THE EFFECT OF GAMIFIED INSTRUCTION ABOUT COMPUTER TECHNOLOGY TERMS ON UNDERGRADUATE STUDENTS' ACHIEVEMENT

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ABSTRACT

THE EFFECT OF GAMIFIED INSTRUCTION ABOUT COMPUTER TECHNOLOGY TERMS ON UNDERGRADUATE STUDENTS' ACHIEVEMENT

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The purpose of this study is to find out how gamified instruction affects the undergraduate learners' achievement in computer technology terms. The study designed as experimental study. For this study, 34 first year undergraduate students from Department of Computer Education and Instructional Technology at Middle East Technical University were selected. In this study, randomized posttest-only control group design was used to control testing threat to internal validity. Gamified and nongamified groups were randomly assigned to make groups equivalent. In this study, midterm exam as posttest and online activities' scores were used as instrument for achievement.

The data were collected by using online activities during treatment and midterm exam as posttest at the end of the semester. Quantitative statistical analyzing methods were used to analyze the data. Results showed that students in gamified and nongamified groups had same level of achievement on online activities and midterm exam.

Keywords: Gamification, Gamified, Nongamified, Game Design, The Effect of Gamification, Achievement

ÖZ

OYUNLAŞTIRILMIŞ ÖĞRETİMİN BİRİNCİ SINIF LİSANS ÖĞRENCİLERİNİN BİLGİSAYAR TEKNOLOJİSİ TERİMLERİNDEKİ BAŞARISINA ETKİSİ

Mizam, Nigar
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Bu çalışmanın amacı, oyunlaştırılmış öğretimin lisans öğrencilerinin bilgisayar teknolojisi terimlerindeki başarısını nasıl etkilediğini öğrenmektir. Çalışmada araştırma deseni olarak deneysel çalışma yöntemi kullanılmıştır. Bu çalışma için, Orta Doğu Teknik Üniversitesi, Bilgisayar ve Eğitim Teknolojileri Eğitimi Bölümü öğrencilerinden 34 birinci sınıf lisans öğrencisi seçilmiştir. Bu çalışmada, iç geçerliliği korumak için yansız atamalı son test kontrol grup modeli kullanılmıştır. Grupların eş değerliğini sağlamak için oyunlaştırılmış ve oyunlaştırılmamış gruplar yansız atama ile oluşturulmuştur. Bu çalışmada, dersin vize sınavı ve çevrimiçi etkinliklerden alınan notlar başarı için ölçüm aracı olarak kullanılmıştır.

Veriler ders süresince çevrimiçi etkinliklerden ve ders sonunda vize sınavıyla toplanmıştır. Verilerin analizinde istatistiksel analiz yöntemi kullanılmıştır. Sonuçlar oyunlaştırılmış ve oyunlaştırılmamış gruplardaki öğrencilerin başarısının aynı seviyede olduğunu göstermiştir.

Anahtar Kelimeler: Oyunlaştırma, Oyunlaştırılmış, Oyunlaştırılmamış, Başarı, Oyunlaştırmanın Etkisi

To my mom

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CEIT: Computer Education and Instructional Technology

GPA: Grade Point Average

METU: Middle East Technical University

SPSS: Statistical Package for Social Sciences

CHAPTER 1

INTRODUCTION

This study is conducted to determine the impact of gamification on level of students' achievement in computer technology terms. This chapter will cover background of the study, problem statement, purpose of the study, definitions of terms, significance of the study, research question, and research hypotheses.

1.1. Background of the Study

In the ever-growing technology, accessing information is a part of humans' daily life because of availability of resources via Internet at any time. While limitless and effortless access of information anytime and anywhere makes information insignificant, the way of presenting it and making it valuable for learners gain importance. Thus, setting goals might make information valuable for achievement. Based on Bandura's social cognitive theory (1986), requirements of personal success are specified by personal goals. According to provided substantial evidence by Locke and Latham (as cited in Zimmerman, Bandura, & Martinez-Pons, 1992), external goals can influence internal goals, which are personal. Many students prefer spending time on playing games more than learning because game design elements such as level, score, leaderboard, and achievement set clear goals for players (De-Marcos, Domínguez, Saenz-De-Navarrete, & Pagés, 2014; Aji & Napitupulu, 2018). At this point, gamification can take place because it aims to achieve organizational and personal goals by applying game design elements (Orosco, 2014). Thus, it can be concluded that gamification has a potential to serve learners the advantages of game by setting clear goals.

On the other hand, new generation reads less and has less attention (Xiang, Ann, Huiand, & Yew, 2014). So as a matter of fact that new generation's expectations on

learning are being engaging and interesting (Xiang et al., 2014). Because of new generation's lack of reading and attention, it gains importance to serve their expectation about learning. Besides, motivation and engagement in learning process are essential since they are accepted as major components in education (Chen, Burton, Mihaela, & Whittinghill, 2015). Furthermore, Kapp (2012) states that gamification "provides the learner with an engaging, relevant learning experience without the heavy time commitment necessary to play most games" (p. 66). Besides, gamification provides significant acceleration and enhancement on the experience of learning (Orosco, 2014). Moreover, gamification is powerful for capturing attention, engaging in an aimed activity (Kim, 2015b, p. 20).

Studies reveal that gamification serves new generation's expectations about learning by motivating learners and engaging them in the target activity and additionally the requirements of personal success are fulfilled by setting clear goals with game design elements (Aji & Napitupulu, 2018; De-Marcos et al., 2014; Kim, 2015a). According to a meta-analysis, there is positive relationship between engagement and achievement (Lei, Cui, & Zhou, 2018). In addition to the relationship between engagement and achievement, motivation -an important predictor of success- also affects achievement (Özhan & Kocadere, 2019; Zheng & Li, 2016). Furthermore, achievement is one of the indicators for the success of used method (Lei et al., 2018). The potential of gamification to increase achievement by being engaging and interesting has been stated by several studies (De-Marcos et al., 2014; Hamari et al., 2014; Kapp, 2012; Kim, 2015b; Orosco, 2014).

1.2. Problem Statement

Gamification in education positively affects achievement and students' attitudes towards lesson with enhancing attentiveness and motivation through using game design elements (Yıldırım & Şen, 2019). The potential of gamification to increase achievement makes it convenient to use in education. Even though there are studies that state gamification significantly promote students' achievement (Fabricatore & Lopez, 2014; Mackinnon et al., 2015; Rouse, 2013; Su & Cheng, 2015; Şahin & Namlı, 2016; Yıldırım, 2017), there are also studies that state the opposite, concluding that gamification has no effect on achievement (Aji & Napitupulu, 2018; Chorney Alan, 2012; Jacobs, 2016; Leaning, 2015). In other words, results of the conducted studies are inconsistent about the effect of gamification on achievement. This inconsistency between the study results in the literature points to necessity of conducting further researches in terms of students' achievement.

1.3. Purpose of the Study

The purpose of this study is to investigate the effect of gamification on students' level of achievement at second part of Information Technology in Education II course. More precisely, this study aims to determine if the use of gamification as an instructional method at computer technology terms subject increases students' level of achievement by comparing scores on posttests and online activities of students exposed to gamified learning environment and those exposed to nongamified learning environment.

1.4. Research Question

This research intends to answer the following question regarding to the effect of gamification about computer technology terms on undergraduate students.

> What is the effect of gamification on students' level of achievement in computer technology terms as a content of Information Technology in Education II course?

a) Is there a statistically significant difference between the students' level of achievement on online activities exposed to gamified versus those nongamified educational settings in computer technology terms?
b) Is there a statistically significant difference between the students' level of achievement on midterm exam as posttest exposed to gamified versus those nongamified educational settings in computer technology terms?

1.5. Research Hypotheses

H1: There is a statistically significant difference between the students' level of achievement on online activities exposed to gamified versus those nongamified educational settings in computer technology terms.

H2: There is a statistically significant difference between the students' level of achievement on midterm exam as posttest exposed to gamified versus those nongamified educational settings in computer technology terms.

1.6. Significance of the Study

Gamification term first showed up in 2012 by Nick Pelling, a computer scientist (Leaning, 2015) and did not become well-known before the second half of 2010 (Deterding, Dixo, Khale, & Nacke, 2011). Gamification as a research topic become popular in education after 2010. According to a meta-analysis study implemented by Yıldırım & Şen (2019), only the 45 studies were investigating the effects of gamification on achievement between 2010 and 2017. Besides, there is inconsistency for achievement between the study results in the literature. Thus, this study will aiming to contribute to the literature by conducting a further research on students' achievement.

A review of empirical literature for gamification of education and learning by Majuri, Koivisto, and Hamari (2018) states that experimental study design was used by only 28 out of 91 studies. It might be concluded that more experimental studies would be worthwhile to minimize the inconsistency between the study results based on achievement and to examine the effect on achievement at different levels, at different

environments and in different educational settings. Thus, this study will contribute to the literature by the use of experimental design for gamification's effect on achievement. Additionally, this study will contribute to the literature by being first study that is conducted at Middle East Technical University as one of Turkey's prestigious universities by examining the effect of gamification on achievement.

1.7. Definitions of Terms

Gamification: The process of adding game design elements to instructional design (Orosco, 2014).

Game ***mechanics*** such as constraints, emotions, narrative, relationships, and progression are high-level components that need to be considered and managed, but not directly implemented in the process (Wood & Reiners, 2015).

Game ***dynamics*** such as challenges, feedback, rewards, competition, and cooperation are basic processes that operate forward action and generate engagement (Wood & Reiners, 2015).

Game ***components*** such achievements, badges, boss fights, collections, content unlocking, gifting, leaderboards, levels, points, quests, social graphs, teams, and virtual goods are more-specific forms of mechanics or dynamics (Wood & Reiners, 2015).

Blended Learning: A hybrid teaching methodology that combines e-learning and traditional classroom method (Olejarczuk, 2014).

Achievement: The students' score at completed online activities and taken exam after studying a course unit.

Moodle: An online learning platform.

CHAPTER 2

LITERATURE REVIEW

The purpose of this study is to determine the effect of gamification on level of achievement in computer technology terms. This chapter will comprise the use of gamification in education, the use of game design elements in non-game context, and the relationship between gamification and achievement.

2.1. Gamification

Before gamification, serious games and game-based learning were aroused for the use of game advantages in training and education. Serious games, also called educational games and training games (Landers, 2014), are used for different purposes such as training and learning, raising awareness, and having healthy life (Hutchison, 2014). Serious games are game designs that intend achieving a purpose rather than the pure entertainment like in the game (Deterding, Dixo, et al., 2011). Additionally, game-based learning are used in different areas such as education, health, military, politics, and business. In the game-based learning, games with "clearly defined learning outcomes through the medium of play" (Felicia, 2014) are used to educate or train people. Both serious games and game based learning are based on using whole game or game experience or game design to educate. When it is thought the required time and effort to design a game for every essential topic to use advantages of game in educational settings, using serious games and game based learning become difficult. At this point, gamification takes place since it takes the advantages of game by using game design elements in non-game context (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011). In other words, a whole game is not required in gamification, which makes gamification feasible to implement in different areas to educate or train people.

To understand gamification, game should be comprehended since gamification is the use of game design elements in non-game concepts. Jesper Juul as a game designer and theorist analyzed several definitions and congregated in one definition; "A game is a rule-based formal system with a variable and quantifiable outcome, where different outcomes are assigned different values, the player exerts effort in order to influence the outcome, the player feels attached to the outcome, and the consequences of the activity are optional and negotiable." (Juul, 2003, p. 35). There are 6 points in the game definition of Juul:

1) *Fixed rules:* The rule of the game should be well defined not to cause any misunderstanding, confusion, and conflict.
2) *Variable and quantifiable outcome:* The game should provide variable outcomes as results of the rules. In addition, those variable outcomes should be quantifiable in order to not cause any disagreement among the players.
3) *Valorization of the outcome:* Different values should be assigned to different potential outcomes to provide challenge. In other words, some possible outcomes should be better than the others.
4) *Player effort:* The players attempt to influence the outcome and to achieve the best possible ones among potential outcomes.
5) *Attachment of the player to the outcome:* Psychological attachment to the outcome is occurred according to their types. The positive outcomes create happy attachment for the player while the negative ones create unhappy attachment.
6) *Negotiable consequences:* "The same game [set of rules] can be played with or without real-life consequences." (Juul, 2003, p. 35).

