Journal of Learning and Teaching in Digital Age, 2023, **8**(1), 93-112
https://dergipark.org.tr/en/pub/joltida
ISSN: 2458-8350 (online)

Research Paper

Effects of Cognitive Load Level on Students' Attitude towards the Gamified Course

Fatma Burcu TOPU*[a]

[a](ORCID ID: 0000-0002-2130-8579), Atatürk University, burcutopu@hotmail.com
*Corresponding author

ARTICLE INFO

Received: 22 June 2022
Revised: 25 October 2022
Accepted: 26 October 2022

Keywords:
Gamified Course
Cognitive Load
Attitude

doi: 10.53850/joltida.1147246

ABSTRACT

The aim of this study was to examine the effects of cognitive load level on students' attitude towards the gamified course. It was also found out the students' views regarding the 14-week gamified course. Participants consisted of 66 undergraduate students. 40 of them had low cognitive load level and 26 of them had high cognitive load level. According to the results, gamification enabled students to have a positive attitude towards the course, even though they had different cognitive load levels. Furthermore, it was determined a negative and medium significant correlation between the cognitive load and attitude of students with low cognitive load. The gamified course had a positive effect on the "Valuing" and "Positive Effects" sub-dimensions of the attitude in favor of students with low cognitive load. The positive views of many students in qualitative findings strengthened these results. While the gamified course had a negative effect on the "Resisting" sub-dimension in favor of students with high cognitive load, it did not have any significant effect on the "Cost Belief" sub-dimension. A few negative views of students in qualitative findings supported the items in these dimensions of attitude scale. Consequently, this study will strengthen the few studies examining both cognitive and affective effects of a gamified course on students. However, further studies need to confirm these results. For this reason, it is recommended to carry out such studies that reveal all the situations which can affect the attitude in the gamified course in order to achieve positive outcomes of students with different cognitive load levels.

INTRODUCTION

The gamification acts an umbrella by using the game elements in non-game context to increase user participation and experience (Deterding et al., 2011; Werbach & Hunter, 2012). It covers a variety of elements such as competition, progress, rewards, collaboration, and interaction among participants to achieve the goals (Kapp et al., 2014; Zichermann & Cunningham, 2011). The positive results especially in the commercial field (Yang et al., 2017) have accelerated the widespread use of gamification in many fields including education (Dichev & Dicheva, 2017; Simões et al., 2013).

The studies on gamification report a relationship between cognitive and emotional psychology (Mullins & Sabherwal, 2020). The main function of gamification is to increase students' motivation by activating their positive emotions, and to support their participation and engagement in the course by providing their cognitive interaction with activities related to learning targets (Buckley et al., 2017; Huang & Hew, 2021; Mullins & Sabherwal, 2020). The course supporting with gamification elements such as competition, rewards, points, badges, leaderboard, and level-up positively affects the cognitive engagement of students and facilitate learning as well as Kahoot and ClassDojo gamified applications (Erümit & Yılmaz, 2022; da Rocha Seixas et al., 2016; Sánchez-Mena & Martí-Parreño, 2017). In addition, the belief of usefulness of gamification drives them to positive emotions and behaviors regarding gamification as well (Sánchez-Mena & Martí-Parreño, 2017). The reward systems encourage to progress within an enjoyable learning environment. The leaderboards also work as a motivation source which providing to students instantly see their progress and compare it with classmates (Dominguez et al., 2013; Huang & Hew, 2021). In other words, these gamification elements have a positive effect on students in terms of emotional aspects.

Attitude towards the Gamified Course

Kapp et al. (2014) stated that using game elements changes behavior and even emotionally attitude. Indeed, the attitude is the critical factor to emerge of the desired behavioral outcome, as it is a predictor of the student's intention to perform a behavior (Fishbein & Ajzen, 1975). At this point, one of the functions of gamification is to ensure its positive reflection on learning by directly influencing the attitude. In other words, gamified elements enable to behaviors which bring about positive effects on learning when they create positive attitude (Deterding et al., 2011; Smith, 2017). Therefore, it is important to identify the attitude score as it provides not only during the learning experience but also an overall prediction regarding students' motivation and attitude towards future gamified courses (Dominguez et al., 2013; Luo et al., 2021).

