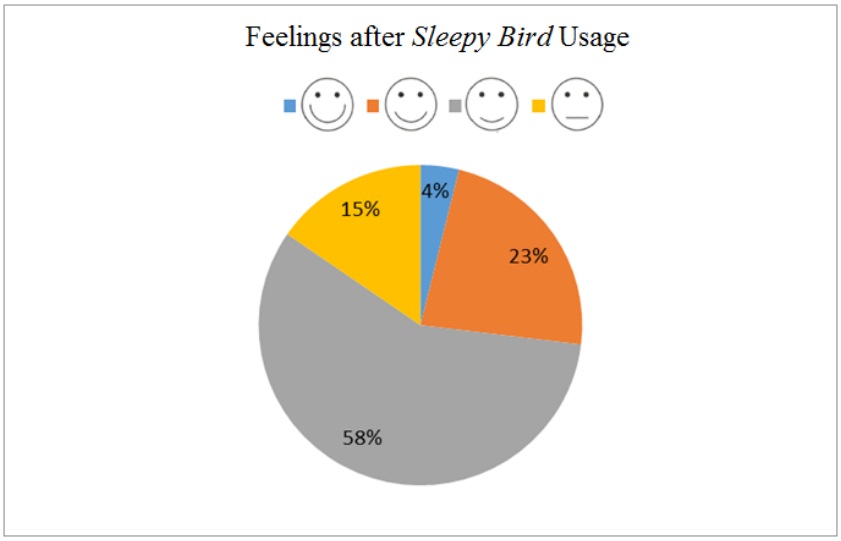

Figure 4.2 Distribution of feelings according to post-use questionnaire by 26 participants

Furthermore, experimental group was more positive than control group towards the app. The average feeling in gamified version was between delighted and happy mood, whereas the average feeling in non-gamified version was between happy and mediocre mood.

ii) Part 2:

This part of the questionnaire (see Appendix D) was used to measure the participants' awareness levels about their sleep-wake habits.

Table 4.16 Score of awareness on behaviors according to post-use questionnaire by 26 participants

	Q1	Q2	Q3	Q4	SCORE
Experimental Group	41	45	45	46	177
Control Group	30	35	30	29	124
Total	71	80	75	75	301

The app drew attention to four main topics; starting the day at correct hours, sleep durations, time interval between waking-up and work/school start and snoozing. The participants assigned scores ranging from 1 to 5 (1 meaning not at all and 5 meaning very much) to each of the four questions. The sum of the scores were then calculated. According to Table 4.16, experimental group scored 177 points where control group scored 124. This result indicated that awareness levels on sleep-wake habits were higher for the participants of gamified version than the participants of non-gamified version.

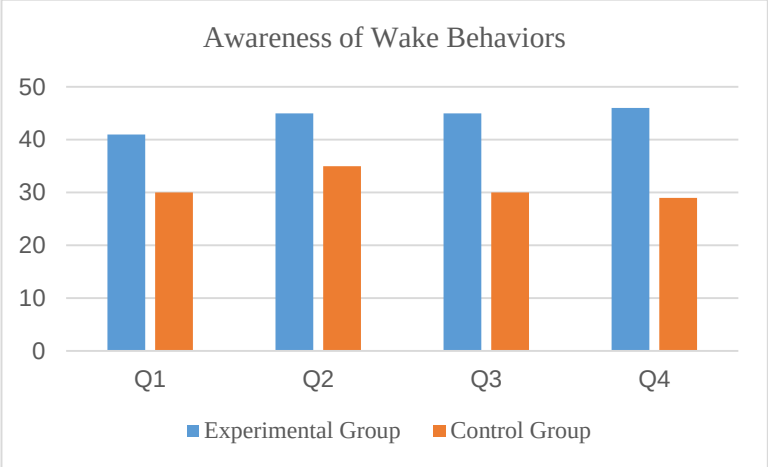

Figure 4.3 Bar chart of awareness according to post-use questionnaire by 26 participants

Additionally, the scores were analyzed by question-base as represented in Figure 4.3. Experiment group, which was symbolized with blue color code, got higher scores for each questions. Q2 was about awareness on sleep duration and got the highest score in total for both groups. On the other hand, total scores of two groups for Q3 and Q4 showed that *Sleepy Bird* helped to gain awareness regarding time interval between wake and work time and snooze action. However, total scores had the minimum value for Q1, which was asking about awareness on starting the day at correct hours.

When results of self-evaluations were analyzed in the SPSS by using t-test method, awareness levels on sleep-wake habits between groups showed statistically significant changes for all of the questions.

- Q1 between experimental (M= 3.15, SD=0.899) and control (M= 2.31, SD=0.630); t (24) = 2.779, p = 0.010 versions.
- Q2 between experimental (M= 3.46, SD=1.050) and control (M= 2.69, SD=0.751); t (24) = 2.148, p = 0.042 versions.
- Q3 between experimental (M= 3.46, SD=1.050) and control (M= 2.31, SD=0.751); t (24) = 3.223, p = 0.004 versions.
- Q4 between experimental (M= 3.54, SD=1.330) and control (M= 2.23, SD=1.092); t (24) = 2.740, p = 0.011 versions.
- Total score between experimental (M= 13.62, SD=3.525) and control (M= 9.54, SD=2.537); t (24) = 3.385, p = 0.002 versions.

iii) Part 3:

This part of the questionnaire (see Appendix D) was used to analyze the participants' self-evaluations about their wake-up attitudes and motivations after using *Sleepy Bird*. In that part, six questions were designed to measure the progress as a reply to the same part of pre-use questionnaire. Participants arranged scores as they had done in the pre-use questionnaire.

Table 4.17 Score of morning attitudes and motivations according to post-use questionnaire by 26 participants

	Q1	Q2	Q3	Q4	Q5	Q6	SCORE
Experimental Group	54	40	36	36	52	50	268
Control Group	49	41	34	33	43	44	244
Total	103	81	70	69	95	94	512

As summarized in Table 4.17, the score was 268 for the gamified version and 244 for the non-gamified version. Although there was not a huge difference between groups, participants of gamified version got a higher score. Experimental group evaluated themselves more successful due to the usage of app in terms of waking-up more motivated and feeling more positive while waking-up at early hours.

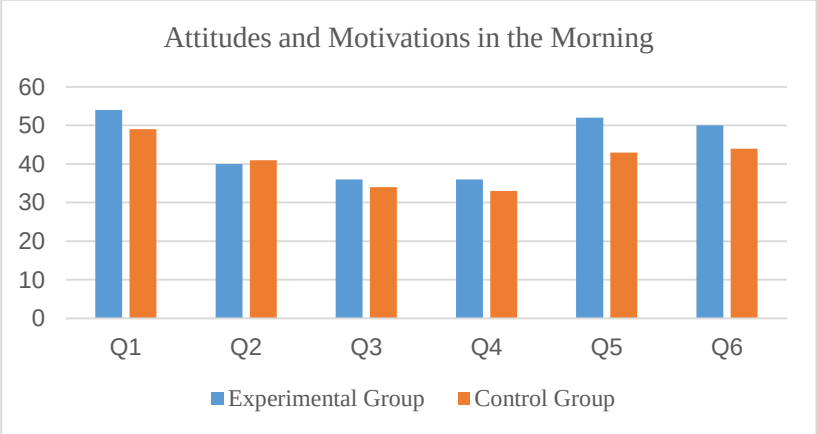

Figure 4.4 Bar chart of morning attitudes and motivations according to post-use questionnaire by 26 participants

The scores were also analyzed by question-base as demonstrated in Figure 4.4. Questions were answered with higher scores by participants of the gamified version. As a result of Q1 score, they mostly believed that they woke-up at correct hours during usage period. Experimental group also scored higher for Q5 and Q6 indicating that the app made them feel psychologically well and motivated in waking-up at required hours. Conversely, they gave the lowest points to Q3 and Q4. They did not believe so much that they felt awake, rested and lively after getting out of bed. Q2 was also scored lower showing that experimental group was not woken-up easily with that app.