Moreover, difference between game and play should be clearly perceived to comprehend gamification. According to Caillois' concept, play activities have two sides: paidia and ludus. "Whereas *paidia* (or "playing") denotes a more freeform, expressive, improvisational, even "tumultuous" recombination of behaviors and

meanings, *ludus* (or "gaming") captures playing structured by rules and competitive strife toward goals" (as cited in Deterding, Dixon, Khaled, & Nacke, 2011, p. 11). Thus, game has rules, levels, challenges, and complexity while play usually does not have rules, is more freeform. Additionally, play is open-ended but a game must have an end or more than one end according to its design. On the other hand, play has some similar goals to the game such as spending time and having enjoyable moment.

A model has developed to clearly understand the distinction among game, gamification, and other subjects by Deterding et al. (2011) (see Figure 2.1). One axis represents to differentiate whole and part -the use of game elements-. The other axis represents to differentiate play and games. A whole game experience is not offered in gamification but game design elements used in it. Thus, the whole game experience is used in games to achieve goals while some elements are used in gamification. The difference between gamification and play is explicit since gamification has specific goal, rules, restrictions, and challenges for goals.

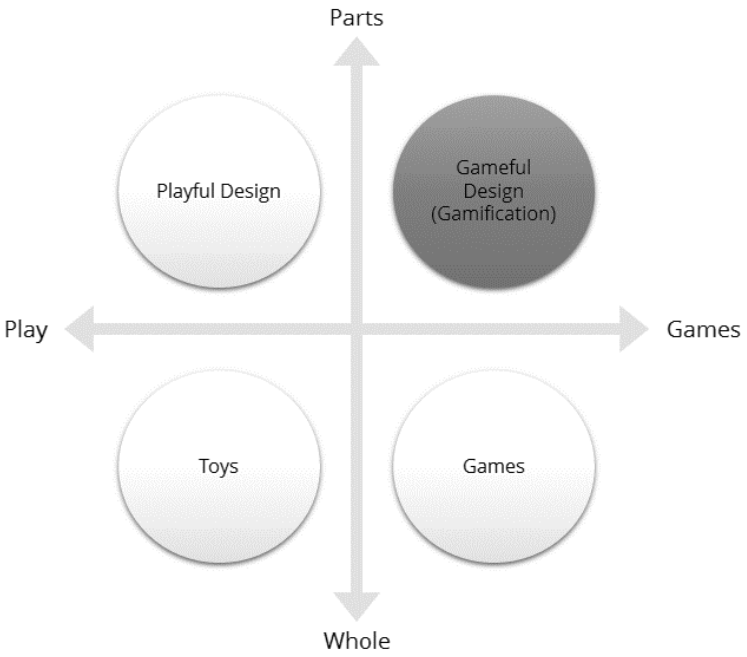

Figure 2.1. "Gamification" between game and play, whole and parts. Adapted from "Gamification: Toward a definition" by S. Deterding, D. Dixon, R. Khaled, and L. Nacke, 2011, Proceedings of CHI 2011 Workshop Gamification, 7-12, p.2, Copyright 2011 by CHI.

2.2. Game Design Elements in Non-Game Context

When the general definition of the gamification is analyzed, applying gamification requires use of game design elements. According to a model of game design elements provided by Werbach and Hunter, the game design elements for gamification are gathered in three categories (see Table 2.1); dynamics, mechanics, and components (as cited in Wood & Reiners, 2015). "Gamification relies on a very careful consideration of key elements with respect to the individual applicant. Gamification is only successful if the key elements join and run in unity in favor of the user" (Wood & Reiners, 2015, p. 3041). Thus, the elements in those three categories are essential to achieve learning objectives.

Table 2.1. *Categories of Elements (Based on Werbach & Hunter, 2012)*

Category	*Definition*	*Elements*
Dynamics	High-level components that need to be considered and managed, but not directly implemented.	Constraints, emotions, narrative, progression, relationships
Mechanics	Basic processes that operate the action forward and generate engagement.	Challenges, chance, competition, cooperation, feedback, resource acquisition, rewards, transactions, turns, win states
Components	More-specific forms of mechanics or dynamics.	Achievements, avatars, badges, boss fights, collections, combat, content unlocking, gifting, leaderboards, levels, points, quests, social graphs, teams, virtual goods

2.2.1. Elements of Dynamics Category

Dynamics are the most abstract elements in games. The elements of dynamics category can be met in a game; however, direct integration of elements in this category is not possible. Thus, it requires to intent usage of components and mechanics to implement dynamics (Wood & Reiners, 2015).

Constraints are driving a play in a specific way by informing the players for the boundaries of the game.

Emotions are serving the players in the game to have emotional experiences such as competition, curiosity.

Narrative is to provide meaning for interactions and adventures of the players by implementing an ongoing story and context.

Progression is supporting the feeling of the players in their development in the game.

Relationships are crating attachments in the players emotionally by variety of interaction.

2.2.2. Elements of Mechanics Category

Mechanics are more abstract than components and more concrete than dynamics for basic processes that operate the action forward and generate engagement. Basically, mechanics are to guide the players, define potential actions, the game progress, and possible reactions. Elements of dynamics can be met by the use of mechanics (Wood & Reiners, 2015).

Challenges require players' determination and great effort to complete.

Chance is possibility of attaining something such as virtual goods, points, quests, hint, and turns in the game.

Competition is a situation in which a player or a group of players trying to win or be more successful.

Cooperation is players or groups of players cooperate for a particular objective that cannot be done alone.

Feedback is provided to allow players to monitor how they are doing with messages, leaderboards, badges, virtual goods or some other displays.

Resource Acquisition is collecting items as supply to use as vital for an objectives, challenges, or competition etc.

Rewards are given to the players in exchange for reaching a goal, completing a challenge or competition.

Transactions allows players resources trading.

Turns are given to the players to perform action.

Win States are defined condition that specify successful completion of a pre-determined goal within a game or level.

2.2.3. Elements of Components Category

Components are more-specific forms of mechanics or dynamics. The intention and purpose specify the selection of components according to target group. Elements of dynamics and some elements of mechanics can be met by the use of elements from components category (Wood & Reiners, 2015).

Achievements are the goals that indicate milestones, which are needed to be achieved by the players, in narrative.

Avatars are the visual representations, with an icon or figure, of the players.

Badges are used to represent success, and defined achievements with visuals for the players.

Boss Fights are experienced as hardest challenges at the end of a stage, section, or level in the game with a character controlled by the machine.

Collections are any kind of things such as items and badges that are collected by the players during the game.

Combat are the battles, fights, actions against to the opponent player.

Content Unlocking is used to present content by unlocking it according to defined difficult or unique actions.

Gifting is used to enable the players to share and give collections to each other.

Leaderboards are basically the lists to display players' success by ranking them according to number of skills, levels, points, badges, collected items etc.

Levels basically represent difficulty that players have achieved as separate sections, steps or part of the game.

Points are representations of the players success in numeric.

Quests are objectives needed to be completed by a player or a group of players in order to earn reward.

Social Graphs are the representation of the players' social connection in the game.

Teams are the groups of players that comes together to complete a common objective.

Virtual Goods are the valuable items, may provide advantage to a player, or may help to distinguish the player from others.

2.3. Gamification in Education

Gamification can serve different purposes such as engagement, motivation, and achievement if components, mechanics and dynamics join and run by considering intention (Reiners & Wood, 2015). The potential of gamification makes the use of gamification desirable in different areas such as business, health, and politics. Education is one of these areas. In the gamification, goals are achieved by engaging people, motivating action, and promoting learning through game design elements

(Kapp, 2012). Gamification is applied in education by the use of game design elements in educational settings.

> *"Gamification is often seen as a way to motivate people to do something they are not intrinsically motivated to do. In the gamification course, for instance, students were rewarded with points and badges for their progress, but playing a game is not (only) about earning points and badges. In particular, games sharpen players' curiosity, challenge them, present a situation through a perspective other than the players' own (via an avatar), and let the player experience a story and act it out (Kapp 2012). ... games provide continuous feedback and a response to the individual's progress. In relation to learning, it is useful to understand gamification as an approach that uses game-based mechanics, and aesthetics and that employs game thinking to engage users, motivate action, encourage learning and promote problem solving (Kapp 2012)." (Ejsing-Duun & Karoff, 2014, p. 94).*

As specified above quotation, gamification motivates people by rewarding points and badges. However, gamification should not be only about earning points and badges; it should arouse curiosity, challenge users, let user have experience, provide continuous feedback. However, it is not clear that which features should be used to gamify a learning experience in advance (Apostol, Zaharescu, & Alexe, 2013). Thus, Kim (2015a) states that setting a clear goal, analyzing target group and considering user types, suitability of gamification elements in the learning content, and considering other variables such as gender, age, and academic performance are essential to design gamification in the right way. In addition, an instructional designer should take the objectives and outcomes into consideration while selecting gamification elements (Apostol et al., 2013). Moreover, Xiang et al. (2014) refer to the significance of gamification processes in education. The processes are listed as (1) understanding the target audience and the context, (2) defining learning objectives, (3) structuring the experience, (4) identifying resources, and (5) applying gamification elements. Thus, the listed processes and the essential points of designing gamification in the right way

according to Kim demonstrates that gamification is not only about earning points and badges. However, “gamification, when applied carefully, leads to learner engagement. It turns disconnected, bored learners into engaged participants” (Kapp, 2012, p. 68).

2.3.1. Gamification for Achievement

Achievement as one of the demonstrators of success for used method (Lei et al., 2018) is affected positively by gamification (Şahin & Namlı, 2016). According to experimental study of Yu, Yu, Fan, and Wang (2014), computer game-based instruction improves achievements. Moreover, the proper use of game design elements for gamification might improve achievement as well. According to result of conducted study by Fabricatore and Lopez (2014), more than half of the participants in the Using Gameplay Patterns to Gamify Learning Experiences research attained high level achievement by gamification even though students expression about a high number of activities were challenging. Jacobs' study (2016) might assist in understanding how achievement is affected by some game design elements. Different game design elements; unlimited lives, badging, and unlocking separately was used for two different groups. According to the results of the study, badge section scored lover than the unlocking section. This might be because of that students took quizzes more than once to earn required score to move forward. As it is understood, different game design elements have different effect on achievement. As Ejsing-Duun and Karoff (2014) states gamification should be about more than earning points and badges. In other words, while implementing gamification in education, recommended processes should be taken into consideration as it is mentioned under the 2.3. Gamification in Education title.

Studies for the effect of gamification on achievement were conducted at different levels and in different learning environments. According to a meta-analysis study conducted by Yıldırım and Şen (2019) there is no significant difference between technology-based and non technology-based environments based on the effect of gamification on achievement. The results of the study also states that “gamification is

an applicable design from primary school to university level" (Yıldırım & Şen, 2019, p. 14). Thus, it can be concluded that gamification might have positive effect on achievement at different levels and in different environments.

CHAPTER 3

DESIGN AND METHODOLOGY

This chapter provides information about the procedure and method of the study. This study focused on the effect of gamification on the level of achievement of first year undergraduate students in computer technology terms. The chapter will cover intervention and the study, subjects, instrument, data analysis, assumptions, limitations, and delimitations.