Many studies results confirmed that gamification elements such as points, badges, leaderboard, and gamified applications had the potential to increase students' attitude towards the course (Ding et al., 2017; Dominguez et al., 2013; Tan & Hew, 2016). Bai (2021)

reported that most students had a positive attitude towards the use of leaderboards in a gamified course because of its potential to create a competitive and comparison environment. According to Özer et al. (2018), using Kahoot as a gamified tool positively influenced the teacher candidates' attitude towards the coding education. Similarly, Rahman et al. (2018) determined that students using Kahoot showed a quite positive attitude towards the gamification as a fresh approach in learning environment. Philpott (2020) revealed that students' high or middle ranking in leaderboard positively affected their performance, emotions, and attitude towards the gamified English course. Öden-Sercanoğlu et al. (2021) determined that using Kahoot as a gamified application in experimental group significantly increased the attitude of the vocational high school students towards the English course whereas attitude of control group decreased.

Galbis-Córdova et al. (2017) figured out that perceived attention, relevance, and confidence affected directly and positively the attitude of undergraduate students towards gamified course. Öztürk and Korkmaz (2020) determined that the gamification significantly increased the fifth grade students' total attitude as well as love, interest, motivation, and trust sub-dimensions except of benefit sub-dimension of attitude scale towards the social studies course more than traditional method. Smith (2017) revealed that gamification reduced students' belief on difficulty of the statistics course (the sub-factor of attitude) and facilitated learning. Sun-Lin and Chiou (2019) found out that the gamification significantly increased the sixth grade students' total attitude as well as enjoyment, motivation, and perceived value sub-dimensions except of confidence sub-dimension towards the algebra course more than control groups. Turan et al. (2016) obtained the qualitative findings that students had the positive attitude towards the gamified course. Yildirim (2017) revealed a significant difference between undergraduate students' attitude scores in affective sub-dimension in favor of gamified group whereas not any difference in emphasis sub-dimension.

Despite the mentioned positive results for attitude in gamified courses, some studies noticed that gamification had not any significant effect on students' attitude. Ertan (2020) determined that there was no significant difference between the attitude scores of the students according to the course achievement levels. According to Türkmen and Soybaş (2019), even if the attitude score of the experimental group was higher than the control group, there was no significant difference between fifth grade students' attitude towards the English course in control and experimental groups. Uz-Bilgin and Gul (2020) determined that the attitude score of experimental group using Edmodo badges was higher than control group. They also found out that although gamification was a positive effect on student's in-group interaction, it was not any effect on students' attitude towards collaborative learning environments.

It is also available the studies to reveal the negative effect of gamification on attitude. Hanus and Fox (2015) stated that students in gamified group were less satisfied than non-gamified group. Moreover, Philpott (2020) determined that the students' low ranking in leaderboard negatively affected their performance, emotions, and attitude towards the gamified English course. Ding et al. (2017) determined that a few of the participants indicated negative attitude towards the gamified course. According to Dominguez et al. (2013), some students had a negative attitude towards the gamified course as the leaderboard created a comparative and competitive learning environment. They also stated that this reaction was more likely to cause poor performance compared to the positive one.

Cognitive Load in Gamified Course

The gamification elements acting as external motivational stimuli at producing desired student's behaviors lead to strong or weak cognitive relationships between student's attitude and behavior (Mee et al., 2021). The success or failure in the gamification process can also trigger various emotions in students (Dominguez et al., 2013). For this reason, gamification is perceived as a useful approach to facilitate learning whereas as a potential risk for in-class atmosphere (Sánchez-Mena & Martí-Parreño, 2017).