For the control group, the highest score was for Q1, followed by Q6, Q2 and Q5 showing that they could wake-up at required hours and felt psychologically well. However, the lowest score for Q4 and Q3 implied that the group did not feel relaxed after getting out of bed. For both of the groups, Q1 got the highest score, whereas Q3 and Q4 got lowest scores.

Furthermore, in contrast to pre-use questionnaire results, the scores became higher. In the previous results, experimental group got 242 and control group got 216 points in total. Yet, after the use of *Sleepy Bird*, both of the scores increased.

Although the scores for questions increased in the post-use questionnaire, only one question was calculated at the statistically significant level. According to t-test analysis, Q1 showed a significant change in experimental group (p=0.00), in control group (p=0.001) and in total score (p=0.00). Moreover, the total score of questions (p=0.012) and total score for the control group (p=0.042) showed statistically significant changes between pre-use and post-use of the app. This situation showed that the app provided motivation and positive attitudes on the hardly-performed sleep-wake habits, especially in (Q1) waking-up at correct hours.

iv) Part 4:

This part of the questionnaire (see Appendix D) was used to analyze the participants' comments concerning; tendency to change their sleep-wake behaviors, desire for additional app features and positive/negative features of the app. It included five open-ended questions. In the first question, it was asked whether that kind of gamified tool would change sleep-wake behaviors in the long term. In the second question, it was asked whether *Sleepy Bird* taught new information related to sleep-wake. In the third question, the suggested features for the app were inquired. In the fourth and fifth questions, positive and negative aspects of *Sleepy Bird* were proposed.

Q.1. First open-ended question was related to future tendencies on behavior change of the participants. It was important to understand future intentions to change sleep-wake behaviors when there was a chance to use a gamified alarm for a long period of time.

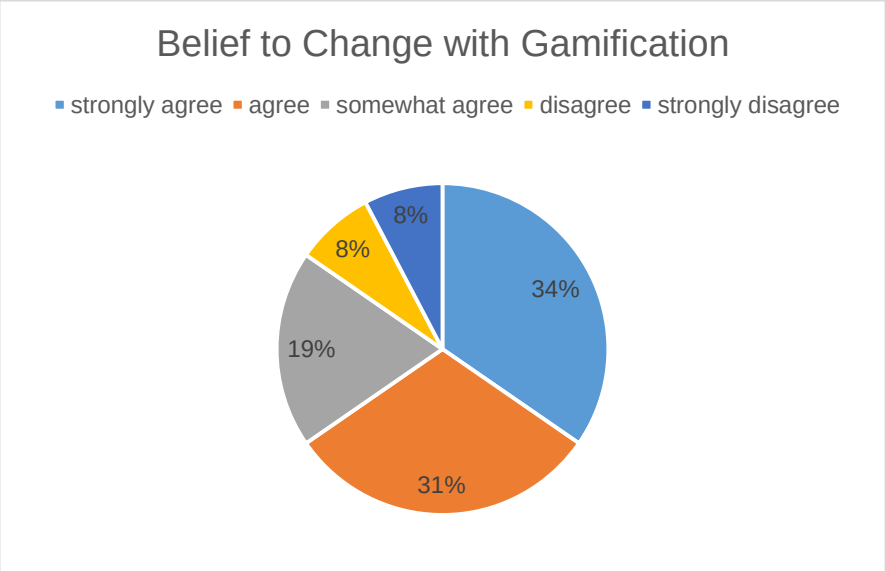

Figure 4.5 Distribution of future intention to change according to post-use questionnaire by 26 participants

In order to analyze the results, they were categorized into five groups as shown in Figure 4.5. 9 participants believed that it would be highly possible to change behaviors by using gamification in the long term. 8 participants supported the idea that although sleep-wake habits were hard-to-perform behaviors, they could be shaped by successful and addictive games. Therefore, 17 participants (65 %) in total, stated that a gamified app would change sleep-wake behaviors in the long term. 5 participants (19%) somewhat agreed that games could be used

as motivational tools; so they could inspire sleep-wake behaviors. 2 participants (8%) stated that it would be very difficult to change that kind of personalized sleep-wake behaviors. 2 participants (8%) also thought that it would be impossible to change sleep-wake behaviors by a game even if it was used for a long while.

Q.2. Second open-ended question asked whether participants had learnt something new about correct wake-up hours and sleep durations. Most of the participants explained that they especially learnt about optimum wake-up hours and sleep durations. They tracked their sleep durations and wake-up hours with the help of regular notifications. Other popular answers were related to decreasing snooze numbers. Time interval between waking up and starting to work was another information learnt by using *Sleepy Bird*. Some noteworthy comments about the gamified version are listed as quotations below:

- "Although the app did not motivate me enough to wake-up at earlier hours, it helped me become aware of the most efficient sleep durations." Participant 5
- "Even if the sleep duration was not very long, it was enough for me when I slept between correct hours. Finally, I realized that with 6-7 hours of sleep, I was feeling rested and happy." Participant 14
- "I noticed that I was sleeping less in the weekdays and more at the weekends. However, I must not sleep less than 6 hours. Before *Sleepy Bird*, I was thinking that long sleep duration was not harmful for the body. Yet, I learnt that more than 8-9 hours of sleep is not good for people." Participant 15
- "I decreased my snooze habit for the game success. I confess that once a day I dismissed the alarm of *Sleepy Bird* and set the alarm of my phone again in order not to lose game lives in the app." Participant 8
- "When I wake-up late, it is an obstacle for me to be active and energetic enough. During the usage period, considering my wake and sleep hours, the app said to me that I will be either fresh or fatigued in the following day. When it said that I will be fresh, I was really fresh. Conversely after the notification of tiredness, I felt tired the next day." Participant 13
- "In order to have more game lives, I woke-up 5-10 minutes earlier." Participant 10

Participants of non-gamified group generally stated that they were not sure whether they learnt something new from the app or not. Simultaneous notifications while setting the alarm increased their awareness about how long they would sleep. Some quotations are:

- "*Sleepy Bird* absolutely made me careful about wake-up hours and sleep durations. Sleep duration must not be too long or short." Participant 21
- "I learned that there is a relationship between wake-up hour and work hour." Participant 23

Q.3. Third question was about demanded properties of the app as summarized in Table 4.18. It was asked to understand which features of gamification has a potential to motivate people in the future uses. Participants mostly desired to see their progress in the game so they chose "level" as an additional feature. They wanted to be motivated with external factors like rewards while using the app. Moreover, since it was an alarm, they wanted to choose personal sounds. They also wanted to have alternatives for the game, characters and environments in the app.

Table 4.18 Request for additional features into the app according to post-use questionnaire by 26 participants

	Number of Participants	Percentage
Game	11	13%
Internet Connection	2	2%
Social Platform	6	7%
Level	16	19%
New Spaces	10	12%
New Characters	12	14%
New Sounds	14	17%
Rewards	13	16%

Participants also commented about additional features. 3 participants suggested to add daily and weekly schedule of sleep and wake hours. That kind of a schedule would help to control physiological and psychological progress in the long term. 2 participants offered to wake friends in a social platform. These ideas would result in developing a better gamified alarm app in future studies.

Q.4. Fourth question was related to positive features of *Sleepy Bird*. The answers were focused on some keywords. In the gamified version, participants generally had a positive attitude towards the combination of alarm app and game elements (graphics, interface and sounds). When game challenge was affected by users' sleep-wake habits, this condition became more appealing, playable and funny to most of them. Leaderboard was interpreted as the most attractive part for competitive users of gamified version. Most of them indicated that competition was the funniest part of the app. Four participants stated that the aim to pass competing with the rivals made them motivated while getting out of bed in the morning. Some comments concerning the game are listed below:

- "I liked the feature of rewarding my wake-up time mostly. Its playability was funny and challenge with game lives and speed was triggering." Participant 1
- "Computing against rivals was appealing. Top score indicating as leaderboard triggered challenge while waking-up. Suddenly changing mood from sleep looseness to struggle state made me woke-up easier." Participant 9

11 participants out of 26 especially liked notifications in the app. Positive comments about notifications made the study reach its goal, as well. One comment was surprising:

- "*Sleepy Bird* was like my mother reminding and encouraging me to go to bed and wake up at correct hours." Participant 26

Q.5. As a fifth question with regard to negative aspects of *Sleepy Bird*, participants wished to control their improvement in the game with levels, new skills, challenges, characters and environments. On the other hand, users commented that they needed a more personal app especially with sounds. They wanted to install new alarm sounds but the app did not let them do this. Furthermore, they needed to set alarm for each minute using multiple alarms. Yet, the app included one set of alarm which could be adjusted within five minutes gaps.

