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# Flipped Learning and Gamification in Information Technologies and Software Course*

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## Abstract

This study aims to determine the impact of flipped learning and gamification methods on student achievement in the subject of ethics and security, which is a topic of the fifth grade information technology and software course, compared to the traditional method. Also, it aims to decide the students' opinion of about the flipped learning and gamification methods. The study used a mixed-methods experimental design, included both quantitative and qualitative research designs. The study's quantitative strand focused on the non-equivalent groups pretest-posttest design and the qualitative strand based on the case study design. The study group consisted of 32 fifth-grade students from a secondary school in a city located in western Turkey. There were 16 students in the experimental group and 16 students in the control group. The ethics and security success test, which the researchers developed, was used for collecting quantitative data. The semi-structured interviews with the students in the experimental group were performed for qualitative data. The descriptive statistics and two-way analysis of variance for mixed measures were used to analyze the quantitative data and the content analysis method was used to analyze the qualitative data. According to the study results, the students in the experimental group were more successful than the students in the control group. The students expressed positive opinions about the flipped learning and gamification methods in the interviews.

**Keywords:** Flipped learning, Gamification, Information technologies and software course, Ethics and security, Students' success.

## Introduction

Smart mobile devices, applications, various social media environments, driverless vehicles, drones, humanoid robots, and artificial intelligence products have all arisen because of technological advances in the twenty-first century. These technological advancements have brought many changes to people's lives, and technology has become an essential factor influencing people's lives. Because of this change, the education system is moving away from traditionalism for new generations to keep up with emerging changes, an understanding that puts students at the center, facilitates students' learning, and enables the use of technology in a learning environment (Şenel & Gençoğlu, 2003). Because of this understanding, new ideas have emerged in education and the use of alternative methods has become a necessity (Kotluk & Kocakaya, 2015). The main idea of alternative methods is that students are active while learning and the methods facilitate students' learning (Alsancak Sırakaya, 2017). Two of alternative methods are flipped learning and gamification.

Flipped learning method is referred to as flipped learning model, flipped classroom, flipped classroom model, flipped model, and flipped instruction in the literature. Flipped learning is defined as doing classroom activities at home and doing homework in the classroom (Bergmann & Sams, 2012). Subjects that need to be learned in the school in traditional education are given to students as homework, and tasks given as homework in traditional education are completed in the classroom when students come to school in the flipped learning model (Demiralay & Karataş, 2014; Karataş, 2014; Turan, 2015). With the flipped learning method, students are expected to engage in the classroom activities actively. The activities are structured to encourage students to adapt what they have learned to new circumstances, and the teacher serves as a guide. The aim is for students to understand the knowledge presented before the lesson and to achieve a high level of learning stages such as implementation,

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analysis, and synthesis during the class periods in school (Hayırsever & Orhan, 2018; Kara, 2016). Subjects can be presented as videos, diagrams, and documents via online and offline platforms in the flipped learning method. Students may use their smart devices (i.e., phone, tablet, computer) to access these resources (Karadeniz, 2015). Lage, Platt, and Treglia (2000) established the theoretical foundation for the flipped learning method. Two chemistry teachers working at a high school in the United States videotaped their lecture presentations for the absent students for various reasons from their classes. They began publishing them on their website, which was the first application of flipped learning. With this application, the students easily accessed the lessons and watched the videos they want, so they knew the subject before they came to the class (Bergmann & Sams, 2012; Filiz & Kurt, 2015; Hayırsever & Orhan, 2018). In this way, the teachers built an interactive and active environment in the classroom by having the students do activities who came to the course with prior knowledge. The teacher's role changed and differentiated in this setting, and s/he became a learning coach (Bergmann & Sams, 2012). The flipped learning method has become increasingly widespread and new teaching model of the 21st century as it enables students to learn (Serçemeli, 2016). Chen, Wang, Kinshuk, and Chen (2014) state that flipped learning has seven pillars. These seven pillars are illustrated in Figure 1 (Wu, Hsieh, & Yang, 2017).

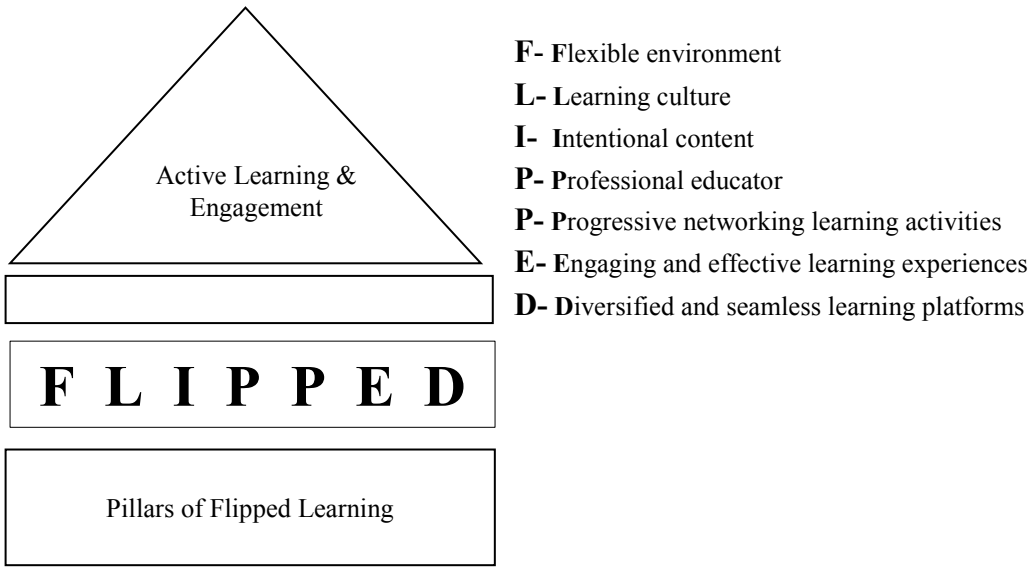


Figure 1. Seven pillars of Flipped Learning (Wu et al., 2017)