3.1. Intervention

In accordance with focus of the study, two micro courses were conducted by the same course content, which is computer technology terms. The study was performed in the last seven weeks of the second semester at Department of Computer Education and Instructional Technology at Middle East Technical University in Ankara. That is why, it was preferred to name as micro courses because of implementing the study in a short time. Fundamentally, both micro courses comprised blended learning additionally micro course using gamification included also game design elements into blended learning (see Table 2.1). More precisely, game design elements were added to the online side of the blended learning implemented on Moodle, one of the learning management systems, to implement gamification in the micro course.

The micro courses took seven weeks including demo, treatment, and course midterm exam as posttest. First week devoted to demo week, following four weeks were dedicated to main weeks of micro courses and last two weeks were weeks before the midterm exam. First week was practiced as a demo week at computer laboratory to make students ready for making use of online content for studying computer technology terms as course content. The main reason for implementing demo week was to provide students with a chance to be familiar with the online content of the

micro courses. Thus, students had a chance to find out their own way to study by themselves. The purpose of demo week was that students from both micro courses took demo week to have the same chance for practicing main weeks of course. Terms were divided into four different categories: technical, software, internet, and hardware. Once demo week was done, categories with terms was presented to students and available in given time period (see Table 3.1) for online self-study at home. It was planned such that a category content was started to present at the beginning of each week. Last two weeks of micro courses were before the exam therefore all categories were available for two weeks until the course midterm exam for giving students a chance to study. However, the score of last two weeks online activities were not took into consideration for the data analysis because there could be momentous changes in online activities' scores in last two weeks.

Table 3.1. *Micro Courses' Schedules*

Week Number	*Week Plan*	*Given Time Period*
Week 1	Demo	Apr 17 - Apr 24
Week 2	Technical Terms	Apr 24 - May 07
Week 3	Software Terms	May 01 - May 14
Week 4	Internet Terms	May 08 - May 21
Week 5	Hardware Terms	May 15 - May 21
Week 6 - 7	All terms' activities available before the exam	May 21 - June 06

Since main aim of micro courses was to prepare students for midterm exam and both of them based on blended learning that requires online and offline activities, printable electronic documents (see Appendix B) including terms with their detailed definition were available for students on webpages of micro courses. The main aim of documents including terms was to give students a chance to study from written document as offline support. Nongamified micro course had three different levels of quizzes for each week while gamified micro course had three different levels of puzzles as online activities. Three different levels of question pools were prepared for each term

category on Moodle to fulfill three levels of online activities. In other words, Levels in activities were provided by different levels in question pools. To clarify, the same level of activities took random questions for each time from same level of question pool (see Table 3.2). The reason for selection of questions randomly was lack of limitation on the number of doing an activity. Additionally, students were informed for retaking an activity. It was their decision to retake an activity since evaluating policy was average score for each activity. Besides, it was highly recommended to retake to see all questions for terms. On the other hand, levels in activities by different levels question pools was not obvious for students. Different question pools were designed to not exercise same question in different activities. Besides, different levels in question pools were prepared to make students feel improvement in online activities without any visual representation or direct notion.

Table 3.2. *Levels in Online Activities*

Level	*Question Pool*	*Quizzes*	*Puzzles*
Level 1	EASY Terms	Quiz A with Short-Answer	Hangman
Level 2	MEDIUM Terms	Quiz B with Matching type questions	Cyrptex
Level 3	HARD Terms	Quiz C with Matching type questions	Crossword

3.1.1. Online Activities

To give detailed information for equivalent design of puzzles in gamified micro course versus quizzes in nongamified micro course, comparative analysis was highly required. Level 1 named EASY Terms because of consisting basic terms. Hangman and Quiz A with short-answer were designed as corresponding to each other because design of both were to know only one term at once without seeing the name of the term asked (see Figure 3.1). Since the number of letters was obvious in the Hangman and students had chance to guess the name of term from the predicted letter(s), each click on incorrect letter in the Hangman reduced the total score by defined rate.

Besides, there was limited number of guess for the letters of the asking term in the Hangman. Thus, it was tried to make the Hangman and Quiz A with short-answer equivalent to each other through limited number of guess for letters and reducing total score in the Hangman because the numbers of letters in Hangman was obvious.

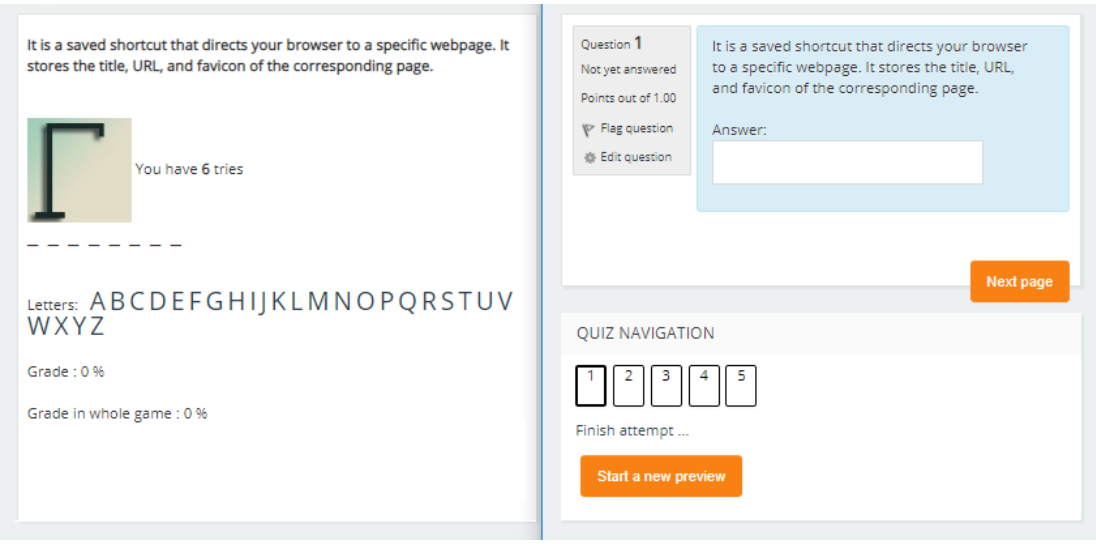

Figure 3.1. Hangman versus Quiz A with Short-Answer

Level 2 named MEDIUM Terms was designed for Cryptex and Quiz B. To illustrate, there was a question pool for Level 2. Both activities took questions from same question pool. Cryptex and Quiz B with matching type questions were designed as equivalent activities to each other through giving three guesses to know each term in the Cyrptex (see Figure 3.2). Since the names of the asking terms were listed obviously in the Quiz B with matching type questions while they were hidden in a cryptex in the Cryptex puzzle, three guesses for each word were provided in the Cryptex. Thus, it was tried to make the Cryptex and Quiz B with matching type questions equivalent to each other through giving three guesses for names of each term in the Cyrptex.

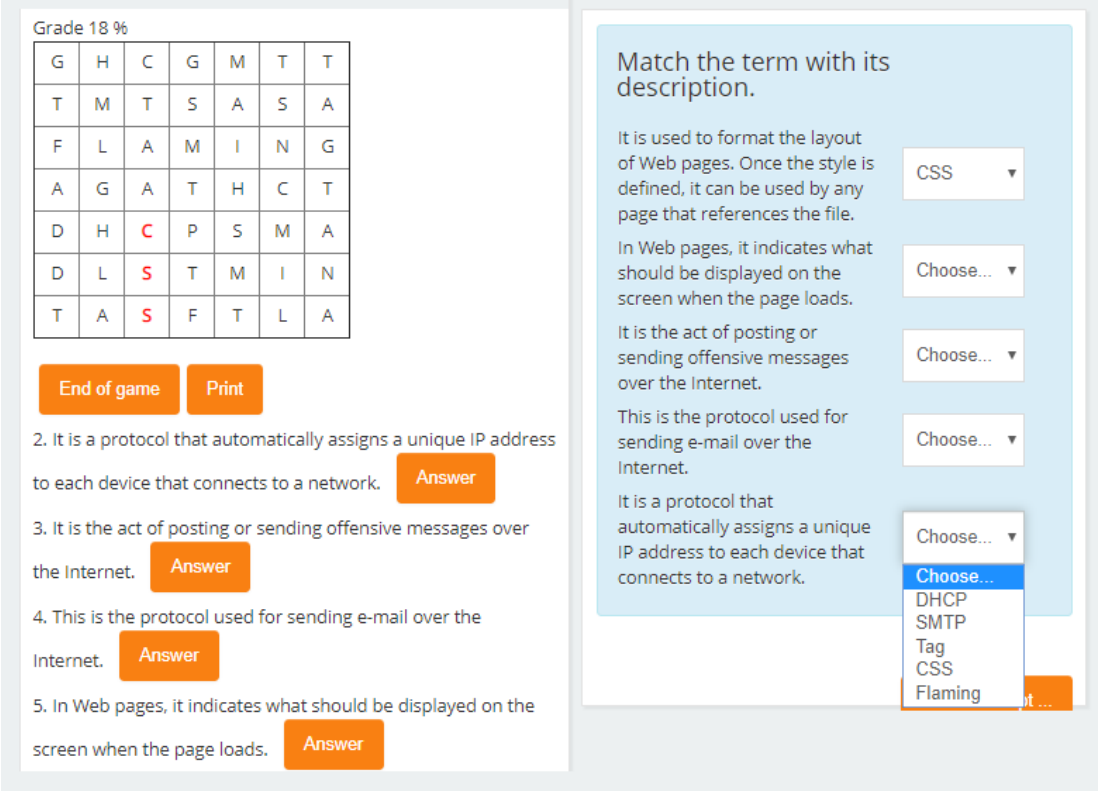

Figure 3.2. Cryptex versus Quiz B with Matching Type Questions

Level 3 named HARD Terms was designed for Crossword and Quiz C. To clarify, there was a question pool for Level 3. Both activities took questions randomly from same question pool. Crossword and Quiz C with matching type questions were accepted as equivalent to each other through their own design (see Figure 3.3). Terms that were been asked were listed obviously in the Quiz C with matching type questions while numbers of letters were obvious and each correct answer helped to guess others in the Crossword. Thus, there was no need to make the Crossword and Quiz C with matching type questions corresponding to each other through any intervention.

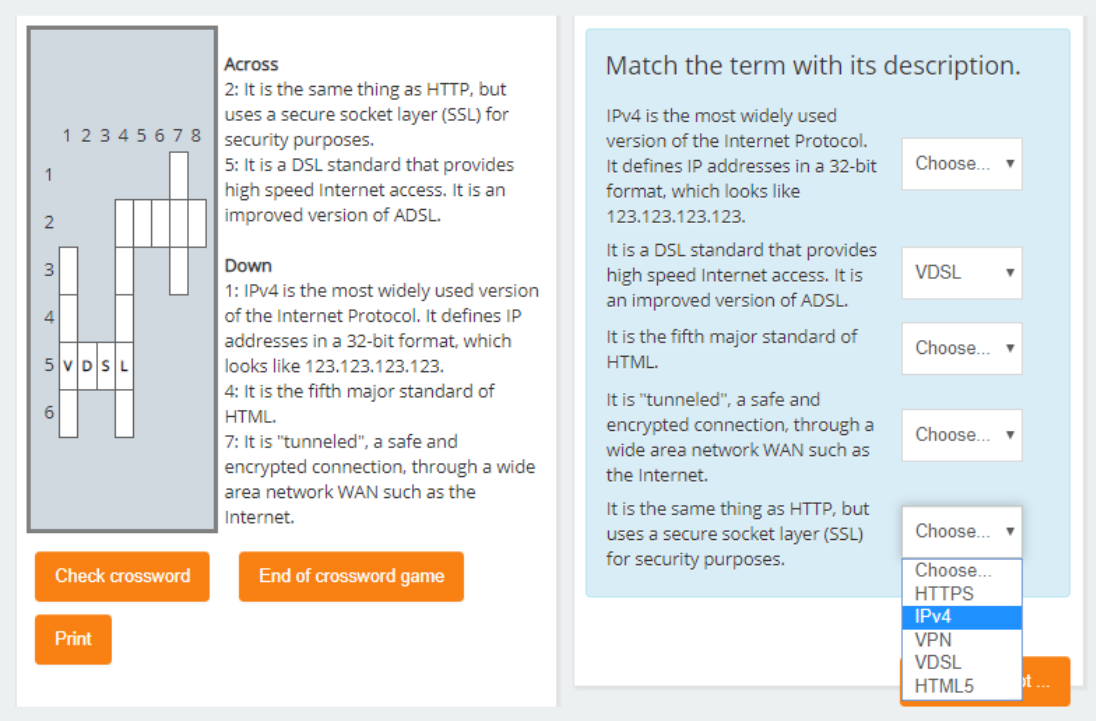

Figure 3.3. Crossword versus Quiz C with Matching Type Question

3.1.2. NonGamified Micro Course

Nongamified micro course was designed for control group including offline documents and online activities such as short answer and matching type quizzes as course content. Each term category had three different levels of and all activities were directly available during their categories' specific weeks.