4.4 Discussion

This part will try to answer and discuss all of the questions given at the beginning of the chapter.

- What is the usage ratio of gamified and non-gamified versions of *Sleepy Bird*?

Main goal of the study was to motivate people in waking-up at required hours by the help of gamification. For this reason a mobile alarm app was designed by using gamification for the experimental group and without using gamification for the control group. Although both of the versions used the app in the same time interval, gamified version was used more both in Pilot Study and Final Study. Game features like points, game lives, score, leaderboard and visual elements probably increased the usage ratio of the gamified alarm version. The usage ratio of gamified version would be increased if a new and original game is designed.

During tests, two groups were compared to each other (by version), their previous states (by first and second half of usage) and special period of times (weekend vs. weekdays) on four focus actions namely wake hours, sleep durations, sleep hours and snooze numbers.

- Does gamified version of *Sleepy Bird* affect wake-up hours more positively compared to non-gamified version?

Wake-up Hours: In the pre-use questionnaire, participants were asked about their wake-up times depending on days of the week. Subjective evaluations were calculated approximately one hour more than the recorded computer results in the average. When analyzed by two versions of the app, subjective evaluations and computer log results showed that wake-up hours changed in a more positive way for participants of gamified version. Participants of non-gamified version also changed their wake-up hours with the help of feedbacks given in the app. It can be interpreted that the usage of the app had a positive effect on wake-up hours.

With regard to wake-up hours, ANOVA results were not at a statistically significant level regarding neither version nor first and second part of usage. However, ANOVA calculated that there was a significant effect between weekday and weekend usage of app. In other words, participants woke-up at different hours in the week and at the weekends. Although, the app helped participants to gain an awareness about waking-up at early hours, they did not totally wake-up early in holidays. It can be concluded that waking-up was a very personalized and special habit that was hard to change in a short period of time. Even if gamified version moved it closer to optimum hours, this was not counted as a statistically significant change.

- Does gamified version of *Sleepy Bird* affect sleep duration more positively compared to non-gamified version?

Sleep Durations: In the subjective evaluations of pre-use questionnaires, participants indicated that they had approximately optimal sleep durations. However, computer logs showed that participants' sleep durations were longer than the required level. When analyzed by two versions of the app, participants of gamified version were closer to optimum sleep durations than participants of non-gamified version at the end of the study.

ANOVA analysis also proved that version difference had a statistically significant effect on sleep duration. *Sleepy Bird* helped participants to gain an awareness about sleep durations. Gamified version used game challenge and speed to have a positive impact on the duration of sleep. Players gave importance to sleep durations to continue the game with its optimum pace.

- Does gamified version of *Sleepy Bird* affect go-to-sleep hours more positively compared to non-gamified version?

Sleep Hours: In the pre-use questionnaire, participants stated their sleep times during a week. Subjective evaluations were made with later sleep hours than the recorded computer results. When analyzed by two versions of the app, subjective evaluations and computer logs showed that go-to-sleep hours changed in a positive way for participants of gamified version and non-gamified version.

ANOVA results also proved that there was a significant effect in go-to-sleep times. Different comparisons presented that sleep time was affected by version and by weekend vs. weekday usage. In order to wake-up refreshed and rested, one of the goals was to draw attention to sleep hours. These results showed that *Sleepy Bird* helped participants to gain an awareness on go-to-sleep hours.

- Does gamified version of *Sleepy Bird* affect snooze numbers more positively compared to non-gamified version?

Snooze Numbers: In the pre-use questionnaire, most of the participants indicated that they snoozed alarms at least three times every morning. Yet, collected data showed that participants snoozed alarms with a mean value less than one. When analyzed by two versions of the app, participants of both gamified and non-gamified versions did not use snooze feature generally. There could be three explanations of that astonishing result. Participants wanted to be successful in the game without snoozing and losing game lives. Participants probably tried to utilize the app without any mistakes being aware that they were observed. Participants had a negative attitude towards the alarm sound and did not want to hear it repeatedly.

Concerning ANOVA results, snooze was at a statistically significant level on most of the comparisons. Version, first and second half of usage and weekend vs. weekdays usage interactions emphasized the importance of the change of snooze action. One of the important outputs of the study was making users avoid snoozing. Minimizing snooze numbers to increase the quality of waking-up and sleeping could be evaluated as a benefit of the study.

- Does gamified version of *Sleepy Bird* create a more positive feeling compared to non-gamified version?

Most of the participants used the app to set alarms, play the game, check notifications and control the leaderboard throughout the day. In terms of emotions, post-use questionnaire showed that nearly all of participants felt happy during usage of the app. They felt themselves special to have this app and even “cool” as indicated in one of the participant’s comment. Moreover, participants of gamified version showed more delighted feelings than participants of non-gamified version about the usage of the app.

- Does gamified version of *Sleepy Bird* create a better awareness on sleep-wake habits compared to non-gamified version?

The app tried to create an awareness on the wake and sleep hours, the time gap between wake and start of work, sleep durations and snooze actions. Most of the participants indicated in the post-use questionnaires that they wanted to change these sleep-wake habits by that kind of gamified alarm clock app. Even if it was not easy to change sleep-wake habits, they showed a tendency to change. They supported the idea that sleep-wake habits can be shaped by an addictive gamification tools in the long term.

According to data results, there were observable changes in some actions in a four-week usage time. For example, snooze numbers, difference from optimum sleep times and difference from optimum sleep durations were importantly affected by gamification. Elements of gamified *Sleepy Bird* like game lives, leaderboard, feedbacks, game speed helped participants to have optimum sleep-wake conditions. Furthermore, notifications, rewards and penalties of the game made experimental group behave more carefully in the app during usage. However, it could be inferred from the data that control group did not give importance to sleep-wake habits as much as experimental group. Thus, it was difficult to interpret that participants of non-gamified version gained an awareness on sleep-wake habits.

Additionally, when first and second half of usage was considered, it was analyzed that mean values approached zero on the second half of usage. This situation could represent that participants gained an awareness about sleep-wake habits. After using the app for a while, both experimental and control groups improved their actions in a healthier way such as decreasing their snooze numbers, waking-up and sleeping closer to required hours and sleeping less but adequately. Thus, all of the actions had a positive progress in the duration of the study.

Regarding the time gap between waking up and starting work, *Sleepy Bird* helped to inform participants, as well. In order to provide concentration on studies, it was needed to get out of bed on time. Participants' comments supported that the app pointed out the need for that time, with game lives in gamified version and notifications in both of the versions.

CHAPTER 5

CONCLUSIONS

This chapter presents the conclusion of the study. It gives direct answers to the research questions as an outcome of the study, and also offers potential pathways for future work. Additionally, the personal reflections with limitations of the study are made.

The popularity of the terms of well-being and gamification increased in several aspects of life. The study analyzed the relationship between these two terms. In the literature, it was explained that people desired to increase their positive experiences to keep their happiness in the long term, which was well-being. The main focus of the study was on subjective well-being with regard to individuals. Sleep-wake habits were focused on since they could have great impact on daily concentration, relaxation and depression levels. On the other hand, it was endorsed in the literature that gamification had the power to motivate people for boring, tiring and hard-to-perform tasks. Thus, the study tracked and collected data of sleep-wake habits of participants through a new design of a gamified alarm clock app. That alarm app was installed on the smart phones of users and utilized approximately for two weeks. The study explored some changes in sleep-wake habits in the usage period. It also gathered subjective evaluations of feelings and awareness levels of the sleep-wake habits after using the app.