***A flexible environment*** refers to a learning environment in which students can choose when and where they learn and an opportunity to learn at their own pace. ***Learning culture*** is that students learn according to their own learning styles and actively engage in the structuring of knowledge by assessing their own learning in the classroom. ***Intentional content*** is teachers' design of materials (written text, video or electronic) that students will examine and evaluate before coming to the classroom, with a student-centered approach to the subject to be learned. ***The professional educator*** has an important role in planning and arranging flipped learning content, developing the learning environment, effective observation of the learning process, and giving feedback to students. ***Progressive networking learning activities*** are sequential, interactive and online learning activities. Students gain knowledge outside of the classroom in different learning environments, evaluate their learning in the classroom, and reinforce what they have learned with their friends. ***Engaging and effective learning experiences*** are students' participation in effective learning activities in the classroom in an interaction focused on student autonomy. ***Diversified and seamless learning platforms*** integrate a learning environment with advanced online learning activities that students can access through Internet from any location and any time (Chen et al., 2014; Filiz & Kurt, 2015; Wu et al., 2017).

There are studies on teaching using the flipped learning method at various educational levels in the literature (Aydın, 2016; Boyraz, 2014; Çakır & Yaman, 2018; Demiralay, 2014; Fisher, LaFerriere, & Rixon, 2020; Gençer, 2015; Güç, 2017; Öztürk & Alper, 2019; Pierce & Fox, 2012; Sağlam, 2016; Su & Chen, 2018; Turan, 2015; Wu et al., 2017; Yavuz, 2016). Pierce and Fox (2012) used the flipped learning method in pharmacy education and examined how it affected students' success and attitudes. Students' performance on the final exam increased compared to students taught in a traditional classroom, and their opinions were positive (Pierce & Fox, 2012).

Boyraz (2014) found that the experimental group taught using the flipped learning method had higher academic achievement than the control group taught using the conventional method. Turan (2015) found that students taught using the flipped learning method had higher levels of success, motivation, and cognitive load than students taught using the conventional method, and that students had positive opinions about the flipped learning method. According to Yavuz (2016), there was no difference in success between the experimental group taught with flipped learning method and the control group taught with the conventional method, and the experimental group had positive opinions. Güç (2017) discovered that in the seventh-grade mathematics courses, there was a significant difference in the students' success in favor of the experimental group taught with flipped learning method, no significant difference in attitudes toward mathematics, and the students' and parents' opinions were positive. Çakır and Yaman (2018) concluded that the experimental group taught with flipped learning increased their science success while their computational thinking skills remained unchanged. The students taught with flipped learning method had higher academic performance, programming language self-orientation learning abilities, and computer attitudes than the students taught with the conventional method (Öztürk & Alper, 2019). Fisher et al. (2020) conducted semi-structured interviews with 19 university students taught with the flipped learning method. The study found that students have both positive and negative opinions about flipped learning method that flipped learning strategies influence and facilitate learning and that students' ability to complete the preparatory learning, which is flipped learning method's basic assumption, may be its weakness.

Gamification is a transition of game elements to non-game contexts and is one approaches that has enabled students to engage more effectively in-class (Deterding, Dixon, Khaled, & Nacke, 2011; Dominguez, Saenz-de-Navarrete, De-Marcos, Fernandez-Sanz, Pages, & Martinez-Herraiz, 2013; Kim & Lee, 2015; Lee & Hammer, 2011; Werbach & Hunter, 2012; Yıldırım & Demir, 2016). Game mechanics and game dynamics are two types of elements in games. Students are moved by game mechanics, such as points, prizes, teams, avatars, ranks, leaderboards, and badges. Feedback from game players, progress in game, relationships between players, in-game shopping, player collaboration, and game limitations are all examples of game dynamics (Aral, Gürsoy, & Köksal, 2001; Zichermann & Cunningham, 2011). Gamification, known as transferring of game elements to non-game environments, is a popular method for increasing students' participation in class (Hanus & Fox, 2018). It was observed that individuals worked harder to achieve their goals and got the game elements they wanted in environments where the gamification method was used. It was stated that the gamification method enables all students to engage actively in-class activities (Lee & Hammer, 2011; Mert & Samur, 2018; Sezgin, Bozkurt, Yılmaz, & Van der Linden, 2018).

There are studies on the gamification method at various educational levels in the literature (Ar, 2016; De-Marcos, Dominguez, Saenz-de-Navarrete, & Pages, 2014; Dominguez et al., 2013; Hanus & Fox, 2018; Li, Dong, Untch, & Chasteen, 2013; Lister, 2015; Mert & Samur, 2018; Meşe, 2016; Mohammed, 2018; Öztürk & Korkmaz, 2020; Türkmen, 2017; Yapıcı & Karakoyun, 2017; Yıldırım, 2016, 2017; Yıldırım, 2018; Yıldırım & Demir, 2016). The experimental group taught with the gamification method had higher performance scores than the control group in the study conducted by Ar (2016). In addition, the students' use of learning strategies improved in the study. Türkmen (2017) investigated the effects of the gamification method on mathematics courses on the fifth-grade students' success and attitudes. According to the results, the experimental group's success improved as compared to the control group, and there was no significant difference between the experimental and control groups' success and attitude scores. According to Yapıcı and Karakoyun (2017), the pre-service teachers' opinions about the use of Kahoot, a gamification application, were positive, and Kahoot increased the pre-service teachers' motivation levels. Mert and Samur (2018) evaluated and interpreted the students' opinions about gamification elements (avatar, feedback, score, reward, progress table) in terms of motivation and game elements. Yıldırım (2018) investigated the effect of the gamification method on the students' success in the social studies course. The researcher concluded that there was no statistically significant difference between the experimental and control group's success scores and that the gamification method drew the students' attention.