The gamified activities including audio-visual materials and competitive tasks may cause highly cognitive effort in students (Becker, 2005). According to cognitive load theory, it is important to keep the cognitive effort and the working memory at optimal level for easily perceiving and encoding the knowledge in mind (Mavilidi & Zhong, 2019; Paas & van Merriënboer, 2020; Sweller, 2010). The simultaneous presentation of related content and materials may support this situation (Debue & van de Leemput, 2014). Cognitive absorption occurs in a positive way when effective stimuli are used to arouse the student's interest in learning (Wu, 2018).

In contrast, this situation may lead to overloading of limited capacity working memory and thus, negatively influence to students in cognitive aspect (Moreno, 2010; Sweller et al., 2019). Additionally, when students overcome this effort and challenge, the negative emotions may also emerge (Mullins & Sabherwal, 2020). In other words, unsuitable implementations in the learning process emerge negative feelings as well as high cognitive load by causing cognitive absorption in a negative way (Wu, 2018). Accordingly, it is critical point to investigate the gamified process by considering both cognition and emotion aspects (Mullins & Sabherwal, 2020).

Researches on cognitive load theory keep the importance depending on contributions to learning (Ayres, 2020). In this direction, it was available a few studies regarding cognitive load in gamified process. Wu (2018), in the study comparing different learning environments, revealed that cognitive load level of undergraduate students was lower, whereas their cognitive absorption and perception of learning performance were higher in the gamified group than the others groups. Wu also concluded that learning materials including rich media in gamification had the potential to facilitate students' cognitive absorption and positively affected their emotions.

According to Shaban et al. (2021), third grade students with a lower cognitive load level were better learning performance and perceived experience in the gamification activities. Furthermore, there was negative correlation between both learning performance

and experience, and cognitive load of students. They also determined that the students had generally optimum cognitive load during gamification, were eager to participate it, and enjoyed. Su (2016) revealed that gamification was not only a useful approach to decrease the learning anxiety and cognitive load but also to increase learning motivation and academic performance.
However, Turan et al. (2016) determined that students had highly cognitive load level in gamification process. Sevcenko et al. (2021) reported that cognitive load depended on not only the complexity of the activity but also timing of the task as it might quickly change when performing the task. They also stressed that even if each student was performing the same task, they might make different mental effort.

The contrasting results of the mentioned studies point out that it is important to decrease cognitive load level whereas increase learning performance of students in gamified activities (Shaban et al., 2021). Regardless of the reason of cognitive load, it should be applied the learning activities by considering the critical importance to manage it (Ayres, 2020; Sevcenko et al., 2021).

Purpose of the Study

It is necessity to highlight that integrating the gamification elements into the learning environments may not guarantee positive effect on learning outcomes. It is more important how gamification is implemented (Dominguez et al., 2013; Kapp et al., 2014; Uz-Bilgin & Gul, 2020). Yildirim (2017) concluded that even if gamification had not any cognitively effect on students, it had a significant positive affectively effect on them. Martí-Parreño et al. (2016) reported that although many teachers had positive attitude towards gamification, just a few of them regularly used the gamification in their courses.

It is available the criticisms regarding gamification (Luo et al., 2021), as it is an approach which directs the emotion and behavior of the participants (Kim & Werbach, 2016). The reward leads the ambition because of heavy competition. It causes students with lower ranking in the leaderboard have negative feelings (Hanus & Fox, 2015). It is important to prefer the suitable gamification tools and elements considering the context of learning process to stimulate positive feeling and desired behavior of student (Adams & Preez, 2022; Kapp et al., 2014; Werbach, & Hunter, 2012).

Consequently, gamification as an intermediary must successfully make changes attitude and behavior of learners in order to strengthen effectiveness of the instruction (Dichev & Dicheva, 2017). From this point, this study aims to use various gamification elements and tools to ensure students' positive attitude towards the course and keep their cognitive load at optimal level. For this reason, this study spreading a long-term process also aims to guide the future studies by explaining the reason which gamification elements and tools preferred throughout 14-week gamified course in the "implementation" section.