3.1.3. Gamified Micro Course

Gamified micro course was designed for experimental group including offline documents and online activities such as Hangman, Cyrptex, and Crossword puzzles as course content. Each term category had three different levels of activities and only the first activity was directly available during their category specific time period. It was required to take defined score from first activity to be eligible to do next activity. Likewise, last activity became available to do when defined score was taken from second activity. Requirement of defined score to access next activity was to implement

challenges from mechanics category of game design elements and to cover components category with unlocking (see Figure 3.4)

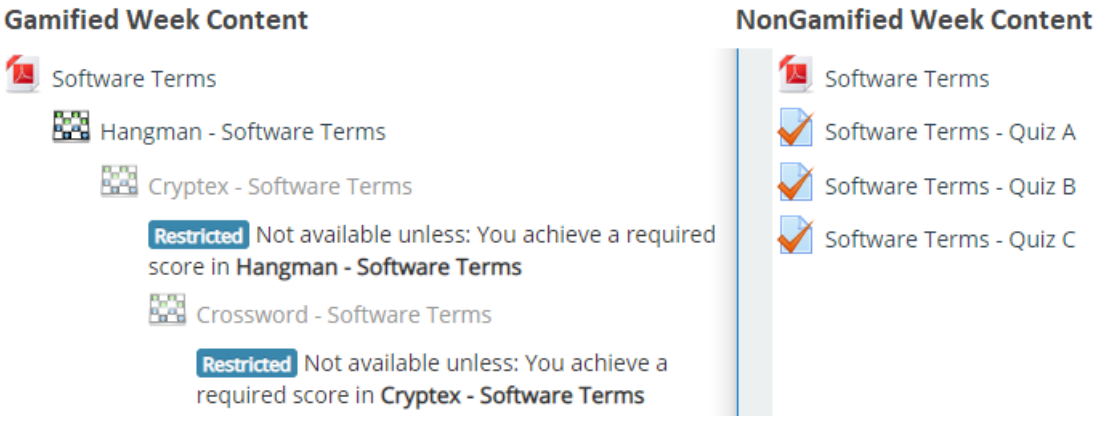

Figure 3.4. Example of Gamified versus NonGamified Week Content View

Achievement element of components and progression element of dynamics were also covered with representation of level with experience points in the gamified micro course for students (see Figure 3.5). There were 10 levels to represent achievement with experience point (see Figure 3.6). Additionally, the required experience points to move to next level was represented visually (see Figure 3.5).

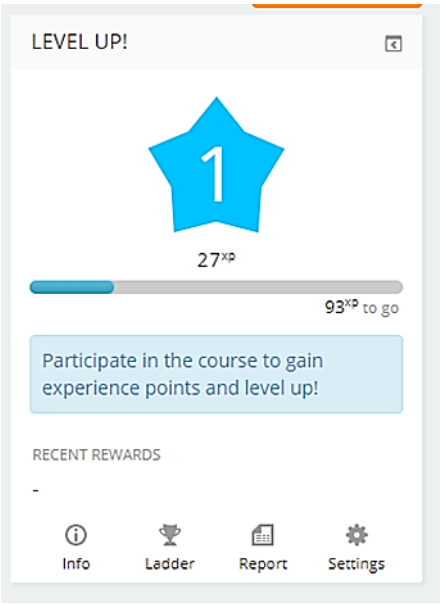

Figure 3.5. Level Up!

Figure 3.6. Levels

Additionally, leaderboards elements of game design was covered by representing leaders with ranking and showing their points weekly, monthly, and general on a board (see Figure 3.7).

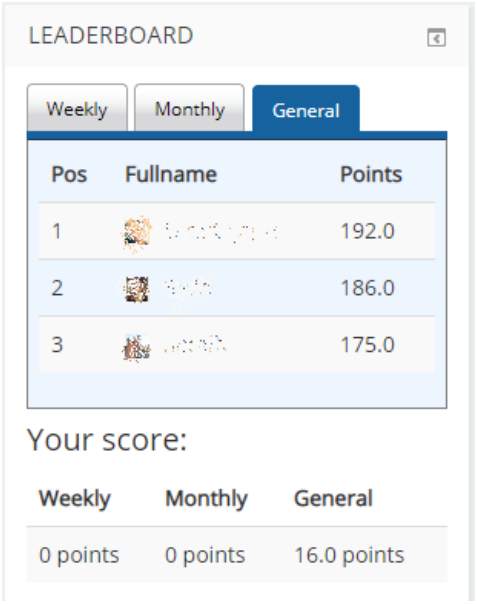

Figure 3.7. Leaderboards

Badges were awarded to students according to completing defined activity. There were two different badges with representing two levels for each category to encourage students to earn badges. First badge of the category represented as having basic knowledge for terms with the shape and name of the badge; Technical Assistant, Internet Associate, Junior Software Developer, and Hardware Officer (see Figure 3.8). Second badge for the category represented as having more than basic knowledge with the shape and name of the badge; Technical Adviser, Internet Expert, Senior Software Developer, and Hardware Manager. Thus, badge element of component category was covered with eight different badges to meet all four different term categories with two different levels of badges in the gamified micro course.

Figure 3.8. Badges for Categories of Terms

3.2. Design of the Study

This study was conducted by the randomized posttest-only control group design with matched subject, which involves two formed groups by random (Fraenkel & Wallen, 2009). Subjects were matched based on their GPA and gender. Each matched pair member was randomly assigned to groups, the control group and the experimental group. The use of random assignment with matching overcame the regression threat, which occurs when the subjects are selected based on low or high performance before the treatment. Subject characteristics such as critical thinking ability and gender were controlled with the use of random assignment with matching. Since individual growth was highly related to critical thinking ability, maturation threat was managed through controlling critical thinking with random assignment. Furthermore, since the study was taken only eight weeks including demo, treatment, and course midterm exam as posttest, maturation was not a potential threat because of implementing the study in a short time.

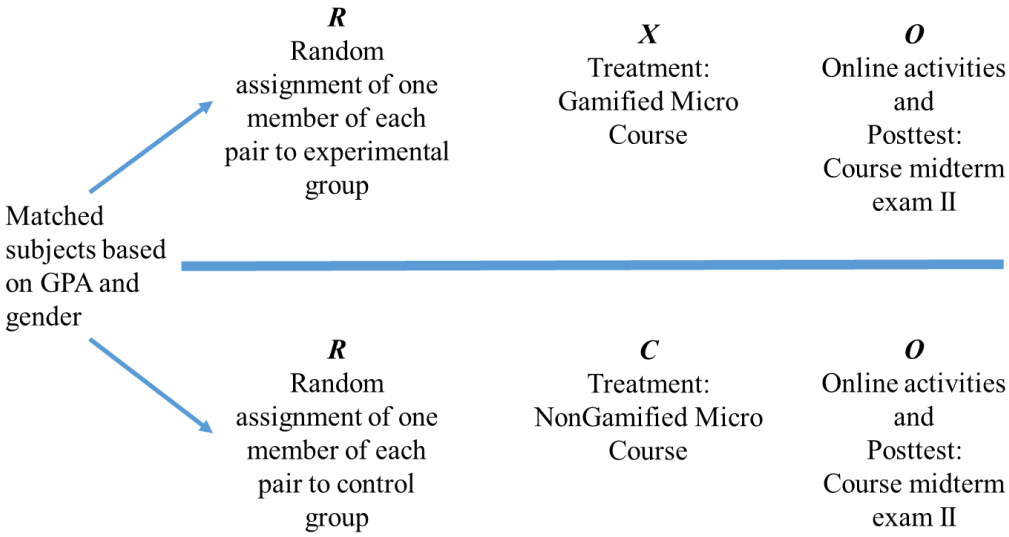

Figure 3.9. Randomized Posttest-Only Control Group Design with Matched Subject

Threat of testing was controlled since subjects in the study were taken posttest only. Since the study was conducted in one university, location was not a threat to internal validity. Moreover, availability of resources for the online micro courses were equivalent; both of them have documents to have opportunity of studying from written document, gamified and nongamified micro courses had online activities such as quizzes and puzzles. Additionally, same level of activities took random questions from the same question pool to prevent inequality in resources. Instrument decay was not a possible threat in the study since multiple choice questions was used in midterm exam as a posttest so scoring procedure was certain and different interpretations of results were not possible for the scorer. Data for the study was collected in two different ways; online micro courses' activities and course midterm exam. Thus, data collector characteristic and bias were not possible threat in this study. On the other hand, history threat was controlled by designing both micro courses with equivalent contents through both having online and offline side, both having documents, both requiring self-study. Moreover, since both micro courses' contents were different from traditional learning design, both groups were exposed to novelty of the treatment. Thus, subject attitude was not a potential threat in the study. Additionally, subject

attitude threat was also controlled by presenting a main aim, studying for midterm exam of the Information Technology in Education II course with micro courses, for both groups. Thus, it was expected from subjects to focus on the studying for midterm exam rather than the treatment. Besides, both educational settings, gamified and nongamified, were implemented by the same teacher, was teacher of the main course. Therefore, implementation was not a possible threat in this study because of implementing methods by the same teacher and of the limited in class implementation.

3.3. Subjects of the Study

The subjects of this study were consist of 34 first year undergraduate students from Information Technology in Education II course of Computer Education and Instructional Technology Department at a public university in Ankara. While selecting sample, background of having same level information on terms in computer technology were taken in consideration. It might safely be assumed that subjects might had the same background level of information about terms in computer technology since it was their second semester at the university. Thus, they might had taken mostly the same first semester must and the prerequisite courses.

In order to state that both groups were equivalent based on GPA scores before the treatment, independent samples t-test was performed (see Appendix C). The results showed that there was no significant difference between the control and experimental groups among the means ($t=0.002$, $df=32$, $p>0.05$). Additionally, there were six female and 11 male subjects in both groups. Thus, groups were thought to be equivalent based on GPA scores before the treatment.

3.4. Data Collection Instruments

Achievement level of control and experimental groups in computer technology terms was compared by course midterm exam score as posttest and online activities' score. As it is stated in detail in the design of courses section, both courses had online side. Thus, score of online activities were used as instrument in this study.

3.4.1. Validity and Reliability

For the validity of the midterm exam as posttest, firstly it was prepared according to the instructional objectives of information about terms in computer technology. Midterm exam consisted of 40 multiple-choice computer technology terms questions by taking the overall percentage of each category into consideration (see Table 3.3). The choices in the questions were determined by identifying distractors from the relevant category. If the corresponding category did not have appropriate distractors, it was chosen from other categories or created a choice to be a distractor (see Appendix D).

Table 3.3. *Number of Questions for Terms Categories in Posttest*

Categories of Terms	*Number of Terms*	*Percentage of Terms*	*Number of Questions*	*Percentage of Questions*
Technical	127	30,90	12	30,00
Software	127	30,90	12	30,00
Internet	95	23,11	10	25,00
Hardware	62	15,09	6	15,00
Total	411	100	40	100

For the validity of the midterm exam, secondly three different expert judgements were obtained. Experts were determined from instructors of the same department of the conducted study in CEIT at METU. Besides, one of the experts was the instructor of the Information Technology in Education II course itself. To obtain expert judgement, a brief information document (see Appendix E), posttest, and documents for each term category with detailed definitions were sent to experts as e-mail. Thus, posttest was improved three times according to expert reviewed before finalized.