5.1 General Outcomes of the Study

This study reached some achievements in terms of technical knowledge and practical outcomes. Subjective well-being could be obtained by changing or shaping some habits into more desired way. In the literature, it was suggested to use gamification as a tool to persuade and motivate people in the achievement of some activities. However, having motivated players with the help of final rewards, gamification was criticized to be a temporary benefit. Game features were implemented into gamified tools ignoring game design process and intrinsic motivations of people. Gamified examples generally forced people to take actions without possessing the fun factor. They were also insufficient for daily and simplest routines of people, which had an important role for subjective well-being. This research provided a broad focus on the relationship between psychology, well-being, sleep-wake habits and gamification.

Accordingly, the achievement of the study was the use of gamification with an improved perspective. The purpose was to see whether gamification can create a motivation and awareness even for such a hardly-performed task as sleep-wake habits. In contrast to negative criticism of gamification, *Sleepy Bird* was designed to focus on ‘intrinsic motivations’ with its gratifying feedback system. With its feedback and notifications, the app gave information on optimum wake and sleep hours to improve users’ awareness on sleep-wake habits. Thus, this

study used gamification with a shift from *an extrinsic reward system* to *an intrinsic feedback system.* In this way, it objected to provide a permanent awareness on sleep-wake habits.

This study revealed that gamification was successfully used for the creation of positive feelings and better awareness about sleep-wake habits. Gamification persuaded people to start the day at required hours. A mobile alarm app informed people about required sleep-wake hours and sleep durations. A gamified alarm app motivated people not to snooze their alarms.

5.2 Research Questions Revisited

This section presents the conclusions of the study including the answers to the research questions that were posed in Introduction chapter. Answers to the questions now will follow.

Question 1: What is gamification and its relevance to human well-being?
In the Introduction and Literature chapters, gamification was explained with its relevance to well-being. Knowledge under the topics of "well-being, well-being and need for play, from games to gamification, gamification, gamification from the perspective of psychology, motivational affordances, persuasive design, Self Determination Theory (SDT), psychological and behavioral outcomes and Transtheoretical Model (Stages of Change)" helped to answer that question.

Gamification was defined as the usage of game elements in non-game contexts. Well-being, on the other hand, was defined as having pleasant cognitional and emotional experiences. People desire to increase positive feelings in order to enhance life satisfaction including health, job, finance, house, environment, and even leisure time satisfactions. For changing unpleasant daily habits into more desired ones, some supportive elements are needed. First, games were utilized in order to have enjoyable interfaces and fun factor. However, human-computer interaction with the developing technologies has drawn attention to usability and playability problems of games. After the 2000s, especially marketers and organizations started to incorporate game mechanics and dynamics into game-irrelevant activities to motivate people. Game features such as point, level, challenge, leaderboard, reward, status and social interaction systems are mostly used to make participants feel inside the related activity. Gamification let them make their own decisions, pay more attention and have more fun in the activity.

Gamification is related to motivational affordances of psychology field including Self Determination Theory (SDT), (Ryan and Deci, 2000). Extrinsic and intrinsic types of motivations, which are the biggest negative criticism topic of gamification, are studied under SDT. Autonomy, competence and relatedness are the common study areas of game and psychology. When a gamified app is designed, psychological needs and well-being should be considered. Moreover, theories related to human behaviors should be analyzed in the design process of gamification in order to predict behavior modifications. The elements of gamified app such as feedback and notifications should let players have self-control and self-efficacy in the stages of change.

Question 2: What roles do sleep-wake habits play in people's well-being?
In the Introduction and Literature chapters, sleep-wake habits were defined relevant to well-being. Information from the topics of "sleep-wake habits and well-being, measurement of sleep-wake habits, gamification for sleep-wake habits" used to answer that question.

People need to rest physically and psychologically to accomplish their daily tasks. They need to wake-up at a reasonable time in the morning, sleep at an appropriate time at night, and have sufficient amount of sleep. Sleep duration and waking-up time affect the happiness level of people. When people start the day at a right time, having had adequate sleep, they are likely to wake-up in a good mood. Starting the day with positive feelings influences the whole day. In fact, sleep-wake habits are both directly associated with subjective well-being in terms of physical and cognitive healthcare. They can also be indirectly related to well-being in economic aspects and social connections.

Sleep plays an important role in terms of physical healthcare. It provides body rest and physiological healing. Physical relaxation creates the required energy level for the body. If people do not have an adequate night sleep, they can be unsuccessful in daily tasks due to inadequate energy. On the other hand, the quality of sleep is determined based on whether the waking-up time is correct in the morning. In other words, the optimum time to start the day is important to evaluate the total quality of daily sleep. If people start the day unrefreshed, some health problems caused by fatigue like discomfort of arms and legs may occur. Additionally, snoozing the alarm time disturbs the quality of sleep. To reach the optimum wellness related to sleep and health, snoozing should be avoided.

Sleep brings not only physical relaxation, but also rest to brain and mind. As sleep provides brain recruitment and memory wellness, it is important for cognitive well-being, which influences learning or working satisfaction. When an individual sleeps, the brain works actively to cure learning and memory tasks in the brain. Hence, if one has sleep-wake problems, school or work performance may deteriorate accordingly. Mental tiredness results in malaise and thinking problems, as well. Wrong hours for waking-up cause some problems in brain functions. Concentration disturbance and amnesia are short-term deficiencies due to incorrect waking-up hours. In addition, people require a time interval to start work or studies after they wake-up. If there is a time gap between getting out of the bed and starting to work, brain functions like concentration would be higher. When people study or work with higher focus and deeper success, this situation would affect economic well-being positively in the long run.

Starting the day after sunrise makes people catch the sun, which is important for the body. By this way, people release melatonin hormone that calms the body with positive feelings. Having sufficient and efficient sleep durations results in psychological wellness. Affective wellness makes people powerful against challenges. These people feel less depressed and stressful. Moreover, positive mood brings them better social relations and stronger social connections. Conversely, sleep-wake habits make people more anxious and stressful.

Several gamification examples are designed with the developing technology. They are used to increase different types of well-being. There are also some examples in the field of personal healthcare specifically about sleep-wake habits. Gamified mobile apps and supportive accessories are widely utilized to inform their users about sleep-wake habits. Gamified tools can be beneficial to gain awareness about sleep-wake habits activities. They are generally game-based alarm clocks or reward-based mobile apps. People can track their sleep schedules and reorganize themselves to have better wake and sleep hours for their health.

Question 3: What are the possible results of implementing a gamified mobile app to create positive feelings and better awareness of sleep-wake habits?
The answer of this question was detailed in the Analysis chapter. Literature chapter was beneficial to design a gamified tool to create an awareness for changing sleep-wake habits. The topics of "well-being, from games to gamification, gamification, persuasive design, Transtheoretical Model (Stages of Change), criticism of gamification" were useful for the fieldwork, development of *Sleepy Bird* and evaluation of the results of the study.

The research focused on the gamification field under the perspective of psychology. For that reason, participants were selected carefully according to their sleep-wake habits. The results of pre-use questionnaires played an important role in deciding the group of participants. Two sets of users were selected for gamified and non-gamified versions of the app, which built experimental and control groups. The analyses were done considering not only the difference between gamified and non-gamified versions but also the participants, weekdays/weekends usage and first/second half of usage.

This study explored whether it was possible to change a daily activity as sleep-wake habits by using gamification as Werbach (2012) suggested. Since behavior change can be observed in longer periods, this study aimed to give awareness and understand tendency of participants. Awareness was generated by feedbacks on the topics of waking-up hours, sleep durations, time interval between getting out of bed and starting work and alarm snooze actions. At the end of the app usage, these four topics were asked in the post-use questionnaire. According to the results, participants gave the highest score to Q2, which was asking the awareness level for sleep duration. The scores were compared between gamified and non-gamified groups, as well. Experimental group indicated that they had gained awareness related to four aspects more than control group. Thus, it demonstrated that gamification became a beneficial tool in creating an awareness on specialized sleep-wake habits. As Prochaska et al. (1992) and Mehta and Kass (2012) proposed, gaining an awareness as an initial step would result in behavior changes finally.