On the other hand, the positive findings of the mentioned studies show that gamification can be used to participate in the students not interested in the course and to increase their attitudes towards the course. However, many of these studies compare the students' attitude towards gamified and non-gamified course. Additionally, most of the studies about gamification focus on students' affective aspect, while just a few studies underline that it needs to be considered the cognitive aspect in gamification as well (Sevcenko et al., 2021; Shaban et al. 2021; Su, 2016; Wu, 2018).

As for this study, it was examined to the effects of cognitive load level on students' attitude towards the gamified course and their views. In this context, the results of this study will strengthen the literature regarding gamification in education the cognitive and affective aspect. Accordingly, the research questions of the study are following.

1. What are the cognitive load levels of the students in the gamified course?
2. What are the attitudes of students with low and high cognitive load levels towards the gamified course?
3. Do the cognitive load levels of students have a significant effect on the attitude towards the gamified course?
4. Are there any significant correlations between cognitive load and attitude of students with low and high cognitive load levels?
5. What are the views of students with low and high cognitive load levels regarding the 14-week gamified course?

METHOD

Research Design

The quantitative and qualitative research designs were applied in this study (Creswell, 2014). Quantitatively, it was determined whether there was a significant difference between the attitudes of students with low and high cognitive load towards the gamified course. In addition, it was figured out the correlation between the attitude and cognitive load of these students. As for qualitatively, it was revealed the positive and negative views of the students regarding the 14-week gamified process.

Participants

The participants determined by convenience sampling (Creswell, 2014) were 66 undergraduate students attending the gamified course conducted by the researcher. 40 students had low cognitive load level (CL_{Low}) while 26 students had high level (CL_{High}). In addition, the total 51 volunteer students (31 of them with CL_{Low} and 20 of them with CL_{High}) answered the structured interview questions. Demographic information of the participants is presented in Figure 1.

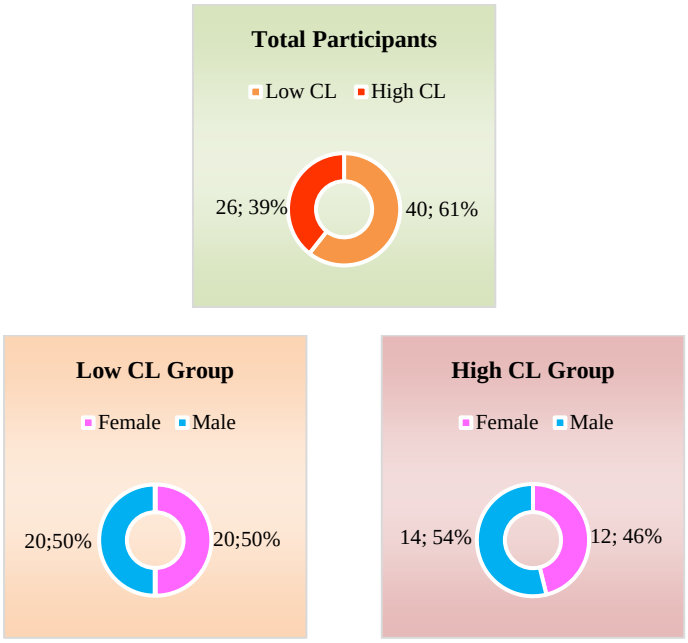


Figure 1. Demographic information of the participants

Data Collection Tools

Cognitive Load Scale was developed by Paas and van Merriënboer (1994) and Cronbach's alpha of the one-item scale was calculated as α =.82. This scale was 9-grades from 1=too low to 9=too high cognitive load level. According to this score range, students with less than five point (<5) were in CL_{Low} group, and with five or more (>=5) were in CL_{High} group. The scale was applied to found out students' mental effort level in the gamified course process, as well as to compare the attitudes and views towards this course of students with low and high cognitive load level.