For the reliability of midterm exam as posttest, Kuder-Richardson approach was implemented by KR21 reliability coefficient formula that is used when items that are scored right versus wrong (Fraenkel & Wallen, 2009). The reliability estimate of

posttest was 0.95 that is higher than the 0.70, which is acceptable for research purpose. Thus, the reliability of posttest was assured by Kuder-Richardson approach.

For the validity of the online activities, same question pool was used by the equivalent activity for groups. As it was mentioned in Design of Course section, there were three different levels of question pools; easy, medium, and hard for each term category. Easy terms are the basic terms that are commonly used and well-known, hard terms are the advanced terms that are not commonly used, and medium terms are between easy and hard terms. The term difficulty levels were determined by the researcher, who hold B.Sc degree in CEIT, and judged by one expert.

For the reliability, average score for online activities was counted as final score for each online activity since corresponding online activities took random questions from same question bank and each activity can be retaken limitless times by the students. Kuder-Richardson approach was implemented by KR21 reliability coefficient formula for online activities. The reliability estimate of online activities was 0.98 that is higher than the 0.70, which is acceptable for research purpose. Thus, the reliability of online activities was assured by Kuder-Richardson approach.

3.5. Data Analysis

The analysis was performed with the objective to test the following hypotheses:

H1: There is a statistically significant difference between the students' level of achievement on online activities exposed to gamified versus those nongamified educational settings in computer technology terms.

H2: There is a statistically significant difference between the students' level of achievement on midterm exam as posttest exposed to gamified versus those nongamified educational settings in computer technology terms.

In this study, data for control and experimental groups were gathered from online activities and course midterm exam as posttest at the end of the semester. In order to analyze data of the study, SPSS tool was used. To indicate the significance of

differences between the means of the online activities and that of midterm exam results groups, Independent Samples *t*-Test was used in this study (Green & Salkind, 2009). It was conducted to examine whether mean scores of students on online activities and midterm exam exposed to gamified educational settings is significantly higher than mean score of students exposed to nongamified. In other words, *t*-test was conducted to analyze the difference in level of achievement in online activities during treatment between the groups. Likewise, it was used to determine the difference in level of achievement in posttest after treatment between the groups.

3.5.1. Assumptions

The assumptions of this study are as follows

- Knowledge of subjects might safely be assumed to be approximately equivalent for the topic since it is their second semester at university so they might have taken the same must courses and the prerequisite of Information Technology in Education II.
- Subjects attentively completed midterm exam as posttest.
- Potential of subjects suffices to respond with thoroughly reading and thinking on each question.

3.5.2. Limitations

The limitations of this study was the number of subjects and their personal interests. Since there was limited number of students at first year from CEIT at one public university as subjects, making generalized inferences might not be possible. Before making generalized inferences, further research with more subjects from different universities is required.

Two different personal interests, interest in computer technology terms and in game design elements such as badges, levels, leaderboards, of subjects might have impact on the result of posttest and online activities as achievement instruments in this study. Subjects with positive interest in computer technology terms might be eager to learn

terms. Since subjects' interest in game design elements is not measured, subjects' interest of control and experimental groups in game design elements might not be equally distributed. Thus, students' interests might influence the results because of distributing them to groups based on their interests.

3.5.3. Delimitations

- The results of this study will be limited to the school that the university was conducted within second semester of 2016-2017 academic year.
- This study was limited to 34 students from department of CEIT.
- This study was limited to quality of activities prepared by the researcher and the teacher.
- This study was limited to quality of posttest prepared by the researcher and evaluated by three experts in three times.

CHAPTER 4

RESULTS

This chapter provides information about the results of the study in order to examine the effect of gamification on the level of students' achievement in computer technology terms. This chapter will briefly explain descriptive statistics, inferential statistics with achievement level of groups on online activities and midterm exam as posttest

4.1. Descriptive Statistics

In this section, descriptive statistics of the online activities' scores and the posttest scores from midterm exam are presented with means, standard deviations, maximum, and minimum for both experimental and the control groups (see Table 4.1). The data of online activities were gathered from Moodle in the four weeks (see Table 3.1) of spring semester and that of posttest was obtained from midterm II exam of Information Technology in Education II course.

Table 4.1. *Descriptive Statistics of the Posttest and the Online Activities*

Group		*Online Activities*	*Posttest*
1	N	17	17
Experimental	Minimum	0.00	0.00
	Maximum	100.00	77.50
	Mean	55.73	51.92
	Std. Deviation	39.27	26.26
2	N	17	17
Control	Minimum	0.00	0.00
	Maximum	98.75	92.50
	Mean	59.97	53.53
	Std. Deviation	40.32	32.63
Total	N	34	34
	Minimum	0.00	0.00
	Maximum	100.00	92.50
	Mean	57.85	52.72
	Std. Deviation	39.25	29.18

Overall summary of descriptive statistics gathered from the posttest scores and the scores of online activities for both experimental and control groups is represented in Table 4.1.

Table 4.1 shows that the online activities' mean score of the experimental group is 55.73 (SD= 39.27) and that of the control group is 59.97 (SD=40.32) out of 100. In addition, the posttest's mean score of the experimental group is 51.92 (SD= 26.26) and that of the control group is 53.53 (SD=32.63) out of 100.

4.2. Inferential Statistics

The purpose of this study was to examine the effect of gamification on the level of first year undergraduate students' achievement in computer technology terms. Descriptive statistics regarding posttest scores and the online activities scores were indicated in the previous section. Thus, inferential statistics will be represented in this section.

4.2.1. Achievement level of Groups in Different Term Categories from Online Activities

This section was to examine the effect of gamification on the level of subjects' achievement in computer technology terms regarding achievement on online activities in detail by analyzing different term categories on online activities. As it stated before, there were four different term categories: technical, software, internet, and hardware. In other words, subjects took online activities in four different category. Data for online activities was gathered in these categories. In this section, each term category was investigated by conducting independent samples *t*-test.

4.2.1.1. Achievement level of Groups in Technical Terms

To investigate the impact of gamification on technical terms as a section for computer technology terms regarding achievement on online activities for technical terms, independent samples *t*-test was conducted. Before performing independent-sample *t*-test, analyses for assumptions were performed.

Assumption of independent samples is assumed as satisfied since groups were randomly selected from the population and the technical terms' scores as the test variable were independent in this study.

Table 4.2. *Normality of Groups for Achievement in Technical Terms*

Group	Std. Deviation	Skewness	Kurtosis
Experimental	47.77	-0.627	-1.775
Control	44.58	-0.968	-1.179

Assumption of normality should be satisfied to conclude that the test variable in two populations from which the samples are selected is normally distributed (Frederick J Gravetter & Wallnau, 2013). In order to examine normality, skewness and kurtosis values of the test were checked. Assumption of normality for technical terms of both groups is satisfied since values of skewness and kurtosis ranged between -2 and 2 (see Table 4.2)

Assumption of homogeneity in variance should be satisfied in order to state that the test variable for the two populations for comparison have the equal variance (Green & Salkind, 2009). Homogeneity of variance assumption for GPA was checked by Levene's Test for Equality of Variances. As seen in Table 4.3, Levene's test p value was greater than alpha value at the 0.05 level [F (32, 31.848) = .638, p=.430]. Thus, homogeneity of variance assumption was assured for technical terms.

Table 4.3. *Levene's Test for Equality of Variances for Achievement in Technical Terms*

	F	df1	df2	Sig.
Achievement in Technical Terms	0.638	32	31.848	0.430

Since the assumptions of independent samples *t*-test were met, *t*-test was performed to investigate the effect of gamification on technical terms as a section for computer technology terms regarding achievement on online activities for technical terms (see Table 4.4).

Table 4.4. *Independent Samples t-test for Achievement in Technical Terms*

		Technical Terms		Levene's Test				
Group	N	Mean	SD	F	Sig.	t	df	p
Experimental	17	62.24	47.77	0.638	0.430	-0.285	32	0.778
Control	17	66.75	44.58					

The results showed that there was no significant difference between the control and experimental groups among the means (t=0.285, df=32, p>0.05). Thus, there is no statistically significant difference between the control group, exposed to gamified environment, and experimental group, exposed to nongamified environment, technical terms as a section for computer technology terms, regarding achievement level on online activities for technical terms.

4.2.1.2. Achievement level of Groups in Software Terms

To investigate the effect of gamification on software terms as a section for computer technology terms regarding achievement on online activities for software terms, independent samples *t*-test was conducted. Before performing independent-sample *t*-test, analyses for assumptions were performed.

Assumption of independent samples is assumed as satisfied since groups were randomly selected from the population and the software terms score as the test variable were independent in this study.

Table 4.5. *Normality of Groups for Achievement in Software Terms*

Group	Std. Deviation	Skewness	Kurtosis
Experimental	49.69	-0.166	-2.203
Control	48.36	-0.153	-2.183

Assumption of normality for software terms of both groups is not satisfied since values of kurtosis did not ranged between -2 and 2 while values of skewness ranged between -2 and 2 (see Table 4.5)

Assumption of homogeneity in variance for software terms was checked by Levene's Test for Equality of Variances. As seen in Table 4.6, Levene's test p value was greater than alpha value at the 0.05 level [F (32, 31.976) = .340, p=.564]. Thus, homogeneity of variance assumption was assured for software terms.

Table 4.6. *Levene's Test for Equality of Variances for Achievement in Software Terms*

	F	df1	df2	Sig.
Achievement in Software Terms	0.340	32	31.976	0.564

Since the assumption of independent samples and homogeneity in variance met, independent samples *t*-test was performed to investigate the effect of gamification on software terms as a section for computer technology terms regarding achievement on online activities for software terms (see Table 4.7).

Table 4.7. *Independent Samples t-test for Achievement in Software Terms*

		Software Terms		Levene's Test				
Group	N	Mean	SD	F	Sig.	t	df	p
Experimental	17	53.88	49.69	0.340	0.564	0.089	32	0.929
Control	17	52.38	48.36					

The results showed that there was no significant difference between the control and experimental groups among the means (t=0.089, df=32, p>0.05). Thus, there is no statistically significant difference between the control group, exposed to nongamified environment, and experimental group, exposed to gamified environment, software

terms as a section for computer technology terms, regarding achievement level on online activities for software terms.

4.2.1.3. Achievement level of Groups in Internet Terms

To investigate the effect of gamification on internet terms as a section for computer technology terms regarding achievement on online activities for internet terms, independent samples *t*-test was conducted. Before performing independent-sample *t*-test, analyses for assumptions were performed.

Assumption of independent samples is assumed as satisfied since groups were randomly selected from the population and the internet terms' scores as the test variable were independent in this study.

Table 4.8. *Normality of Groups for Achievement in Internet Terms*

Group	Std. Deviation	Skewness	Kurtosis
Experimental	49.51	-0.363	-2.094
Control	46.07	-0.978	-1.175

Assumption of normality for internet terms of both groups is not satisfied since values of kurtosis did not range between -2 and 2 while values of skewness ranged between -2 and 2 (see Table 4.8)

Assumption of homogeneity in variance for internet terms was checked by Levene's Test for Equality of Variances. As seen in Table 4.9, Levene's test p value was greater than alpha value at the 0.05 level [F (32, 31.835) = 1.488, p=.232]. Thus, homogeneity of variance assumption was assured for internet terms.

Table 4.9. *Levene's Test for Equality of Variances for Achievement in Internet Terms*

	F	df1	df2	Sig.
Achievement in Internet Terms	1.488	32	31.835	0.232

Since the assumption of independent samples and homogeneity in variance met, independent samples *t*-test was performed to investigate the effect of gamification on internet terms as a section for computer technology terms regarding achievement on online activities for internet terms (see Table 4.10).