In the post-use questionnaires, participants were asked whether they had a future tendency to change their habits related to waking-up hours or not. With regard to tendency of participants, gamified mobile alarm app was advantageous in some aspects. Most of the gamified version users supported the idea that a gamification would help them wake-up and sleep at required hours in the long run. Participants believed that the motivation to wake-up was higher with a gamified alarm. As McGonigal (2011) stated, game elements, social interactions, funny graphics and sounds brought participants into a happy mood in the morning. Moreover, the

belief that gamification could change sleep-wake habits was stronger. The habit of using the app would persuade users to behave in an appropriate way in terms of sleep-wake habits. On the other hand, participants gained an awareness about the danger of snoozing habit on wake and sleep quality. They were persuaded to minimize the number of snoozes in the long term.

Furthermore, results of collected computer logs proved the differences between gamified and non-gamified groups. The reliability and significance of data were detailed in the Analysis chapter. As a brief summary, gamified version of *Sleepy Bird* was used more than non-gamified version in the same time interval, i.e. four-week usage. Four main topics namely number of snoozes, difference from optimum wake-up hours, difference from optimum going to sleep hours and difference from optimum sleep durations were analyzed between groups. Mean values for those variables were calculated specially for each participant.

First, all of the participants were compared in terms of versions of the app. The results demonstrated that snooze action, optimum sleep times and optimum sleep durations were different at a significant level between groups. In the gamified version, participants started to snooze their alarms less than before-use of *Sleepy Bird*. They also slept at optimum hours with optimum sleep durations in contrast to users of non-gamified version. Thus, the difference between versions affected behaviors of participants importantly in those aspects.

Secondly, the improvement in the sleep-wake habits of participants were evaluated according to first part of usage and second part of usage of *Sleepy Bird.* These results were important to interpret whether the app was successful in informing users about sleep-wake habits. The results showed that participants had decreased their snooze numbers at a significant level. Although other aspects of wake and sleep hours and sleep duration had changed to some extent, they were not counted as statistically significant from first half to second half of use. For version differences, gamified one had an important role in decreasing number of snoozes in the second half of app usage.

Thirdly, weekdays and weekend usage was affected by versions. Optimum wake and sleep hours were changed in an important level between weekdays and weekends. Concerning versions, snooze numbers altered importantly between weekdays and weekend in the gamified one. In the non-gamified version, on the other hand, participants changed their optimum sleep times at a significant level throughout a week.

In conclusion, implementing a gamified mobile app created better awareness of people's sleep-wake habits. Yet, although there was not an expectation about behavior changes, computer logs demonstrated that some issues like snooze and sleep durations became close to optimum cases in approximately one month of usage. Moreover, it has a potential to change those behaviors in a positive manner in the long run (Prochaska et al. 1992 & Mehta and Kass, 2012).Thus, it would increase well-being in terms of physical, psychological and cognitive healthcare. When people regulate their sleep-wake habits in a positive way, their education/work success, economical power and social connections would be affected indirectly. The satisfaction in different fields was supported Van Praag et al. (2003) in the idea that this app would help to increase general satisfaction and well-being.

Subjective evaluations:
Delighted-Terrible Scale was utilized in the post-use questionnaires to comprehend the feelings during *Sleepy Bird* usage. The participants were given a scale including positive and negative smileys. The worst smiley about this app was chosen as straight faced one. None of the users stated that they had a negative feeling about this alarm app. On the contrary, most of the participants indicated that the gamified alarm app had motivated them with its special design. Gamified version users selected happier faces more than non-gamified version users due to their experiences. Experimental group scored between delighted and happy mood, whereas the control group scored between happy and mediocre mood in the average. Deterding et al. (2011b) defined gamification as providing better user experiences, which was supported by that happy mood of participants after the app usage.

Participants generally asserted that they had some motivation to start the day without snoozing and to go to bed at required hours during the use of *Sleepy Bird.* Gamified version users were affected positively by the graphics, interface and sound of the app. The more they competed against the rivals in the game, the more they cared about the game. In other words, to be better in the game, they behaved carefully in sleep-wake habits. Thus, gamified version motivated participants in terms of rewarding system and leaderboard. Moreover, regular and detailed feedbacks were given in both of the versions to create an intrinsic motivation with the app. The notifications and feedbacks were evaluated as giving friendly information on sleep durations, wake hours, sleep hours and snoozes. As Ryan et al. (2006) and Granic et al. (2014) stated, both of the gamified and non-gamified users had positive comments on detailed feedback system of *Sleepy Bird.* This situation supported Pink (2011) and Ferrara (2013) in the belief that extrinsic reward systems in gamification made precious experiences diminished. If gamified tools are not used with intrinsic factors, they would be unsuccessful. On the contrary, when they utilize fun factor and friendly messages they would motivate intrinsically, which would result in positive results.

Sleepy Bird also increased morning motivations and positive attitudes concerning sleep-wake habits in some aspects. The answers of participants were compared using pre-use and post-use questionnaires. The same judgments took place in both of the questionnaires. In the pre-use one, participants pointed smaller than post-use questionnaires. After using the app, the scores became higher in both of the gamified and non-gamified groups. This increase demonstrated that the app provided a positive approach against sleep-wake habits. Especially the score of Q1 was doubled when compared with its before-use rating. Gamified and non-gamified group members believed that they had woken-up at required hours in the morning. Q2 was asking whether they had woken-up easier in the duration of usage. The total score of Q2 remained at the same number, where gamified app users scored better and non-gamified app users scored worse. Q3 and Q4 were associated with feelings of physical relaxation after waking-up. Total score of these questions were approximately same before and after using the app. Q5 was asking if participants were pleased of starting the day at the right time. The decrease of the score after using the product indicated that the participants had not changed their wake-up hours in a crucial way and did not feel happy for that reason. In Q6, it was asked whether *Sleepy Bird* had motivated participants to start the day. Both of the version users scored higher points after using the app in that question.

5.3 Practical Implications

The study was beneficial for game development studies, as well. The gamified version showed that the competition between rivals made the game more challenging. Once people got feedback messages about competition and controlled the leaderboard, they gave importance to their sleep-wake habits in order to be better in the game. It was possible to collect the information about numbers of game lives, game points and top scores. Moreover, time, sequence and frequency of actions taken by the players were controlled by the gamified app. Game-related data collection provided to design a challenging and enjoyable game balance.

Numbers of tests and quick iterations helped to know the bugs and problems of the game in order to improve it. The different steps of implementation process gave an idea about the success of visual and audial elements in the game. Color and sound alternatives were important criteria that were desired by many participants.

The app can be published on Google Play easily after the study. It just needs to replace Parse.com service with official Google Play Services as Google offers cloud data and high score functions with higher free capacity than Parse.com. Reason behind not choosing Google Play Services for the study was that it had required a login to Google+ services. To make the test groups enter directly to the app, a barrier was not demanded in the study.

5.4 Limitations and Reflections

The outcomes of the study have evoked some surprising pleasurable or challenging results, which were not foreseen at the beginning of the study.

App content:

- The aim of the study was to create a gamified tool to enhance intrinsic motivation. It explored fun factor to evoke intrinsic need to wake-up at a reasonable hour in the morning without giving external rewards. It gave gratifying feedbacks and notifications about time interval between waking and starting to work, going to bed hours, sleep durations and snooze actions. One of the users said that the app resembled his mother surprisingly. This result supported the importance of detailed feedbacks as explained by Granic et al.(2014).
- *Flappy Bird* in the gamified version was found easier, more playable and enjoyable than the original version. Participants felt themselves lucky to have that kind of special alarm app that joined alarm and game together. The surprising case was that *Sleepy Bird* was found addictive by ones who had not thought *Flappy Bird* as an addictive game before. Even these users stayed at the top score of leaderboard.
- Leaderboard became a highlight for the gamified version. The competition increased the fun in the app.

Participant selection:

- Finding participants for non-gamified version of the app was challenging. Even if they wanted to join into the study at the beginning, they did not set app's alarm because of

having less motivation. Thus, old participants that had not used the app properly were replaced with new participants to complete the study in a useful way.