There are also studies in the literature that use the flipped learning and gamification methods together in the teaching, and the results demonstrate that the flipped learning and gamification methods are successful (Alsancak Sırakaya, 2017; Gómez-Carrasco, Monteagudo-Fernández, Moreno-Vera, & Sainz-Gómez, 2020; Gündüz & Akkoyunlu, 2020; Huang & Hew, 2018; Huang, Hew, & Lo, 2018; Hung, 2018; Lai & Foon, 2019; Lo & Hew, 2020; Matsumoto, 2016; Özer, Kanbul, & Ozdamli, 2018; Parra-González, López-Belmonte, Segura-Robles, & Moreno-Guerrero, 2021; Pozo Sánchez, López Belmonte, Fuentes Cabrera, & López Núñez, 2020; Sailer & Sailer, 2021; Segura-Robles, Fuentes-Cabrera, Parra-González, & López-Belmonte, 2020; Thongmak, 2019; Zainuddin, Shujahat, Chu, Haruna, & Farida, 2019; Zou, 2020). Matsumoto (2016) used the flipped learning and gamification method in English teaching. Teaching with the flipped learning and gamification methods successfully improved students' understanding and motivation in the study. Alsancak Sırakaya (2017) concluded that the first-year students in the preschool education department had positive opinions about the gamified flipped classroom model.

Özer et al. (2018) concluded that most pre-service teachers were pleased with the gamification supported flipped classroom activities and an increase in classroom competitiveness and motivation. Huang et al. (2018) found that university students taught with gamification-enhanced flipped learning method were more likely to complete pre- and post-classroom tasks on time than students who taught with non-gamified flipped learning method. The gamification-enhanced flipped learning group's pre-classroom thinking practices were higher, and the group got a higher score on the post-test than the non-gamified flipped learning group. Thongmak (2019) investigated and compared the effectiveness of flipped learning and gamification methods. The study found that these methods were effective in changing students' perceptions of usefulness and participation intentions. Compared to the flipped learning method, the gamification method provided better results regarding participants' viewpoints. Sailer and Sailer (2021) used gamified flipped classroom model with the educational science students in their experimental research. The results indicated that gamified activities positively affected social relatedness and intrinsic motivation, but no significant effect on competence need satisfaction.

It is expected that the teaching methods like flipped learning and gamification methods that have emerged in recent years will provide students with a novel experience and opportunity to learn with fun. These new methods may allow the Information Technologies and Software [ITS] course to be taught more effectively. There has been no study about the use of flipped learning and gamification methods in teaching the ITS course in the literature. Because the Ethics and Security subject of the fifth-grade ITS course is an abstract subject, it was decided to use flipped learning and gamification methods to teach the Ethics and Security subject. The flipped learning method aims to allow students to learn at their own pace using virtual platforms at their home and the gamification activities aim to reinforce students' learning instead of teaching an abstract subject verbally in the classroom. For all the reasons mentioned above, the study would contribute to the field of ITS teaching. The research question of the study is "What is the impact of flipped learning and gamification methods on student achievement in Ethics and Security subject compared to the conventional method and what are the opinions of students taught using flipped learning and gamification methods?" The following section describes the research method used to find a solution to this problem.

## Method

### Research Model

The research model was a mixed-methods experimental design because the study used both quantitative and qualitative data collection methods. In the mixed-methods experimental design, qualitative data is collected to support experimental study results to understand whether the intervention works and how it works (Creswell & Plano Clark, 2018; Kong, Mohd Yaacob, & Mohd Ariffin, 2018). The nonequivalent groups pretest-posttest design was used to collect the quantitative data for the analysis in the experimental strand (Büyüköztürk, Çakmak, Akgün, Karadeniz, & Demirel, 2014; Fraenkel & Wallen, 2012). In the nonequivalent group pretest-posttest design, dependent variable measurements are taken from two groups (experimental and control) determined before the application without using random assignment, and the dependent variables are measured again using the same form or co-form after the intervention. It is decided whether there is a significant difference between the two groups for the change observed in the dependent variable through data got before and after the experiment (Büyüköztürk et al., 2014; Fraenkel & Wallen, 2012). Random assignment was not possible because the experimental and control groups students were studying in two classes. The ethics and security success test was first given to both groups in the study. The students in the experimental group were taught with flipped learning and gamification methods. The conventional method, i.e. lecture method, was used to teach the subject in the control group. The subject was taught in both groups and at the end of the lesson the same success test was given in both groups. When the pre-test and post-test were administered, students were informed that the results of the tests would not affect their success in the ITS course. In addition, the case study design was used to gather qualitative data from the experimental group. A case study aims to analyze the process of an event, phenomenon, or situation in the research in depth, understand its effects, and reveal how the research participants are affected (Yin, 2003). Interview is one of the most common methods for determining what the participants' opinions are about the process in qualitative research (Yıldırım & Şimşek, 2013). The students in the experimental group were interviewed in semi-structured interviews for their opinions about the teaching methods.

### Study group

The study group comprised 32 students enrolled in two different fifth-grade classes at a secondary school in a city located in western Turkey during the 2018-2019 academic year. The convenience sampling method was used to decide on the study group. The convenience sampling method aims to save money, time, and effort by allowing the researcher to get an easily accessible sample (Büyüköztürk et al., 2014). In both classes, the students were

asked about their technological devices. The class, with a greater number of students having technological devices, would be the experimental group. Table 1 demonstrates the distribution of the students in the study by the experimental group, control group, and gender.