Table 4.10. *Independent Samples t-test for Achievement in Internet Terms*

		Internet Terms		Levene's Test				
Group	N	Mean	SD	F	Sig.	t	df	p
Experimental	17	57.11	49.51	1.488	0.232	-0.729	32	0.471
Control	17	69.08	46.07					

The results showed that there was no significant difference between the control and experimental groups among the means (t=0.729, df=32, p>0.05). Thus, there is no statistically significant difference between the control group, exposed to nongamified environment, and experimental group, exposed to gamified environment, internet terms as a section for computer technology terms, regarding achievement level on online activities for internet terms.

4.2.1.4. Achievement level of Groups in Hardware Terms

To investigate the effect of gamification on hardware terms as a section for computer technology terms regarding achievement on online activities for hardware terms, independent samples *t*-test was conducted. Before performing independent-sample *t*-test, analyses for assumptions were performed.

Table 4.11. *Normality of Groups for Achievement in Hardware Terms*

Group	Std. Deviation	Skewness	Kurtosis
Experimental	49.52	-0.010	-2.197
Control	50.23	-0.120	-2.255

Assumption of normality for hardware terms of both groups is satisfied since values of kurtosis did not range between -2 and 2 while values of skewness ranged between -2 and 2 (see Table 4.11)

Assumption of homogeneity in variance for hardware terms was checked by Levene's Test for Equality of Variances. As seen in Table 4.12, Levene's test p value was greater than alpha value at the 0.05 level [F (32, 31.993)=.338, p=.538]. Thus, homogeneity of variance assumption was assured for hardware terms.

Table 4.12. *Levene's Test for Equality of Variances for Achievement in Hardware Terms*

	F	df1	df2	Sig.
Achievement in Hardware Terms	0.338	32	31.993	0.538

Since the assumption of independent samples and homogeneity in variance met, independent samples *t*-test was performed to investigate the effect of gamification on hardware terms as a section for computer technology terms regarding achievement on online activities for hardware terms (see Table 4.13).

Table 4.13. *Independent Samples t-test for Achievement in Hardware Terms*

		Hardware Terms		Levene's Test				
Group	N	Mean	SD	F	Sig.	t	df	p
Experimental	17	49.67	49.52	0.388	0.538	-0.114	32	0.910
Control	17	51.61	50.23					

The results showed that there was no significant difference between the control and experimental groups among the means (t=0.114, df=32, p>0.05). Thus, there is no statistically significant difference between the control group, exposed to nongamified environment, and experimental group, exposed to gamified environment, hardware

terms as a section for computer technology terms, regarding achievement level on online activities for hardware terms.

4.2.2. Achievement level of Groups in Online Activities

To investigate the effect of gamification on the level of subjects' achievement in computer technology terms regarding achievement on online activities, independent samples *t*-test was conducted. Before performing independent-sample *t*-test, analyses for assumptions were performed.

Assumption of independent samples is assumed as satisfied since groups were randomly selected from the population and the online activities variable was independent in this study.

Assumption of normality was examined by checking skewness and kurtosis values of the test and histograms.

Table 4.14. *Normality of Groups for Achievement on Online Activities*

Group	Std. Deviation	Skewness	Kurtosis
Experimental	39.27	-0.300	-1.389
Control	40.32	-0.588	-1.360

Assumption of normality for online activities of both groups is satisfied since values of skewness and kurtosis ranged between -2 and 2 (see Table 4.14). Furthermore, normality of online activities is supported by the histograms of experimental and control group with normal curve (see Figure 4.1 and 4.2).

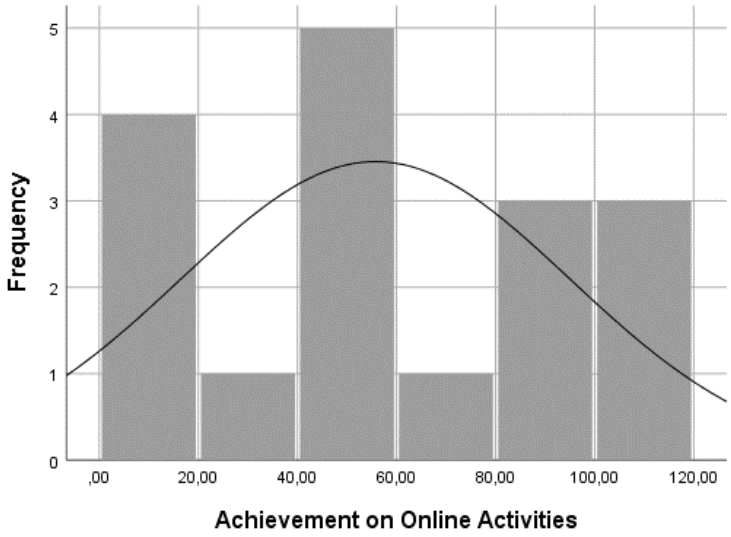

Figure 4.1. Histograms of Experimental Group for Online Activities with Normal Curve

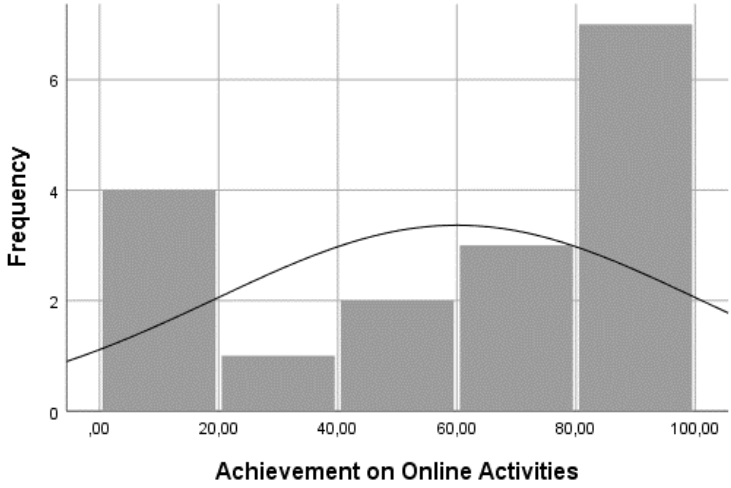

Figure 4.2. Histograms of Control Group for Online Activities with Normal Curve

Assumption of homogeneity in variance for online activities was checked by Levene's Test for Equality of Variances. As seen in Table 4.15, Levene's test p value was greater than alpha value at the 0.05 level [F (32, 31.987) = .164, p=.688]. Thus, homogeneity of variance assumption was assured. The variances of population for both experimental and control groups were equally distributed.

Table 4.15. *Levene's Test for Equality of Variances for Achievement on Online Activities*

	F	df1	df2	Sig.
Achievement on Online Activities	0.164	32	31.987	0.688

Since the assumptions of independent samples *t*-test were met, *t*-test was performed to investigate the effect of gamification on the level of subjects' achievement in computer technology terms regarding achievement on online activities (see Table 4.16).

Table 4.16. *Independent Samples t-test for Achievement on Online Activities*

		Online Activities		Levene's Test				
Group	N	Mean	SD	F	Sig.	t	df	p
Experimental	17	55.73	39.27	0.164	0.688	-0.311	32	0.758
Control	17	59.97	40.42					

The results showed that there was no significant difference between the control and experimental group among the means (t=0.311, df=32, p>0.05). Thus, there is no statistically significant difference between the control group, exposed to nongamified environment, and experimental group, exposed to gamified environment, in computer technology terms, regarding achievement level on online activities.

4.2.3. Achievement level of Groups in Midterm Exam as Posttest

To investigate the effect of gamification on the level of subjects' achievement in computer technology terms regarding midterm exam as posttest, independent samples *t*-test was conducted. Before performing independent-sample *t*-test, analyses for assumptions were performed.

Assumption of independent samples is assumed as satisfied since groups were randomly selected from the population and the posttest variable as midterm exam was independent in this study.

Assumption of normality should be met to concluded that the test variable in each two groups is normally distributed. In order to examine normality, skewness and kurtosis values of the test and histograms were checked.

Table 4.17. *Normality of Groups for Midterm Exam as Posttest*

Group	Std. Deviation	Skewness	Kurtosis
Experimental	26.26	-1.429	0.731
Control	32.63	-0.936	-0.640

The assumption of normality for midterm exam as posttest of both groups is satisfied since values of skewness and kurtosis ranged between -2 and 2 (see Table 4.17). Furthermore, normality of midterm exam as posttest is supported by the histograms of experimental and control groups by normal curve (see Figure 4.3 and 4.4).

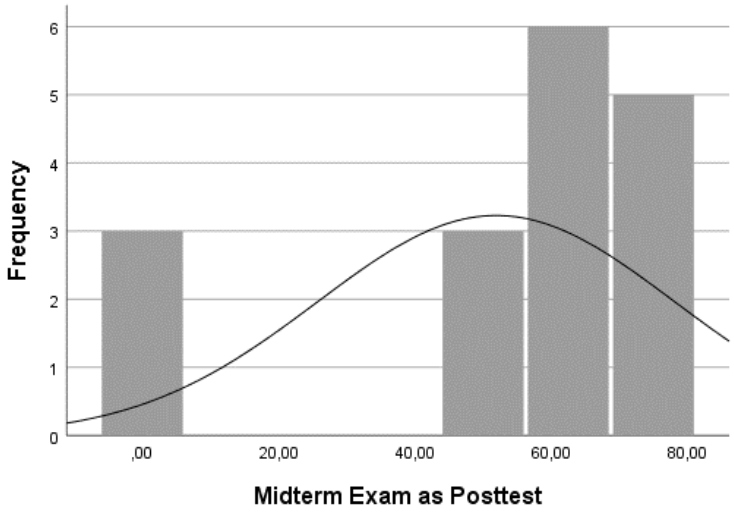

Figure 4.3. Histograms of Experimental Group for Midterm Exam as Posttest with Normal Curve

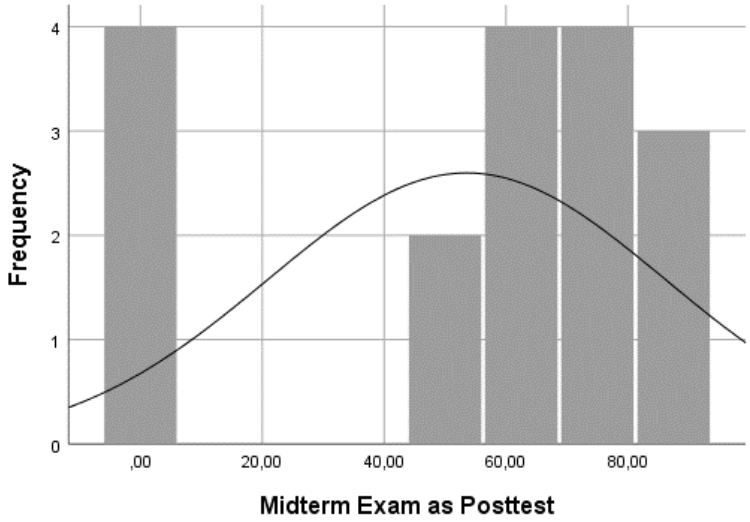

Figure 4.4. Histograms of Control Group for Midterm Exam as Posttest with Normal Curve

Assumption of homogeneity in variance should be satisfied to state that the test variable for the two populations for comparison have the equal variance. Homogeneity of variance assumption for midterm exam as posttest was checked by Levene's Test for Equality of Variances. As seen in Table 4.18, Levene's test p value was greater than alpha value at the 0.05 level [F (32, 30.599) = 1.182, p=.285]. Thus, homogeneity of variance assumption was assured. The variances of population for both experimental and control groups were equally distributed.