- A practical limitation occurred when participants did not have a regular sleep pattern. Since the scope of the study focused on regular sleeping orders depending on the literature review, the system operated for people who sleep at night and work in the morning. The mathematics and rules of the game did not work correctly for users that sleep in the morning and wake–up at night. The same situation was valid for users who did not work or study, because it made calculations considering the starting time of work. Therefore, some people were not incorporated in the study. In the future studies, it would be possible to collect personal data about waking-up and sleeping patterns of participants before starting the development of the app. After analyzing sleep-wake habits for each individual, the math of game would be designed specifically on those hours even if one has a reverse order of sleep and work.
- Since Android was easily personalized and used by many people, it was chosen as the operation system of the app. However, this situation played a role as a technical constraint of the study for the selection of participants. In the future studies, the app would be developed to be compatible with IOS operator, as well. By this way, it would be downloaded to higher number of smart phones.
- Questionnaire results were used for the selection of participants. As explained in the Methodology chapter, different scales in questions were chosen for different purposes. Epworth Sleepiness Scale (ESS) was used as 4-point Likert scale to save its original form of Turkish version, whereas the other scales were used as 5-point Likert scales. Saving the scales as their original forms provided to make evaluations without any incorrect interference. However, it was a limitation for the assessments of study. It made the process harder both for the participants while answering and comprehending the questions and for the study while analyzing the results.

Study duration:

- Making observations on daily special habits, especially on sleep-wake habits, was a challenge in the study. However, it resulted in a pleasurable outcome that a few of the participants desired to continue using the gamified app after the study. They said that the app was helpful to remind and control their sleep-wake habits although their participation would not affect the final results anymore. Furthermore, one of the users postponed changing his phone with a new one due to his desire to continue the usage of gamified version.
- When emotions after usage of the app was asked, participants generally chose happy smileys. *Sleepy Bird* made most of them pleased. Furthermore, they implied this gamified mobile app would be more beneficial to change sleep-wake habits in the long run. Thus, the app had a positive effect on well-being according to the definition of Diener (1984) including pleasurable experiences and positive feelings.

Change in sleep-wake habits:

- It was aimed to make users gain awareness about sleep-wake habits at the beginning of the study. The biggest handicap of the study was to use two strong topics namely game and sleep-wake in the same app. Game should be a hidden element to make

participants aware of sleep-wake habits. On the other hand, sleep-wake actions should stay behind the gamification to measure the success of gamified app. At the end, it was not expected that users would gain so much awareness on sleep-wake habits by a gamified app. It was intriguing that participants could probably explain all the rules about sleep-wake habits and game features.

- Besides gaining an awareness, they changed some behaviors like snoozing and going to sleep hours. Behavior change was not expected while starting study.
- Before the usage, participants had told that they generally snooze the alarms. However, during usage, most of the participants decreased their snooze times in order not to lose their success in the game. It was surprising that snooze times were near zero according to the results.
- Similar to snooze action, some of the gamified users waited for sleeping at right hours at night in order to get more game success. They also set their alarms at right hours in the morning to win game lives.

5.5 Future Work

This study helped to figure out some beneficial results. It showed how gamification could be used in daily personal activities like sleep-wake habits in order to enlighten future studies. The more fun is given with a gamified tool, the more satisfied users would become. If gamified alarm app is designed in a more addictive way, it would not only satisfy personal intrinsic needs to enhance well-being but also shape a habit in the long term.

To provide behavior changes, the gamification should be addictive. This study provided a game-based gamification to control sleep-wake habits. Using a game inside the app helped to increase the fun to motivate participants with a gamified alarm clock. In the future studies, waking-up and sleeping habits can be gamified as a whole process without using a game in the app. Game-like gamification by gamifying the actions would create more beneficial results and habit changes in the long run. Also, in this study the choice of *Flappy Bird* game was done due to its addiction in a short-time interval. If the study was based on a less popular game, it would take a longer time for participants to get used to the game and for the study to observe the effect of gamification. For future research, there can be different game options to increase the addiction level. Less popular games or new games can be tried to observe the effects of gamification. Development of city building games or progressive games with levels can be other alternatives to motivate players in the long run. This motivation can be beneficial to control special daily habits like sleep-wake habits.

Participants were selected as a mix of gamers and non-gamers to get objective outcomes for that research. Gamers and non-gamers took place in the experimental and control groups of the study. This study tried to observe participants without making them bored with the app usage. However, a different composition of groups may have different results in future research.

- If experimental group has gamers and control group has non-gamers in the study, the effect of gamification would be observed in a stronger way. Since gamers can use the gamified app easily and having more fun, it would be possible to change their habits

by the app usage. On the contrary, it can be possible that a group of gamers would not be so satisfied with such a gamified alarm app due to its being lack of game features.

- If experimental group has non-gamers and control group has gamers in the study, the effect of gamification would be observed in a different way. Due to being not familiar to playing games, non-gamers would not continue using the gamified app easily and having fun. This situation would be the same for people that do not like *Flappy Bird* game. If they are not so interested in playing games, the usage of gamification would be hard and useless for this group. As a result, observation of habit change would be more difficult in this condition.

Yet, it is proposed to see the effect of different distribution of participants in order to get the most appropriate usage scenarios in the future research.

Personalization for participants would be given importance. Future design of the app would serve personalization elements with sound and graphic alternatives. The app can use a social network to provide a cooperation and competition in order to satisfy autonomy, competence and relatedness needs of users.

This study made participants use the app during one month for the collection of high numbers of sleep-wake data to track people's alarm times, sleep hours and snooze action. In order to see some crucial alterations in sleep-wake behaviors, observation time of participants can be longer to collect more data in the future studies.

Additionally, this study has a future potential by collecting whole user data for each actions. It can record when participants play the game and what they do with the app throughout the day. According to those recordings, many interpretations can be done related to lost game lives, remained game lives, game durations in a day, number of visits to the leaderboard screen, etc. Therefore, the study can also serve a potential to make interpretations and developments from the game perspective.

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APPENDICES

APPENDIX A – FEEDBACK MESSAGES IN THE APP

Feedbacks of gamified and non-gamified versions of *Sleepy Bird* are listed below.

Feedbacks in Gamified Version:

1. When users set their alarms, they are informed about the number of game lives that they will win the next day.
2. When users wake-up at a correct hour, they get the message:

"Günaydın ☺ Tebrikler! Günü kaçırmamak ve işine odaklanmak için güzel bir zamanda kalktın. Ayrıca bu sayede x can kazandın."

3. When users wake-up at their ideally best hours, they get the message:

"Günaydın ☺ Tebrikler! Senin için en ideal zamanda kalktın, saat x de ve işinden 1,5 saat önce. Ayrıca bu sayede bugünkü en yüksek canı sen kazandın."

4. When users wake-up at a late hour, they get the message:

"Günaydın ☺ Yarın günü kaçırmamak ve daha verimli çalışmak için daha erken kalkmaya ne dersin? Biraz geç uyandığın için bugün x can kazandın."

5. When users wake-up at an early hour, they get the message:

"Günaydın ☺ Yarın daha çok uykunu almış olarak biraz daha geç bir saatte uyanmaya ne dersin? Çok erken uyandığın için bugün x can kazandın."

6. When users snooze the alarm, they get the message:

"Günaydın ☺ Daha kaliteli bir uykun olsun istiyorsan yarın alarmını ertelememeye çalış. Alarmı her ertelemen için oyunda 5 metre geriye düştün."

7. When users pass in front of the rivals in the game, they get the notification:

"Tebrikler, az önceki oyunda rakibini solladın. Artık onun önündesin. Sakın seni geçmesine izin verme."

8. At 22:00 PM each night, they get the notification:

"Lütfen yatarken uyuma saatini *Sleepy Bird*'e bildirmeyi unutma. ☺"

9. When users go to bed at a correct hour, they get the message:

"İyi geceler ☺ Bugünkü x saatlik uykun, yarın güne uykunu almış ve dinlenmiş olarak başlamanı sağlayacak. Ayrıca bu sayede yarın uykucu kuşun da ideal bir hızda oyuna devam edecek."