Table 1. Demographic characteristics of the participants in the sample

| | Gender | | |
|---|---|---|---|
| Group | Female | Male | Total |
| Experimental | 7 | 9 | 16 |
| Control | 9 | 7 | 16 |
| Total | 16 | 16 | 32 |

**Data Collection**

This study taught the Ethics and Security subject of the fifth-grade ITS course with flipped learning and gamification methods. The ethics and security success test was used in the study to find the change in students' success. The researchers developed the ethics and security success test, and a validity and reliability analysis was performed. The ethics and security success test was used as a pre-test before the instruction and as a post-test afterwards for both the experimental and control groups. The Ethics and Security subject outcomes were analyzed before designing the success test, and a question pool of 46 questions was prepared. An expert opinion form was designed for the questions in the question pool. The expert opinion form was sent for expert opinion to the faculty members from the department of Computer Education and Instructional Technology [CEIT], the ITS teachers who had completed their master's degree in the department of CEIT, and the ITS teachers who taught the Ethics and Security subject.

After consulting with nine experts, it was decided that 42 questions would remain in the test (Alpar, 2016). With the remaining 42 questions, a draft test form was designed. The draft test was given to 235 students in two different secondary schools in a city located in western Turkey. The data from the draft test form was coded with the statistical analysis software. The double point-serial correlation was used to decide which question should be discarded from the test because the test's items scored as 1 and 0 (Alpar, 2016). The analysis was made also by using the item-total correlations, upper 27% of total test score distribution and lower 27% of total test score distribution comparison, Guttman split-half coefficient and Kuder Richardson 20 [KR-20] test. The items that needed to be discarded from the test and the items that needed to be included in the test were decided. The item-total correlation coefficients were found between .368 and .618; upper 27% of total test score distribution and lower 27% of total test score distribution comparison were statistically meaningful ($p<.05$); the KR-20 value was statistically meaningful was found as .888 and Guttman split-half coefficient was calculated as .829. Following all the analyses, it was agreed to keep 25 items in the test in the final version of the ethics and security success test. The items' difficulty values of these 25 items were between .51 and .86. The highest score on the test was 25, and the lowest score was zero.

A semi-structured interview form was prepared to figure out the students' opinions in the experimental group. Semi-structured interviews start with asking questions that had already been prepared, but they provide flexibility to the researcher with the changeable or updatable questions and help to gain in-depth information on the subject being researched (Yıldırım & Şimşek, 2013). The literature (Alsancak Sırakaya, 2017; Güç, 2017; Yavuz, 2016; Özer et al., 2018; Yapıcı & Karakoyun, 2017) was reviewed to prepare the semi-structured interview questions based on similar questions in the studies examined. The interview form was sent to two faculty members from the department of CEIT to get an expert opinion. The semi-structured interview form was made ready for implementation based on the experts' suggestions. Before the interviews, the students were told that the answers they gave to the questions would not affect their success in the course and it was important to express their positive or negative thoughts.

**Analysis of Data, Validity and Reliability**

The statistical analysis software was used to code the quantitative data collected from the ethics and security success test. The success test was used to measure the students' total scores in the experimental and control groups before and after instruction. It was tested whether the scores had a normal distribution or not before deciding whether parametric or nonparametric tests would be used in the data analysis. The Shapiro-Wilk test was used to determine the normality of the data. The sample size is less than 50, the Shapiro-Wilk test is used (Alpar, 2016). Table 2 presents the result of Shapiro-Wilk's normality test.

Table 2. The result of Shapiro-Wilk's normality test

| | Group | Statistics | df | p |
|---|---|---|---|---|
| Pre-test | Experimental | .903 | 16 | .091 |
| | Control | .948 | 16 | .457 |
| Post-test | Experimental | .941 | 16 | .357 |
| | Control | .912 | 16 | .127 |

When looking at Table 2, the p values for the scores are greater than .05. According to Alpar (2016), when the Shapiro-Wilk's test produced p values greater than .05, it indicates that the data are normally distributed. As a result, the scores demonstrated a normal distribution. Since the data had a normal distribution, two-way analysis of variance [ANOVA] for mixed measures, one of the parametric tests, was used to decide whether there was a statistically significant difference between the experimental and control groups' scores (Alpar, 2016; Büyüköztürk, 2020; Salkind, 2019/2011; Seçer, 2017). To decide the reliability of the data, KR-20 values were calculated. Table 3 shows the coefficients.

Table 3. KR-20 values calculated for the scores

| Group | Pre-test | Post-test |
|---|---|---|
| Experimental | .784 | .900 |
| Control | .809 | .808 |

When looking at Table 3, the reliability coefficients are high. According to Büyüköztürk et al. (2014), values of 0.70 and above are sufficient for the reliability of the data. As a result, the data collected in the study can be reliable.

The data got from semi-structured interviews was scripted. The scripted data were shown to the participants randomly selected and their accuracy was confirmed to ensure the validity of the data. The content analysis was conducted to analyze the data. The content analysis is defined as coding and summarizing research data systematically based on the concepts that emerge after conceptualization and determination of the categories accordingly (Büyüköztürk et al., 2014; Yıldırım & Şimşek, 2013). The students' answers to the questions were used as quotations. The second researcher coded the data from eight randomly selected students for reliability, and the agreement ratio between the coders was examined. The formula the Reliability=(number of categories with agreement)/(total number of categories with and without agreement) was used to calculate the agreement ratio between coders (Miles & Huberman, 1994). The agreement ratio between coders was calculated as Reliability=162/201=.81. According to Miles and Huberman (1994), the agreement ratio between the two coders is greater than .70, indicating the reliability between the coders. As a result, the data analysis made by the first researcher can be reliable. The data from eight randomly selected students were re-coded by the first researcher one month after the first coding, and the reliability was calculated using the same formula as 196/201=.98. This ratio, which means internal consistency, should be around .90, according to Miles and Huberman (1994).