Table 4.18. *Levene's Test for Equality of Variances for Midterm Exam as Posttest*

	F	df1	df2	Sig.
Posttest	1.182	32	30.599	0.285

Since the assumptions of independent samples *t*-test were met, *t*-test was performed to investigate the effect of gamification on the level of subjects' achievement in computer technology terms regarding midterm exam as posttest (see Table 4.19).

Table 4.19. *Independent Samples t-test for Midterm Exam as Posttest*

		Posttest		Levene's Test				
Group	N	Mean	SD	F	Sig.	t	df	p
Experimental	17	51.91	26.26	1.182	0.285	-0.159	32	0.874
Control	17	53.52	32.63					

The results showed that there was no significant difference between the control and experimental groups among the means (t=0.002, df=32, p>0.05). Thus, there is no statistically significant difference between the control group, exposed to nongamified environment, and experimental group, exposed to gamified environment, in computer technology terms as a course content of Information Technology in Education II, regarding midterm exam as posttest.

This section was examined the effect of gamification on terms of computer technology regarding achievement on online activities in different term categories, overall online activities, and midterm exam as posttest. Statistical analyses based on all variables in the study showed that there is no statistically significant difference between the groups in computer technology terms. In other words, groups have the same level of achievement at the end of the treatment.

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CHAPTER 5

DISCUSSION AND CONCLUSION

This chapter provides information about discussion and conclusion of the study, which focused on the effect of gamification on the level of freshmen's achievement in computer technology terms at Department of Computer Education and Instructional Technology. This chapter will briefly discuss results of this research, give a summary of results and discussion, and give recommendation for the future researches.

5.1. Discussion and Conclusion

The potential of gamification in engagement, motivation, and achievement causes gamification to be implemented in different areas such as business, health, and education. Education uses the gamification to increase motivation, engagement, and achievement of students (Reiners & Wood, 2015). Motivation and engagement in educational context is directly related to the level of achievement. In fact, gamification is one of the methods, which is conducted to improve the level of achievement through accomplishing motivation and engagement. Moreover, since the achievement is one of the indicators for success of used method (Lei et al., 2018), it is essential to examine the effect of gamification on the level of achievement.

The main goal of this study was to determine the impact of gamification on the level of freshmen's achievement in computer technology terms. To meet this purpose, two micro courses, gamified and nongamified, were conducted as a part of the main course. In this study, the type of teaching method was independent and level of students' achievement in midterm exam and online activities was dependent variables.

After four weeks treatment period, overall average scores from four different categories of online activities; technical, software, internet, and hardware were analyzed by conducting independent samples *t*-test. The results indicated that there was no statistically significant difference between means of the experimental group

exposed to gamified environment and that of the control group exposed to nongamified environment based on overall average score of online activities.

In fact, there was no restriction while taking online activities. To clarify, subjects have the capability of carrying out a search of answers during online activity on the internet and they had limitless time to do an activity. The main reason for designing online activities with no restriction was to give subjects a chance of studying by themselves. It follows that no restriction while taking online activities could be a reason for nonexistence of statistically significant difference between means of groups on online activities. On the contrary, it was expected that the mean of online activities for the experimental group is greater than that for the control group. The reason for the expectation was because of the distinctive design of the activities in the micro courses. As mentioned in Section 3.1 the Design of Courses, there were three distinctive online activities for each category. Activities in gamified group required a minimum score to access next one, while all activities were available at once in the nongamified micro course. In other words, content unlocking game design element (Werbach & Hunter, 2012) was used to increase the level of achievement by gathering intrinsic motivation (Hamari, 2017) and allowing self-learning (McGrath & Bayerlein, 2013) with challenge in the content unlocking element. However, the mean of online activities with the content unlocking in the experimental group is lower than that of without the content unlocking in the control group ($M_{Control}$=59.97 and $M_{Experimental}$=55.73). The inefficiency of the content unlocking in this study caused by subjects in the control group might have used the advantage of having limitless time for an activity and searching on the internet for the answer causing better scores than the experimental group.

On the other hand, online activities for each category of terms were available in predefined and announced time period (see Table 3.1) to make subjects participate actively, otherwise they might try to do all activities at once. Since online activities did not have considerable effect on subjects' overall course score, they might not have or devote considerable time to do activities. Thus, subjects in both groups might not

have attached expected importance to the online activities because of a certain time period and negligible effect on total score. This could be another reason for the fact that there was no statistically significant difference between means of the groups based on online activities.

Additionally, ability of subjects in online learning was not measured in this study. As it was mentioned before, activities were online so subjects might not be capable of online learning. Thus, this this might be a reason for the no statistically significant difference between means of groups based on online activities.

In this study, after the treatment was implemented, midterm exam was taken by subjects as posttest to analyze the achievement level with an instrument confirmed by experts. In accordance with the posttest results, there was no statistically significant difference between the means of groups.

The most remarkable reason for nonexistence of difference between the means of groups might be caused by the view that subjects might not feel the micro courses' content as the main course of the Information Technology in Education II. The main course had a large weight of face to face learning for the first two months of the semester while micro courses had a large weight of online learning. To illustrate, subjects used to face to face learning environment more than online before this study so they might not give enough importance to the micro courses because of not feeling the content of computer technology terms as an actual content of the main course. Therefore, this might be the most notable reason for the no statistically significant difference between means of groups based on posttest.

Secondly, subjects stood a chance of study from documents for the midterm exam used as posttest because of not limiting them to online contents. In other words, both micro courses had online and offline parts of studying so documents provided for offline studies to give them a chance to study using other means and to not influence their study negatively for only accomplishing this study. Thus, this might be caused of nonexistence of statistically significant difference between means of groups with

respect to posttest since documents might have been frequently used as better source by subjects for studying compared to online activities.

Lastly, both of online and offline side of micro courses required self-learning and interaction with the teacher was expected only whenever there was a problem, a question, any misunderstanding with terms. Ability of subjects in self-learning was not measured in this study. Subjects might not be capable of self-learning. Thus, this this might be a reason for the no statistically significant difference between means of groups based on both online activities and midterm exam as posttest.

Analyses based on both online activities and posttest indicated that there was no statistically significant difference between means of experimental and that of control groups in computer technology terms. Actually, it was concluded that gamification has no statistically significant effect on subjects' level of achievement in this study. The result of the current study is consistent with some studies while inconsistent with other studies. Leaning (2015) stated that the mean of experimental group was slightly higher than that of control group. In other words, there was no change on subjects' level of achievement after implementation of gamification. In the current study, subjects' opinions and motivation was not took place and it was assumed that these might affected the results. However, Leaning (2015) also stated that even if subjects' opinions about gamified module were positive and their motivation was increased, gamified module did not affect subject performance. Additionally, Jacobs (2016) stated that even if students might have positive perception for gamification, achievement might not be supported by these positive perceptions.

Result of a study conducted by Şahin and Namlı (2016) stated that statistically significant difference between pretest and posttest scores of experimental was observed while there was no statistically difference between posttest scores of experimental and control group. In other word, there was a change on subjects' level of achievement in experimental group but there was no difference between groups at the end of the study. In the current study, pretest was preferred to be used to not cause

testing threat by alerting subjects. Therefore, only the differences between the groups were analyzed in the current study to determine the impact of gamification on the level of freshmen's achievement. Moreover, Rouse (2013) stated that the mean of experimental group was significantly higher than that of control group based on posttest. Additionally, the result in the study was supported by the significant differences between pretest and posttest of experimental group. Besides, subjects were given the class time to participate the activities in the study while the current study required self-study at home.

A study conducted Yıldırım (2017) was gamified online side of blended learning like the current study and stated that the gamification had positive effect on student achievement. Contrary to the current study, face to face learning took more time than online learning in his study. According to a mobile gamification learning system conducted by Su and Cheng (2015), subjects' achievement of the experimental group was higher than that of the control group. Contrary to the Yıldırım's study and current study, there was no face to face learning in the study. Thus, it might be concluded that gamification with different learning methods might causes different results for achievement. A study conducted by Lo and Hew (2018) with different learning methods by gamification reveals that there were differences between groups among achievement in different learning styles.

The main reason for different results might be that studies were implemented on different topics, at different levels, to different learning styles, and by different research design methods.

5.2. Summary

This study targeted to determine the effect of gamification on the level of student achievement in computer technology terms. For this aim, two micro courses, gamified and nongamified was implemented. Both micro courses comprised blended learning besides gamified micro course included also game design elements into blended

learning. In other words, game design elements were added to the online side of the blended learning.

In this study, different game design elements were used to implement gamification**.** Unlocking element was used to implement challenges. Moreover, it was stated as motivation for high score based on perceptions of students by Jacobs (2016). Another game design element used in this study was points as representation for feeling of progression and achievement. In addition, leaderboards element was used to create feeling of competition to get high score. Lastly, badge element was used to serve level of motivation through setting clear goals. Thus, it was expected that gamified group would get high score on online activities than that of nongamified group. Contrary to expectation, result of this study showed that gamified group get slightly lower score than the nongamified group although there was no statistically significant difference between the groups.

To accomplish the purpose of the study, one following research question with two sub-questions were asked.

> What is the effect of gamification on students' level of achievement in computer technology terms as a content of Information Technology in Education II course?

First was to investigate the difference between the students exposed to gamified and nongamified educational settings in computer technology terms based on online activities. Online activities were provided to students in four different categories. The results for each category and the result for overall average of categories on online activities were examined in detail. The results showed that gamified and nongamified students had same level of achievement on online activities.

Second was to examine the difference between the gamified and nongamified students in computer technology terms based on midterm exam as posttest. The results showed that students exposed to gamified and nongamified educational settings had same level of achievement on midterm exam.

5.3. Recommendations for Future Research

This study was conducted in a computer related context and interest in computer technology terms might have impact on results of the study. Further research should concern subject interest in such context.

This study was implemented during a limited period and it took only two months. Future research could be conducted for a longer period than the present study for more reliable results.

Subjects of this study was limited to 34 students enrolled in the micro courses. Hence, the generalizations for findings from this study were bounded. This study could be replicated with many subjects.

To assign subjects to groups, their GPA was used as a criterion of success. Only random assignment based on GPA is applied in this study and pretest was not conducted. Achievement level of subjects was measured with only posttest. Therefore, future research could be conducted by pretest and posttest to measure achievement level of subjects.

5.3.1. Lessons Learned

The main focus of this study was the effect of gamification on the level of student achievement in computer technology terms. The subjects in this study were freshmen at Department of Computer Education and Instructional Technology. Some possible lessons learned are presented as follows;

- To apply gamification accurately, selection of game design elements is immensely important. As stated in the literature section, despite of the fact that there are many game design elements, it is unfeasible and meaningless to use all of them.
- Besides, selected game design elements should correspond to the course' content. Badges in this study could be taken as an example of selection because they have designed in a way that it represents knowledge of computer related

terms. While first badge represents basic knowledge with its shape and name, second one represents more than basic knowledge. For example, “Technical Assistant” was first badge for the technical terms while “Technical Adviser” was second badge.

- Game design elements such as badges, levels, and leaderboards might have impact on subjects. Given the above, understanding of your target audience’s interest in the game design elements is essential to implement gamification effectively.
- Moreover, gamification mostly serves extrinsic motivation with external rewards such as badges, levels, leaderboards, and points. As Zichermann (2011) suggests, it is essential to understand intrinsic motivation of target audience and shape design of gamification.

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APPENDIX A

APPROVAL FORM FOR THE STUDY

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

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05 Mayıs 2017

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Yrd.Doç.Dr. Cengiz Savaş AŞKUN ;

Danışmanlığını yaptığınız yüksek lisans öğrencisi Nigar MİZAM'ın ***"The Effects of Gamification on Students' Participation and Success"*** başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek gerekli onay **2017-EGT-082** protokol numarası ile **05.05.2017 – 30.10.2017** tarihleri arasında geçerli olmak üzere verilmiştir.

Bilgilerinize saygılarımla sunarım.