10. When users sleep too short, they get the message:

"İyi geceler ☺ Bugün x saat uyuyorsun. Güne daha zinde başlamak için uyku süreni yarın biraz daha uzun tutmaya ne dersin? Ayrıca bu kısa uyku süren oyununun hızlanmasına sebep olacak."

11. When users sleep too long, they get the message:

"İyi geceler ☺ Bugün x saat uyuyorsun. Güne daha zinde başlamak için uyku süreni yarın biraz daha kısa tutmaya ne dersin? Ayrıca bu uzun uyku süren oyununun hızlanmasına sebep olacak."

12. When users have no game lives left, they get the notification:

"Üzgünüm, bugünlük hiç canın kalmadı.Yarın alarmını senin için doğru zamana kurar ve vaktinde kalkarsan daha çok can kazanabilirsin."

Feedbacks in Non-Gamified Version:

1. When users wake-up at a correct hour, they get the message:

"Günaydın ☺ Tebrikler! Günü kaçırmamak ve işine odaklanmak için güzel bir zamanda kalktın."

2. When users wake-up at their ideally best hours, they get the message:

"Günaydın ☺ Tebrikler! Senin için en ideal zamanda kalktın, saat x de ve işinden 1,5 saat önce."

3. When users wake-up at a late hour, they get the message:

"Günaydın ☺ Yarın günü kaçırmamak ve daha verimli çalışmak için daha erken kalkmaya ne dersin?"

4. When users wake-up at an early hour, they get the message:

"Günaydın ☺ Yarın daha çok uykunu almış olarak biraz daha geç bir saatte uyanmaya ne dersin?"

5. When users snooze the alarm, they get the message:

"Günaydın ☺ Daha kaliteli bir uykun olsun istiyorsan yarın alarmını ertelememeye çalış."

6. At 22:00 PM each night, they get the notification:

"Lütfen yatarken uyuma saatini *Sleepy Bird'*e bildirmeyi unutma. ☺"

7. When users go to bed at a correct hour, they get the message:

"İyi geceler ☺ Bugünkü x saatlik uykun, yarın güne uykunu almış ve dinlenmiş olarak başlamanı sağlayacak."

8. When users sleep too short, they get the message:

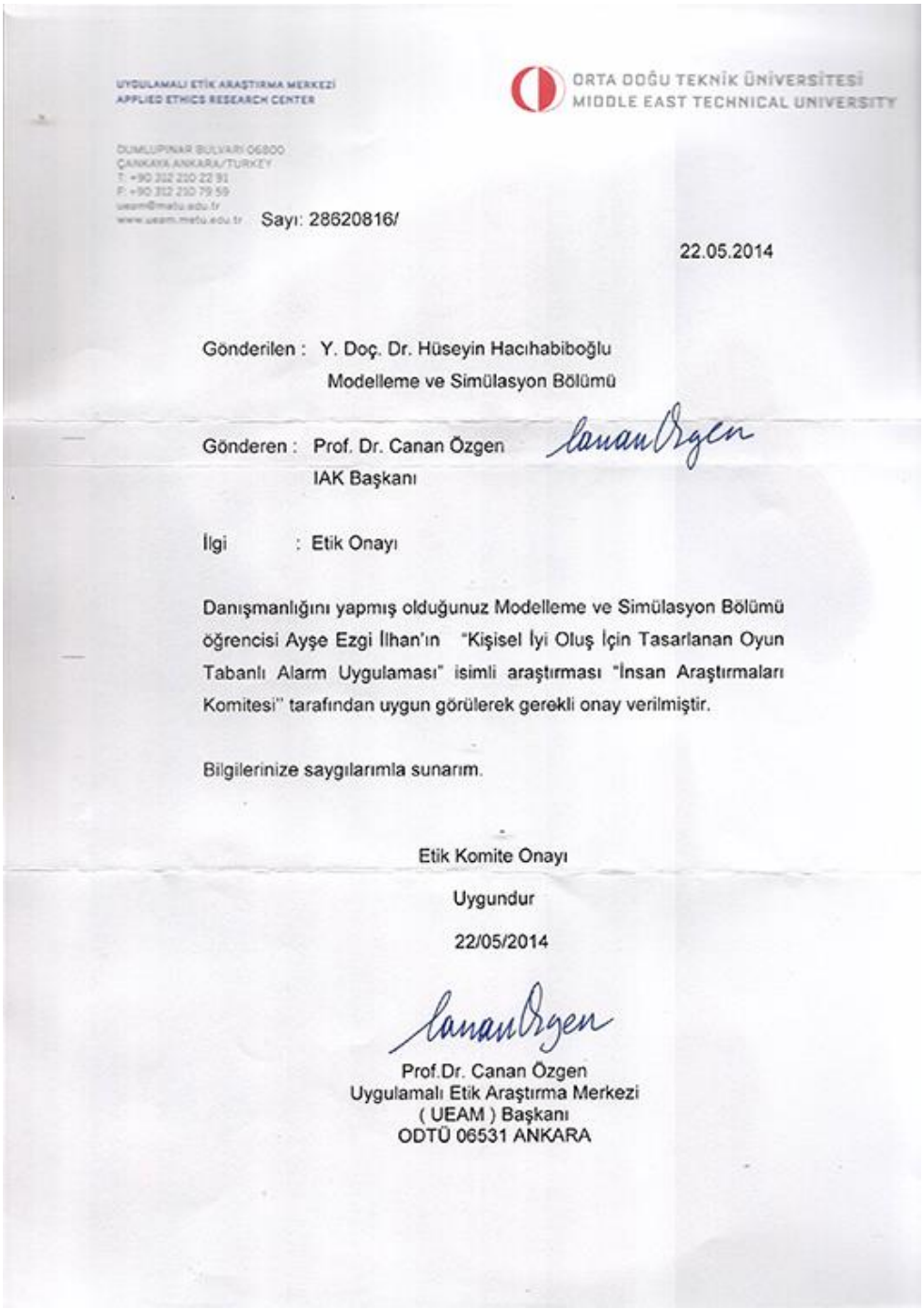
"İyi geceler ☺ Bugün x saat uyuyorsun. Güne daha zinde başlamak için uyku süreni yarın biraz daha uzun tutmaya ne dersin?"

9. When users sleep too long, they get the message:

"İyi geceler ☺ Bugün x saat uyuyorsun. Güne daha zinde başlamak için uyku süreni yarın biraz daha kısa tutmaya ne dersin?"

APPENDIX B - APPROVAL OF METU HUMAN SUBJECTS ETHICS COMMITTEE

Approval of METU Human Subjects Ethics Committee is shown below.



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22.05.2014

Gönderilen : Y. Doç. Dr. Hüseyin Hacıhabiboğlu
Modelleme ve Simülasyon Bölümü

Gönderen : Prof. Dr. Canan Özgen
IAK Başkanı

İlgi : Etik Onayı

Danışmanlığını yapmış olduğunuz Modelleme ve Simülasyon Bölümü öğrencisi Ayşe Ezgi İlhan'ın "Kişisel İyi Oluş İçin Tasarlanan Oyun Tabanlı Alarm Uygulaması" isimli araştırması "İnsan Araştırmaları Komitesi" tarafından uygun görülerek gerekli onay verilmiştir.

Bilgilerinize saygılarımla sunarım.

Etik Komite Onayı

Uygundur

22/05/2014

Prof.Dr. Canan Özgen
Uygulamalı Etik Araştırma Merkezi
(UEAM) Başkanı
ODTÜ 06531 ANKARA

APPENDIX C – PRE-USE QUESTIONNAIRE

Pre-use questionnaire is given below.

Bu çalışma, Ezgi İlhan tarafından yüksek lisans tezi kapsamında yürütülmektedir. Çalışma, oyunlaştırma uygulamalarının, insanların uyku düzeni/uyanma zorluğu üzerindeki etkilerini araştırmayı amaçlamaktadır.