**Flipped learning and gamification activities in the study**

Videos were prepared for the flipped learning method applied in the experimental group. For this, all the outcomes and subject contents of the Ethics and Security subject were examined by using the ITS course Curriculum (fifth and sixth Grades) (Milli Eğitim Bakanlığı [Ministry of National Education] [MEB], 2018) as a guide. The flipped learning videos were created using the PowToon platform and free objects. The videos were assessed in terms of whether the content was appropriate for the subject, whether the visualizations were appropriate for the subject, the duration of the content's visibility in the video, the appropriateness of the sound effects added to the videos, the transitions of the video content, and the suitability of the object's entry and exit timescale. They were presented to two experts from the department of CEIT, and their feedback was taken into consideration. The videos were rearranged according to the experts' suggestions. Videos on "ethical values", "Internet and ICT usage rules", "What we should do on the Internet", "digital citizenship", "nine elements of digital citizenship", "e-government", "copyright and what a digital citizen should do", "strong passwords", and "cybercrimes" were produced. All videos were made publicly available on YouTube. The students in the experimental group were given the video links through the Education Information Network [EBA] platform that an online learning management system used in Turkey by K12 students and teachers. The videos were uploaded to students' mobile devices that did not have access to the Internet, and all students could access them. The gamification activities were prepared according to the activities of the student's textbook by using Kahoot and LearningApps application. "Matching", "true-false", "puzzle" and "memory game" were forms of gamification activities. The students were asked to form two-person groups when taking part in the gamification activities. Those who were successful in the gamification

activities received badges that had been previously planned. The photos of the students in the group that received the most badges at the end of the gamification activities were posted on the classroom bulletin board.

## Results

The students' total scores were calculated from the ethics and security success test, which was applied to the experimental and control groups before and after the Ethics and Security subject was taught. Table 4 shows the descriptive statistics of the test scores.

Table 4. The descriptive statistics of the ethics and security success test scores

| | Pre-test | | | Post-test | | |
|---|---|---|---|---|---|---|
| Group | N | $\overline{X}$ | SD | N | $\overline{X}$ | SD |
| Experimental | 16 | 11.63 | 4.992 | 16 | 15.75 | 6.547 |
| Control | 16 | 14.44 | 5.033 | 16 | 15.25 | 4.879 |

*Note*. $\overline{X}$: mean; SD: standard deviation

When the descriptive statistics of the test scores in Table 4 are examined, the experimental group's mean score on the test increased from 11.63 to 15.75, while the control group's mean score increased from 14.44 to 15.25. The significance of the increases observed in the experimental and control groups' scores was assessed using a two-way ANOVA for mixed measures, one of the parametric tests. The assumptions related to ANOVA were not met because Mauchly's test of sphericity statistics was not significant ($p<.05$), so it was used Huyn-Feldt correction (Field, 2016), Table 5 presents the results of the test.

Table 5. The results of two-way ANOVA for mixed measures

| Source | Sum of Squares | df | Mean Square | F | p | $\eta^2$ |
|---|---|---|---|---|---|---|
| Between-Subjects | 1574.985 | 31 | | | | |
| Group (experimental/control) | 21.391 | 1 | 21.391 | .413 | .525 | .014 |
| Error | 1553.594 | 30 | 51.786 | | | |
| Within-Subjects | 341.501 | 32 | | | | |
| Measure (pre-/post-test) | 97.516 | 1 | 97.516 | 14.620 | .001 | .328 |
| Group*Measure | **43.891** | **1** | **43.891** | **6.581** | **.016** | **.180** |
| Error | 200.094 | 30 | 6.670 | | | |
| Total | 1915.576 | 63 | | | | |

Table 5 demonstrates that there is no significant difference between the experimental and control groups' mean scores [$F(1,31)=.413$, $p>.05$, $\eta^2=.014$], but there is a significant difference between the pre- and post-test mean scores [$F(1,32)=14.620$, $p<.05$, $\eta^2=.328$]. According to the Group*Measure test, the mean scores demonstrate a significant difference [$F(1,30)=6.581$, $p<.05$, $\eta^2=.180$]. These findings were interpreted as the experimental group, taught with flipped learning and gamification methods, was more successful than the control group (Figure 2).

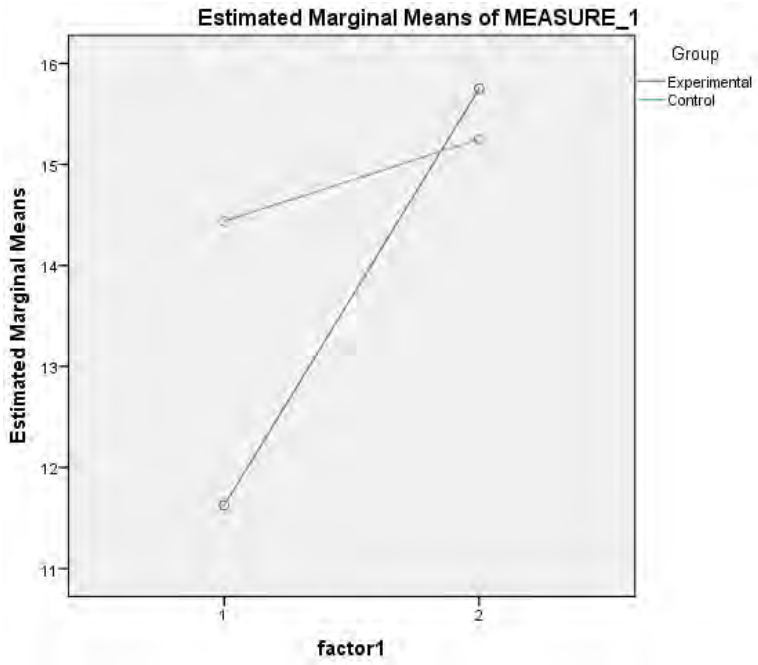


Figure 2. Estimated marginal means of measure for ANOVA

It was also done a two-way ANCOVA for mixed measures using pre-test scores as covariance. The assumptions related to ANCOVA were not met because Mauchly's test of sphericity statistics was not significant ($p<.05$), so it was used Huyn-Feldt correction (Field, 2016), Table 6 presents the results of the test.