Attitude Scale was applied by Koç (2014). The 27-items scale (α=.93) consisted of four sub-dimensions: Valuing (ten items, α=.94), Resisting (seven items, α=.89), Positive Effects (six items, α=.90), and Cost Belief (four items, α=.84). The rating of 5-point Likert scale was from 1 (strongly disagree) to 5 (strongly agree). It was assumed that the intervals was equal in the 5-point Likert rating scale. For the interpretation of arithmetic mean scores, the formula "Score Range = (Highest Value – Lowest Value) / 5 = (5 – 1) / 5 = 4 / 5 = 0.80" was used. Accordingly, score range was calculated as 1.00-1.80 (Strongly Disagree) "quite low attitude", 1.81-2.60 (Disagree) "low attitude", 2.61-3.40 (Neutral/Neither Disagree nor Agree) "medium attitude", 3.41-4.20 (Agree) "high attitude", and 4.21-5.00 (Strongly Agree) "quite high attitude". It was accepted that the students' attitude towards the gamified course were higher as the scores approached 5.00, and lower as they approached 1.00.

Structured Interview Guide was created by the researcher who was also the instructor of the course in order to the students freely answer the questions. Accordingly, it was asked open-ended questions to obtain their positive and negative views regarding the 14-week implementation and evaluation process in this gamified course. Although the form was applied online to all participants at the end of the course, some students did not answer the questions. Therefore, the response of the volunteer students were taken as qualitative data.

Gamifying of the Course Process

The gamified course process was based on one of the instructional design models, the Planning-Implementation-Evaluation model (Newby et al., 2000). This model was used to guide what and which educational resources such as learning and teaching approaches, instructional technologies, students and teachers, why, when, and how to integrate into the learning environments. According to course schedule, the gamified course lasted 14 weeks. Weekly course period were four lesson hours. The whole process in a semester conducted and managed by the researcher as this course instructor was completed in total 56 hours. The gamified course process is summarized in Figure 2.

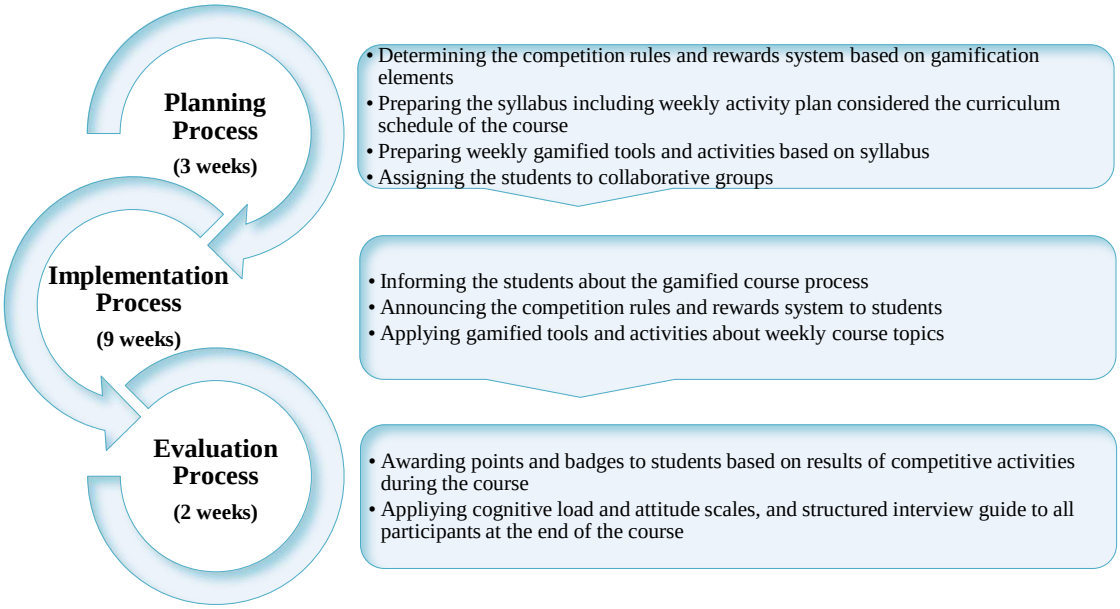


Figure 2. Summary of gamified course process

Planning Process

Firstly, the instructor, considering some gamification elements of Werbach and Hunter (2015), has determined the competition rules and rewards system on ClassDojo and Edmodo apps. Figure 3 shows how the gamified elements and tools are utilized in this study.