Prof. Dr. Ş. Halil TURAN
Başkan V

Prof. Dr. Ayhan SOL
Üye

Prof. Dr. Ayhan Gürbüz DEMİR
Üye

Doç. Dr. Yaşar KONDAKÇI
Üye

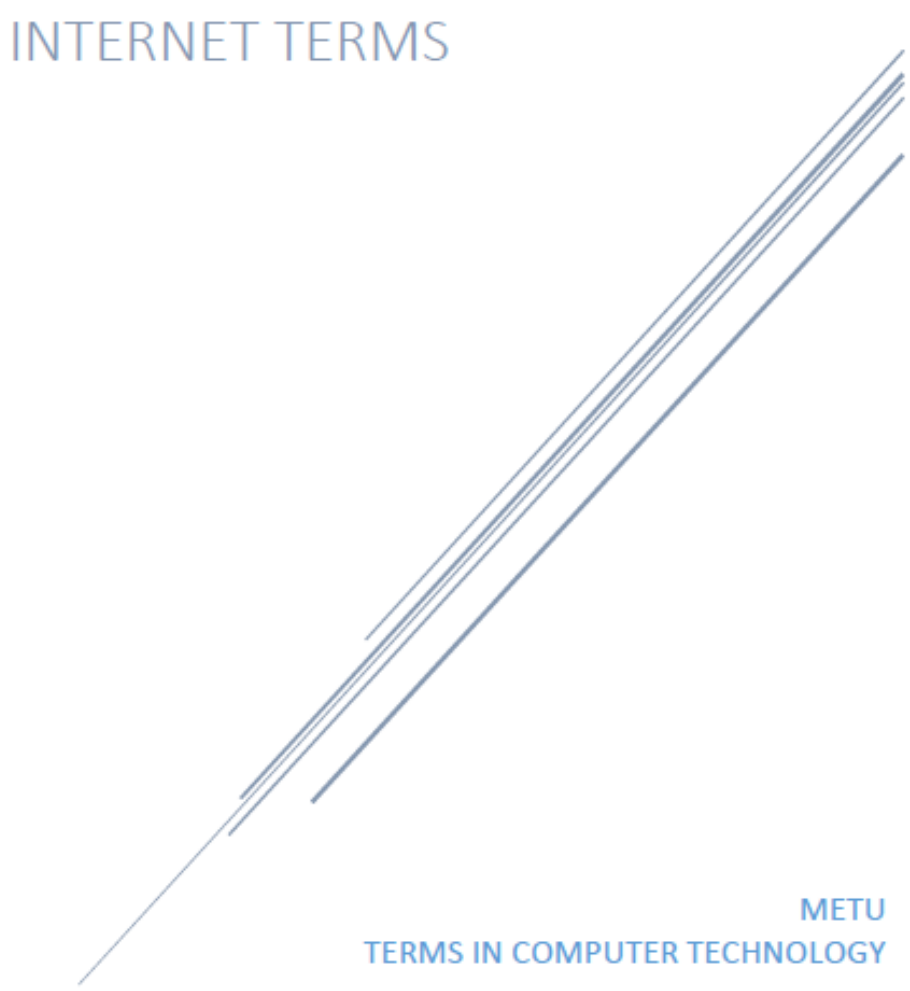
Doç. Dr. Zana ÇITAK
Üye

Yrd. Doç. Dr. Pınar KAYGAN
Üye

Yrd. Doç. Dr. Emre SELÇUK
Üye

APPENDIX B

EXAMPLE OF DEFINITION DOCUMENT FOR TERMS



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404 Error

A 404 error is a common website error message that indicates a webpage cannot be found. It may be produced when a user clicks an outdated (or "broken") link or when a URL is typed incorrectly in a Web browser's address field. Some websites display custom 404 error pages, which may look similar to other pages on the site. Other websites simply display the Web server's default error message text, which typically begins with "**Not Found**." Regardless of the appearance, a 404 error means the server is up and running, but the webpage or path to the webpage is not valid.

So why call it a "404 error" instead of simply a "Missing Webpage Error?" The reason is that 404 is an error code produced by the Web server when it cannot find a webpage. This error code is recognized by search engines, which helps prevent search engine crawlers from indexing bad URLs. 404 errors can also be read by Web scripts and website monitoring tools, which can help webmasters locate and fix broken links.

Other common Web server codes are 200, which means a webpage has been found, and 301, which indicates a file has moved to a new location. Like 404 errors, these status messages are not seen directly by users, but they are used by search engines and website monitoring software.

ActiveX

ActiveX is a technology introduced by Microsoft in 1996 as part of the OLE framework. It includes a collection of prewritten software components that developers can implement within an application or webpage. This provides a simple way for programmers to add extra functionality to their software or website without needing to write code from scratch.

Software add-ons created with ActiveX are called ActiveX controls. These controls can be implemented in all types of programs, but they are most commonly distributed as small Web applications. For example, a basic ActiveX control might display a clock on a webpage. Advanced ActiveX controls can be used for creating stock tickers, interactive presentations, or even Web-based games.

ActiveX controls are similar to Java applets, but run through the ActiveX framework rather than the Java Runtime Environment (JRE). This means you must have ActiveX installed on your computer in order to view ActiveX controls in your Web browser. Additionally, when loading a custom ActiveX control within a webpage, you may be prompted to install it. If this happens, you should only accept the download if it is from a trusted source.

While ActiveX provide a convenient way for Web developers to add interactive content to their websites, the technology is not supported by all browsers. In fact, ActiveX is only officially supported by Internet Explorer for Windows. Therefore, ActiveX controls are rarely used in today's websites. Instead, most interactive content is published using Flash, JavaScript, or embedded media.

APPENDIX C

INDEPENDENT SAMPLES T-TEST FOR GPA BEFORE TREATMENT

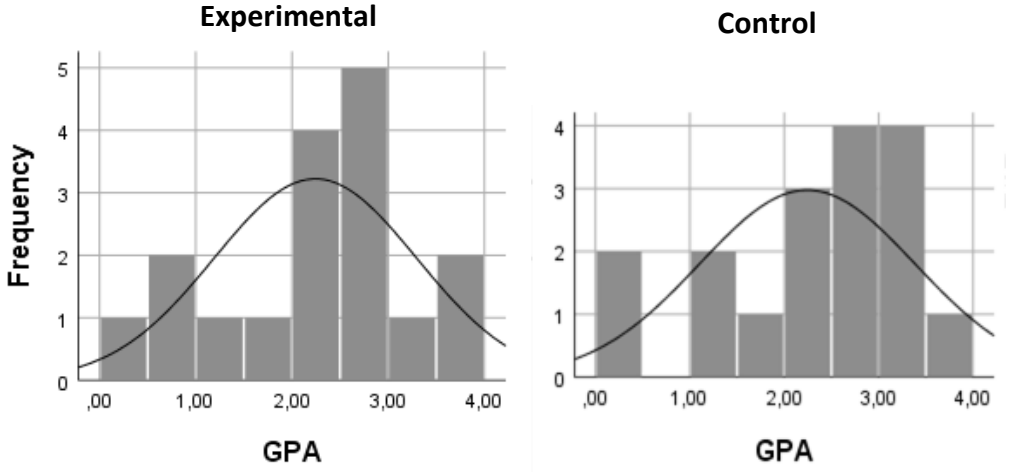
Assumption of independent samples is assumed as satisfied since groups were randomly selected from the population and the GPA as the test variable were independent in this study.

Assumption of normality should be satisfied to conclude that the test variable in two populations from which the samples are selected is normally distributed (Frederick J Gravetter & Wallnau, 2013). In order to examine normality, skewness and kurtosis values of the test and histograms were checked.

Normality of Groups for GPA

Group	Std. Deviation	Skewness	Kurtosis
Experimental	1.05	-0.716	-0.119
Control	1.14	-0.858	-0.248

The assumption of normality for GPA of both groups is satisfied since values of skewness and kurtosis ranged between -2 and 2 (see Normality of Groups for GPA) (Pallant, 2007). Furthermore, normality of GPA is supported by the histograms of experimental and control groups by normal curve (see Figure Histograms of Groups for GPA Normal Curve).



Histograms of Groups for GPA Normal Curve

Assumption of homogeneity in variance should be satisfied in order to state that the test variable for the two populations for comparison have the equal variance (Green & Salkind, 2009). Homogeneity of variance assumption for GPA was checked by Levene's Test for Equality of Variances. As seen in Table Levene's Test for Equality of Variances for GPA, Levene's test p value was greater than alpha value at the 0.05 level [F (32, 31.797) = 0.198, p= .659]. Thus, homogeneity of variance assumption was assured. The variances of population for both experimental and control groups were equally distributed.

Levene's Test for Equality of Variances for GPA

	F	df1	df2	Sig.
GPA	0.198	32	31.797	0.659

Since the assumptions of independent samples *t*-test were met, *t*-test was performed to conclude that both groups were equivalent based on GPA scores before the treatment (see Table Independent Samples t-test for GPA).

Independent Samples t-test for GPA

		GPA		Levene's Test				
Group	N	Mean	SD	F	Sig.	t	df	p
Experimental	17	2.242	1.052	0.198	0.659	-0.002	32	0.999
Control	17	2.243	1.139					

The results showed that there was no significant difference between the control and experimental groups among the means (t=0.002, df=32, p>0.05). Thus, groups were thought to be equivalent based on GPA scores before the treatment.

APPENDIX D

DOCUMENT OF BRIEF INFORMATION FOR THE EXPERT JUDGEMENT

Bilgisayarla ilgili terimler 4 kategori altında toplanıp öğrencilere sunulmuştur.

Post-test her kategorinin genel toplamdaki yüzdesi göz önünde bulundurarak soru içerecek şekilde hazırlanmıştır ve 40 adet çoktan seçmeli sorudan oluşmaktadır.

Sorulardaki şıklar ilgili kategoriden çeldiriciler tespit edilerek belirlenmiştir. İlgili kategoride uygun şık yok ise diğer kategorilerden seçilmiş veya çeldirici olması için şık türetilmiştir.

Topics/Categories	Number of Terms in Categories	Percentage of Terms	Number of Questions for Knowledge & Understanding	Percentage of Items/Questions
Technical	127	30,90	12	30,00
Software	127	30,90	12	30,00
Internet	95	23,11	10	25,00
Hardware	62	15,09	6	15,00
Total	**411**	**100**	**40**	**100**

APPENDIX E

SAMPLE QUESTIONS FROM MIDTERM EXAM AS POSTTEST

1. Which of the following refers to classes of IP addresses?
    a. Netmask
    b. DNS
    c. Domain
    d. SSL

2. Which of the following is the most general term that refers to software programs designed to damage or do other unwanted actions on a computer system?
    a. Spyware
    b. Virus
    c. Malware
    d. Adware

3. Which of the following data transfer protocol uses a secure socket layer for security purposes?
    a. HTTPS
    b. HTTP
    c. FTP
    d. FTPS

4. Which of the following is a program used to verify that a human, rather than a computer, is entering data?
    a. ActiveX
    b. Captcha
    c. Telnet
    d. SSL

5. Which of the following is a specific and common set of communication rules and instructions for computers to communicate with each other?
    a. Protocol
    b. Ipv6
    c. Portal
    d. Certificate

6. What does "WWW" stands for?
    a. World Widely Web
    b. World Wide Web
    c. Widely World Web
    d. Wider World Web

7. Which of the following is the address of a specific webpage or file on the Internet?
    a. Domain Name
    b. URL
    c. Host
    d. IP Address

8. Which of the following is a hardware identification number that uniquely identifies each device on a network?
    a. Mac Address
    b. ID Name
    c. Device IP
    d. IP Address

9. Which of the following is a digital image composed of a matrix of dots?
    a. Bitmap
    b. JPEG
    c. PNG
    d. GIF

10. Which of the following is the most general term that refers to software programs designed to damage or do other unwanted actions on a computer system?
    a. Spyware
    b. Virus
    c. Malware
    d. Adware