Table 6. The results of two-way ANCOVA for mixed measures

| Source | Sum of Squares | df | Mean Square | F | p | $\eta^2$ |
|---|---|---|---|---|---|---|
| Between-Subjects | 1587,370 | 31 | | | | |
| Pre-test | 1357.427 | 1 | 1357.427 | 200.673 | .051 | .125 |
| Group (experimental/control) | **33.776** | **1** | **33.776** | **4.993** | **.033** | **.147** |
| Error | 196.167 | 29 | 6.764 | | | |
| Within-Subjects | 261.997 | 32 | | | | |
| Measure (pre-/post-test) | 28.127 | 1 | 28.127 | 4.158 | .051 | .125 |
| Pre-test*Measure | 3.927 | 1 | 3.927 | 0.581 | .452 | .020 |
| Group*Measure | **33.776** | **1** | **33.776** | **4.993** | **.033** | **.147** |
| Error | 196.167 | 29 | 6.764 | | | |
| Total | 1849,367 | 63 | | | | |

Table 6 demonstrates that there is a significant difference between the experimental and control groups' mean scores when the pre-test scores were used as covariance [$F(1,29)=4.993$, $p<.05$, $\eta^2=.147$]. According to the Group*Measure test, the mean scores show a significant difference [$F(1,29)=4.993$, $p<.05$, $\eta^2=.147$]. These findings were interpreted as the experimental group was more successful than the control group when the pre-test scores were used as covariance (Figure 3).

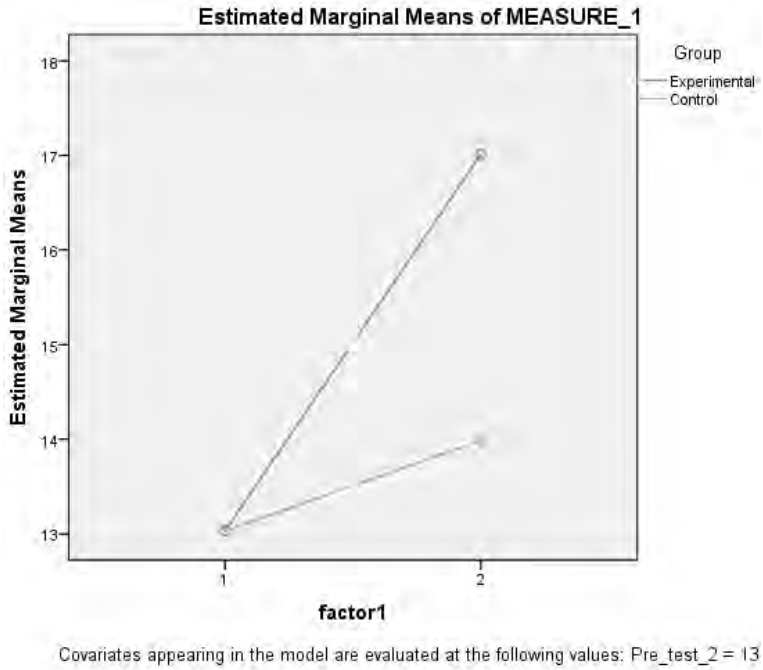


Figure 3. Estimated marginal means of measure for ANCOVA

Semi-structured interviews with students in the experimental group were conducted to learn about students' opinions. The students were asked six questions and related sub-questions during the interviews. The categories and sub-categories from the interviews and the frequencies of the responses are given in Table 7.

Table 7. The categories and sub-categories obtained from the analysis of the interviews

| Themes | Categories | Sub-categories | Frequencies |
|---|---|---|---|
| Performing activities similar to flipped learning and gamification activities in other courses | Yes | - | 0 |
| | No | | 16 |
| Thought about flipped learning and gamification activities | Flipped learning | Has a positive aspect | 15 |
| | | Has a positive aspect | 1 |
| | | Has a negative aspect | 2 |
| | | Has no negative aspect | 14 |
| | | Enjoyable | 15 |
| | | Not enjoyable | 1 |
| | Gamification | Has a positive aspect | 15 |
| | | Has a positive aspect | 1 |
| | | Has a negative aspect | 6 |
| | | Has a negative aspect | 10 |
| | | Enjoyable | 15 |
| | | Not enjoyable | 1 |
| Thought about the instructiveness of flipped learning and gamification activities | Flipped learning | Instructive | 15 |
| | | Not instructive | 1 |
| | Gamification | Instructive | 16 |
| | | Not instructive | 0 |
| Difficulties or problems in the flipped learning and gamification activities | Flipped learning | Has a difficulty or problem | 0 |
| | | Has no difficulty or problem | 16 |
| | Gamification | Has a difficulty or problem | 6 |
| | | Has no difficulty or problem | 10 |
| Thought about flipped learning and gamification activities in other courses | Flipped learning | Should be used | 12 |
| | | Should not be used | 4 |
| | Gamification | Should be used | 14 |
| | | Should not be used | 2 |

The first question in the interview was "did you perform activities similar to the flipped learning and gamification activities we implemented in your other courses? If that is the situation, then how?" All the students answered "*no*" stating that they did not perform similar to the flipped learning or gamification activities in any course.