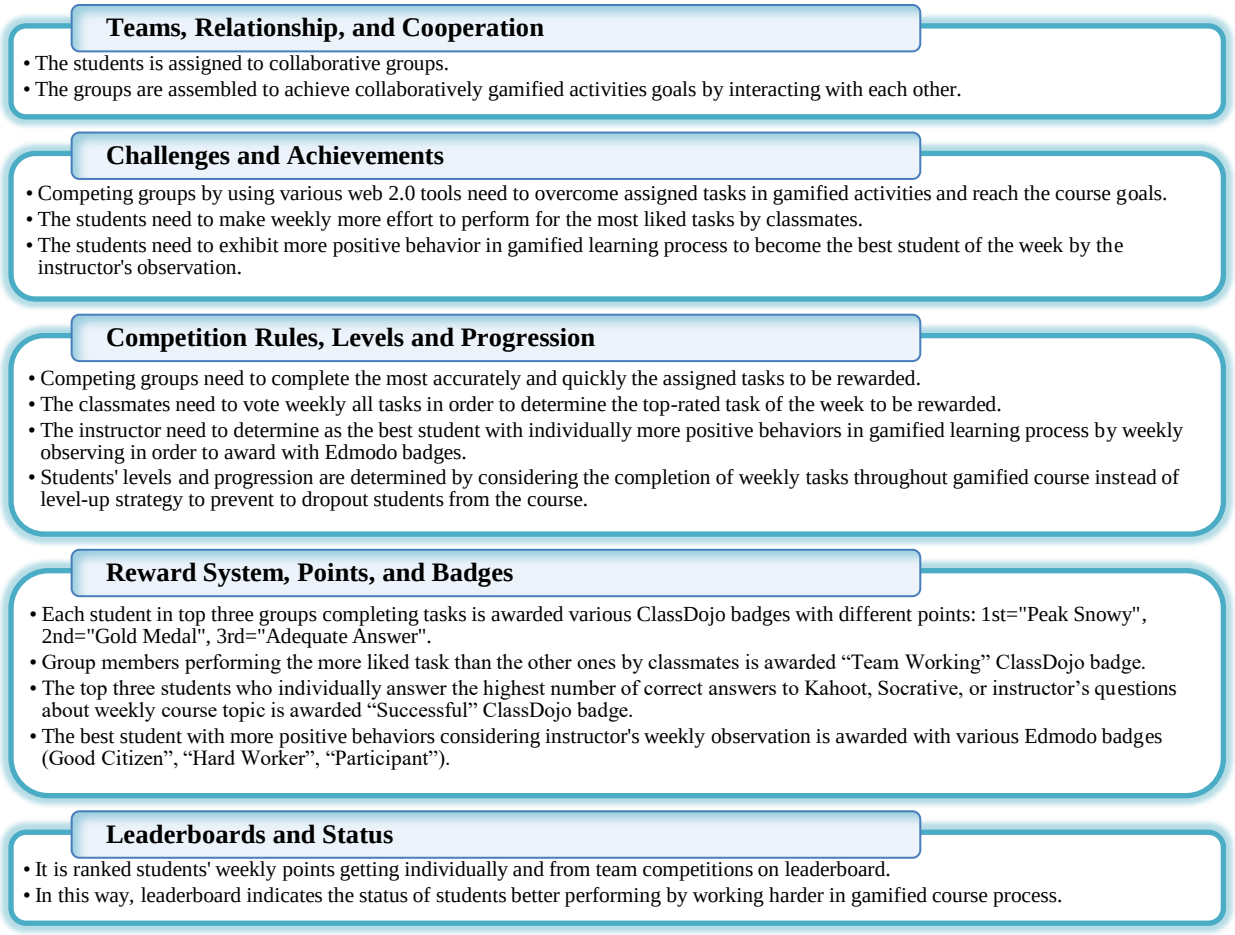


Figure 3. Utilizing the gamified elements and tools in the study

According to Figure 3, the students' levels and progression depend on their completion of weekly tasks using various web 2.0 tools (Jigsaw Puzzle, QR Code Hints, Padlet, Pawtoon, Storyboard.That, and Kahoot etc.) throughout the gamified course. Namely, unlike

the level-up strategy, the levels are not locked. The students who attend weekly lessons are able to pass that level. However, in order to continue their chance to be on the leaderboard, they have to get points and badges, and for this they have to attend the each lesson.

The task completion timing is adjusted on ClassDojo considering difficulty level of tasks, and thus, it is expected that each group completed these tasks in the same time. The members of the top three groups who completed the tasks most accurately and quickly are awarded ClassDojo badges with various names and different points by the instructor: 1st="Peak Snowy" (3 points), 2nd="Gold Medal" (2 points), 3rd="Adequate Answer" (1 point). ClassDojo badge named "Team Working" (1 point) are awarded to the group members performed the more liked task than the other ones by voting classmates. Additionally, the top three students individually who got the highest number of correct answers to Kahoot, Socrative, or instructor's questions about weekly course topic are awarded ClassDojo badge named "Successful" (1 point * student's rank in the list).

Furthermore, at the beginning of the implementation process, it is announced that the best student with more positive behaviors considering instructor's weekly observation will be rewarded with various named Edmodo badges after the lesson: "Good Citizen", "Hard Worker", and "Participant" (1 point). In this way, it is tried to keep activeness of students throughout the learning process and to prevent distraction of them.

After determining the competition rules and rewards system based on gamification elements, the instructor has prepared the syllabus with the weekly activity plan based on curriculum schedule of the course including knowledge on the critical features and implementation steps of various learning and teaching approaches. While preparing the activity plan, it has been considered the contents of undergraduate and graduate courses on gamification conducted by the instructional technology experts as well as literature. Additionally, the instructor as faculty member, who is an expert in instructional technologies, has been conducting this course about learning and teaching approaches for ten years, and frequently applying the online tools as well as various gamification elements in in-class activities. Accordingly, the activity plan and using web 2.0 tools, in which group members interact with each other to achieve the goals in gamified tasks related to weekly topics, is summarized in Figure 4.