Çalışma hakkında daha fazla bilgi almak için ODTÜ Enformatik Enstitüsü, Modelleme ve Simülasyon Ana Bilim Dalı, Oyun Teknolojileri Yüksek Lisans Programı öğrencisi Ezgi İlhan (Tel:0312 586 87 27 ; E-posta: (ezgikeser@gmail.com)ile iletişime geçebilirsiniz.
Katılımınız için şimdiden teşekkürler.

KULLANICI BİLGİLERİ

AD, SOYAD:	YAŞ:	18-23	24-29	30-35	CİNSİYET:

BÖLÜM 1: Aşağıdaki soruları kısaca cevaplayınız.

Uyku ile ilgili sıkıntılar yaşar mısınız?
Uyanma probleminiz var mı?
Uyanmak için alarm kullanma alışkanlığınız var mı?
Herhangi ciddi bir sağlık probleminiz var mı?
Flappy Bird oyununu daha önce oynadınız mı?
Evet ise: Bu oyunu sever misiniz?
Hayır ise: Platformda ilerleme oyunları (örn. Temple Run) ilginizi çeker mi?

Aşırı yorgun olmadığınız bir günde aşağıdaki durumlarda uykuya dalma olasılığınız nedir? Lütfen her durum için bir puan veriniz.

	Hiç 0	Düşük 1	Orta 2	Yüksek 3
1. Oturur durumda gazete veya kitap okurken				
2. Televizyon seyrederken				
3. Pasif olarak topluluk içinde otururken (örn. tiyatro, toplantı…)				
4. Aralıksız 1 saatlik araç yolculuğu yaparken				
5. Öğleden sonra uzanınca				
6. Alkolsüz bir öğle yemeğinden sonra otururken				
7. Birisi ile konuşurken				
8. Araç kullanırken birkaç dakika trafik durduğunda (örn. kırmızı ışık, kalabalık trafik…)				

BÖLÜM 2: Aşağıdaki soruları sizi en uygun tanımlayacak şekilde cevaplayınız.

1. Genellikle gece saat kaçta uyursunuz?					
Hafta içi					
Hafta sonu					
2. Genellikle sabah saat kaçta uyanırsınız?					
Hafta içi					
Hafta sonu					
3. Geceleri ortalama uyku süreniz ne kadardır? (yatakta geçirilen süre hariç uyku süresi)					
4. Genellikle kaçta işte/okulda olmanız gerekir?	7:00-8:00	8:00-9:00	9:00-10:00	10:00-11:00	Daha geç
5. Uyanırken çalan alarmı erteler misiniz?	Sürekli	Çok sık	Bazen	Nadiren	Hiç bir zaman
6. Alarmı genellikle kaç kez ertelersiniz?	Bir kez	İki kez	Üç kez	Dört kez	Daha fazla

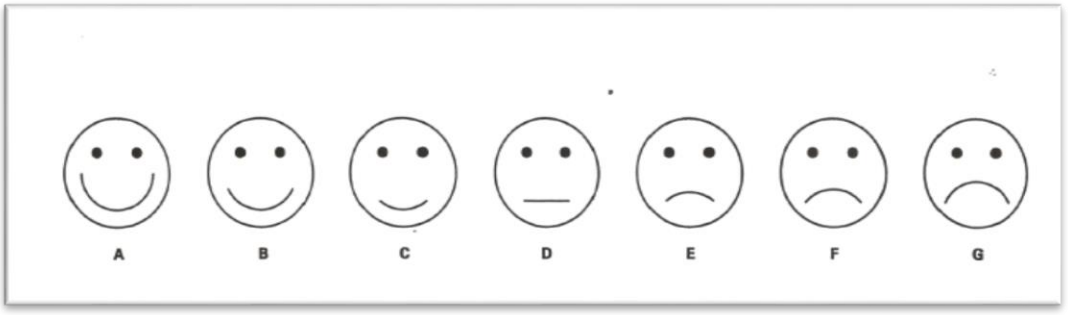
BÖLÜM 3: Lütfen aşağıdaki sorularda size en uygun seçeneği daire içerisine alınız.

1. Sabahları yataktan kalkmak size ne kadar kolay gelir?	Asla kolay gelmez	Çok kolay gelmez	Emin değilim	Oldukça kolay gelir	Çok kolay gelir
2. Oyun tabanlı bir alarm uygulaması daha kolay uyanmanızı sağlar mı?	Asla sağlamaz	Çok sağlayamaz	Emin değilim	Bir parça sağlar	Mutlaka sağlar
3. Sabahları kalktıktan sonraki ilk bir saat içinde kendinizi ne kadar canlı ve uyanık hissedersiniz?	Asla canlı hissetmem	Hafif canlı hissederim	Emin değilim	Oldukça canlı hissederim	Çok canlı hissederim
4. Sabahları kalktıktan sonraki ilk bir saat içinde kendinizi ne kadar yorgun hissedersiniz?	Çok yorgun	Oldukça yorgun	Biraz dinlenmiş	Oldukça dinlenmiş	Çok dinlenmiş
5. Güne doğru zamanda başlandığında iyi hissedileceğine inanır mısınız?	Asla inanmam	Çok inanmam	Emin değilim	Oldukça inanırım	Çok inanırım
6. Oyun tabanlı bir alarm uygulaması sizi güne başlamak için ne kadar motive edebilir?	Asla edemez	Çok edemez	Emin değilim	Bir parça edebilir	Mutlaka edecektir

APPENDIX D – POST-USE QUESTIONNAIRE

Post-use questionnaire is given below.

BÖLÜM 1: Bu uygulama ile güne başlamak size nasıl hissettirdi? Lütfen aşağıdaki yüz ifadelerinden size en yakın geleni işaretleyiniz.



BÖLÜM 2: Uygulama size birtakım yeni farkındalıklar kazandırmayı sağladı mı? Bu doğrultuda aşağıdaki yargıları puanlayınız.

	Hiç 1	Çok az 2	Biraz 3	Çok 4	Fazlasıyla 5
1. Güne başlama saatlerime dikkat etmeye başladım.					
2. Uyku süreme dikkat etmeye başladım.					
3. İşim veya dersim başlamadan önce doğru zamanda uyanmaya dikkat etmeye başladım.					
4. Alarm erteleme sayılarıma dikkat etmeye başladım.					

BÖLÜM 3: Uygulamayı kullandığınız süreyi düşünerek, aşağıda yer alan yargılar için size en yakın gelen ifadeyi işaretleyiniz.

	Kesinlikle katılmıyorum 1	*Katılmıyorum 2*	*Emin değilim 3*	*Katılıyorum 4*	*Kesinlikle katılıyorum 5*
1. Sabahları doğru zamanda yataktan kalkabildim.					
2. Bu uygulama daha kolay uyanmamı sağladı.					
3. Sabahları kalktıktan sonra kendimi çok canlı ve uyanık hissettim.					
4. Sabahları kalktıktan sonra kendimi çok dinlenmiş hissettim.					
5. Güne doğru zamanda başladığım için kendimi iyi hissettim.					
6. Bu uygulama beni güne başlamak için motive etti.					

BÖLÜM 4: Aşağıda yer alan sorular için lütfen hislerinizi ve iletmek istediğiniz düşüncelerinizi yazınız.

1. Sizce oyun tabanlı bir uygulama ile uyanma alışkanlıkları uzun vadede değiştirilebilir mi? Lütfen düşüncenizi kısaca açıklayınız.

2. Bu uygulama doğru uyanma zamanı/uyku süresi ile ilgili bilmediğiniz bir şey öğrenmenize yardımcı oldu mu? Lütfen düşüncenizi kısaca açıklayınız.

3. Bu uygulamaya ne eklense mutlu olurdunuz? (Birden fazla seçenek işaretleyebilirsiniz.)

☐ Oyun ☐ İnternet bağlantısı ☐ Sosyal platform ☐ Level

☐ Farklı mekanlar ☐ Farklı karakterler ☐ Farklı sesler ☐ Ödül

Diğer(Lütfen belirtiniz)..... ....

4. Uygulamanın sevdiğiniz özellikleri varsa lütfen açıklayınız.

5. Uygulamanın özellikle beğenMEdiğiniz/geliştirilebileceğini düşündüğünüz özellikleri varsa lütfen açıklayınız.