The students were asked "What do you think about using flipped learning activities in your course?" as a second question. 15 students gave the answers coded as "positive" and one student coded as "negative". "*It allows us to learn everything*" (Student 1), "*we can watch easily at home and take notes*" (Student 5), and "*it was fun to watch videos*" (Student 16) were examples of positive answers. "*It's not fun to learn at home*" said the student, who answered negatively (Student 4). "What are the aspects of flipped learning method that you think is positive and negative?" was asked regarding the second question. "*I learned what I do not know through the videos*" (Student 1), "*to watch the videos again*" (Student 2), "*I learned things I did not know*" (Student 8), "*I learned the subject with the videos at home. I concentrated in class while playing games*" (Student 9), and "*I saw the words we did not know in the videos*" (Student 13) were among the responses of 15 students whose responses were coded as "has a positive aspect". One student's answer was coded as "has no positive aspect". Two students' answers were coded as "has a negative aspect" and their explanations was "*we should do lessons in the classroom*" (Student 4), and "*I think the videos should be watched in the classroom*" (Student 16). 14 students' answers to the question were coded as "has no negative aspect". The final question asked concerning the second question was "do you think learning with the flipped learning activities are enjoyable or not?" 15 students' answers to this question were coded as "enjoyable" and, one student's answer "not enjoyable". "*Videos are like funny cartoons*" (Student 1), "*very amusing*" (Student 5), "*videos are incredibly fun*" (Student 9), and "*I think it is fun*" (Student 14) were among the 15 students' answers.

As the third question, the students were asked the following question: "What do you think about the use of gamification activities in your course?" 15 students gave the answers coded as "positive" and one student gave the answer coded as "negative". Examples of positive answers were "*badges are interesting, I loved playing games*" (Student 9), "*games contributed to my learning*" (Student 13), "*it's good to play*" (Student 4). The negative answer is "*it is better to listen to the lesson in the classroom*" (Student 3). Regarding the third question, the question "what are the aspects of gamification activities that you think are positive and negative?" was asked. "*It enables us to learn*" (Student 1), "*learning with the computer is fun and instructive*" (Student 2), "*it is better to teach religion at home. Gamification activities are fun, but should be in religion course* " (Student 4), "*we are competing and winners are getting badges, they become the star of the week*" (Student 5), "*I played a game to earn a badge*" (Student 8), "*I got a badge in class*" (Student 6), "*the positive aspect is that it was good that the teacher made a video instead of explaining it*" (Student 12), "*it is fun, we gain knowledge. We learn things we do not know*" (Student 15) were among the answers from 15 students whose answers were coded as "has a positive aspect". The explanation "*I do not like to play games*" (Student 3) was coded as "has no positive aspect". Six students' answers were coded as "has a negative aspect" and the examples of the student answers were "*boring*" (Student 3), "*not getting a badge*" (Student 6), "*not being able to look at what the teacher showed*" (Student 7), "*if we have not learned something, we can't do it. Some games were hard to play due to lack of knowledge*" (Student 10). 10 students' answers were coded as "has no negative aspect". Finally, regarding the third question, the question "do you think learning with the gamification activities are enjoyable or not?" was asked to the students. 15 students' answers were coded as "enjoyable", one student answer was coded as "not enjoyable".

Students were asked the following question in the fourth question: "What do you think about the instructiveness of flipped learning and gamification activities?" About the flipped learning activities, 15 students gave the answers coded as "instructive" and one student as "not instructive". The answer of the student, whose answer was coded as "not instructive", was "*the lesson at home is not instructive*" (Student 4). Examples of comments coded as "instructive" were "*I think it is good*" (Student 1), "*beautiful*" (Student 2), "*instructive*" (Student 3, 6, 11, 12, 14, 16), "*enabling us to learn*" (Student 10), "*I think it has a good effect*" (Student 13). Regarding the gamification activities, comments were received from all the students (16 students) that they were instructive. Answer examples were "*instructive*" (Student 1), "*very entertaining and teaching*" (Student 5), "*we learn well*" (Student 7), "*I think well*" (Student 10), "*I learned*" (Student 14).

The students were asked the following question as the fifth question: "Did you have any difficulties or problems in the flipped learning and gamification activities? If yes, please explain." Regarding flipped learning method, all the students (16) answered "no", stating that they did not have any difficulties or problems. Regarding the gamification activities, six students answered "yes". The responses of these students were "*Once my group friend accidentally left the game*" (Student 1), "I do not like to play games so I got bored" (Student 3), "The time of the games is short" (Student 6), "*I had difficulty answering the questions*" (Student 9 ), "*I did it wrong sometimes*" (Student 10), "*Doing it wrong or not being able to mark in the Kahoot application, lack of time*" (Student 15). 10 students answered "no" and indicated that they had no difficulties or problems.

In the sixth question, students were asked the following question: "What do you think about the use of flipped learning and gamification activities in other courses?" Regarding the flipped learning method, 12 students' answers were coded as "should be used" and four were coded as "should not be used". Examples of responses

coded as "should be used" were "*it should be used in religion class*" (Student 4), "*would be very good. I liked the videos*" (Student 5), "*I think it's good*" (Student 10), "*It would be good*" (Student 11), "*It would be good if it was used in religion class*" (Student 16), examples of responses coded as "should not be used" were "*Watching videos is boring*" (Student 9), "*We should not watch videos, we should do a lesson*" (Student 12). When asked why students wanted to use these methods in religion class, they indicated that they wanted to use them to be used because they did not like the religion course. Regarding gamification activities, 14 students' answers were coded as "should be used" and two students' answers were coded as "should not be used". One answer coded as "should not be used" was "*games are not played in every course, I cannot learn*" (Student 12).

## Discussion, Conclusion and Suggestions

The Ethics and Security subject of the fifth-grade ITS course was taught with flipped learning and gamification methods. Flipped learning is defined as performing the classroom activities at home and applying the activities given as homework in the classroom (Bergmann & Sams, 2012). The students could access videos online were prepared and shared with them for the flipped learning method. When the students who had learned at home with the videos came to the classroom, they made their learning permanent with gamification activities guided by the teacher (Demiralay & Karataş, 2014). Gamification activities were not games, although they came from a game concept. Game elements (badge, progress chart, winner's bulletin board, ambition to win, entertainment, motivation) were used in the gamification activities. The goal was for the students to learn while having fun and for all of them to be active. Online applications were used in some of the gamification activities, such as Kahoot and LearningApps.

It was revealed in the study that the students in the experimental group, who were taught with flipped learning and gamification methods, were more successful and had positive opinions about the methods. The content of the Ethics and Security subject, which includes abstract topics, was visualized and concretized with the videos used for the flipped learning activities. The students' success also was increased with the gamification activities. As a result, the students better learned the Ethics and Security subject, which was taught with flipped learning and gamification activities. It can be concluded that flipped learning and gamification methods may have facilitated students' learning. The flipped learning method allowed the students to learn at their own pace using virtual platforms at home. Students' learning was reinforced with the gamification activities in the classroom. Similarly, there were studies in the literature that used flipped learning and gamification methods together in the teaching (Alsancak Sırakaya, 2017; Gómez-Carrasco et al., 2020; Gündüz & Akkoyunlu, 2020; Huang et al., 2018; Huang & Hew, 2018; Hung, 2018; Lai & Foon, 2019; Lo & Hew, 2020; Matsumoto, 2016; Özer et al., 2018; Parra-González et al., 2021; Pozo Sánchez et al., 2020; Sailer & Sailer, 2021; Segura-Robles et al., 2020; Thongmak, 2019; Zainuddin et al., 2019; Zou, 2020). Matsumoto (2016) found that the flipped learning and gamification activities were to be successful in improving students' understanding and motivation. Huang et al. (2018) concluded that the gamified flipped learning group's post-test scores were higher than those of the non-gamified flipped learning group. Gündüz and Akkoyunlu, (2020) found that the experimental group taught with the online flipped learning and gamification activities had higher scores than the control group. In their studies, Huang and Hew (2018), Hung (2018), Lai and Foon (2019), Thongmak (2019), Zainuddin et al. (2019), Gómez-Carrasco et al. (2020), Lo and Hew (2020), Pozo Sánchez et al. (2020), Segura-Robles et al. (2020), Parra-González et al. (2021), Sailer and Sailer (2021), found that flipped learning and gamification methods were beneficial. The results matched the results of the studies in the literature. Using flipped learning and gamification methods to teach the Ethics and Security subject of the fifth-grade ITS course is recommended because the Ethics and Security subject is abstract.

It was determined how the experimental group's opinions about teaching in this study. The students expressed positive opinions about the methods in the semi-structured interviews. The students stated they learned the subjects from the flipped learning videos and that they found the flipped learning and gamification activities to be interesting, instructive, and enjoyable. As a result, it can be concluded that students can take on their own learning responsibilities and desire to engage in various activities during lessons. Besides studies in the literature reporting students' positive opinions about flipped learning method (Güç, 2017; Yavuz, 2016) and gamification methods (Yapıcı & Karakoyun, 2017), there were studies in the literature reporting students' positive opinions about use of these two methods together: Alsancak Sırakaya (2017), Huang and Hew (2018), Özer et al. (2018), Lai and Foon (2019), Thongmak (2019), Gómez-Carrasco et al. (2020), Lo and Hew (2020) and Zou (2020) concluded that participants in their studies had positive opinions about flipped learning and gamification methods. The students' opinions about the course used the flipped learning and gamification methods in this study were like those of the studies in the reviewed literature. Considering the students' success in the ethics and security success test, it can be concluded that the students' opinions revealed in the interviews support this finding. As a result, it

can be stated that teaching with flipped learning and gamification methods has a positive effect on students' success and opinions.

The effect of the flipped learning and gamification activities on learning the Ethics and Security subject was examined in this study. The effect of flipped learning and gamification activities on learning different subjects can be examined in different studies. The effect of the flipped learning and gamification activities on the students' success in the Ethics and Security subject was investigated in this study. The study has the limitations of 32 fifth-grade students and the measurement tool used in the study. Different measurement tools, such as scales like attitude scale, self-efficacy scale, can be used for the effect of flipped learning and gamification activities in another study. The nonequivalent group pretest-posttest design was used to collect the quantitative data. A true experimental study can be performed by randomly assigning participants to the experimental and control groups in another study. It can be studied with a sample that includes more participants in another study. The flipped learning videos were produced using PowToon, and the gamification activities were produced using Kahoot and LearningApps. Different applications can be used in different studies. The online platform EBA was used for the videos in the study. Other platforms can also be used in another study.

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## Author(s) Contribution Rate

**Gülseren Tarhan:** Conceptualization, Validation, Investigation, Resources, Data Curation, Writing - Original Draft, Visualization
**Gülcan Öztürk:** Conceptualization, Methodology, Validation, Formal analysis, Writing - Review & Editing, Supervision

## Conflicts of Interest

The authors declare that they have no conflict of interest.

## Ethical Approval (only for necessary papers)

Since the study was produced from a master's thesis completed before 2020, ethical approval was not obtained. But legal permission was obtained from the Ministry of National Education in Turkey to conduct the study and anonymity of the participants was provided in the reporting. In the study, no images were used by revealing the identity of the participants.

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