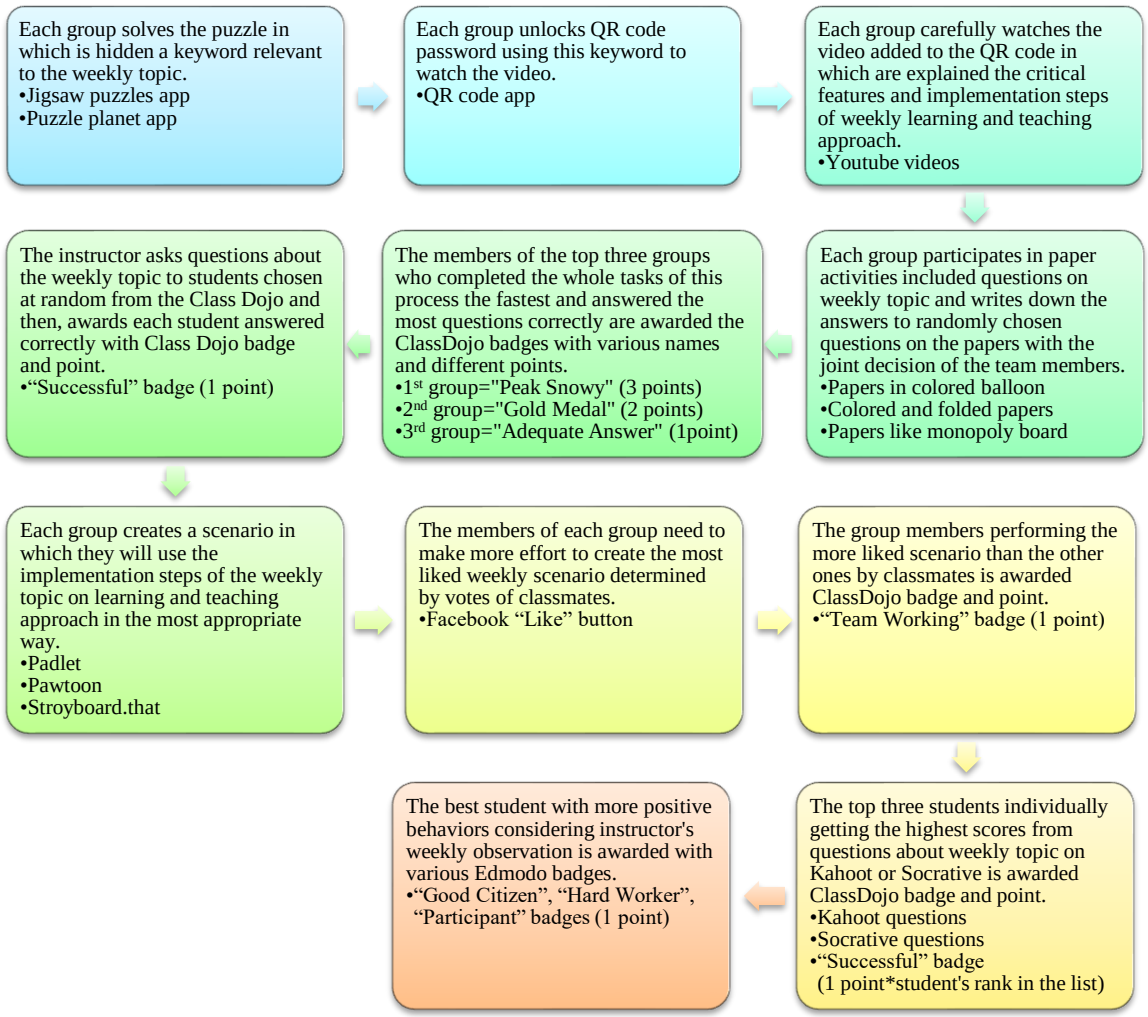


Figure 4. The activity plan

The instructor, considering the activity plan in Figure 4, has prepared weekly gamified tasks using various web 2.0 tools and in-class activities about course topics and then, has assigned the students to collaborative groups. Accordingly, gamification elements, tools, tasks and activities about weekly course topics has been carried out in implementation process based on the detailed planning in Figure 3 and Figure 4 above.

Implementation Process

According to activity plan, how to apply the gamified course process in four lesson hours per week is explained in-detail as follows:

In the first lesson of each week, each group solved the puzzle in which was hidden a keyword relevant to the weekly topic by using Jigsaw puzzle or Puzzle planet apps. Each group solving this puzzle unlocked password with QR code app on the phone using that keyword to watch the video. Then, each group carefully watched the Youtube video added to the QR code in which were explained the critical features and implementation steps of weekly learning and teaching approach. The groups could replay the video. However, it was recommended that groups watched the video carefully once to increase their chances of being #1.

In second lesson of each week, each group participated in paper activities included questions on weekly topic and wrote down the answers to randomly chosen questions on the papers with the joint decision of the team members considering the video content. These paper activities made modify from week to week as papers in colored balloon, colored and folded papers, or papers like monopoly board. The members of the top three groups who completed the whole tasks of this process the fastest, and answered the most questions correctly were awarded the ClassDojo badges with various names and different points: 1st group = "Peak Snowy" badge (3 points), 2nd group = "Gold Medal" badge (2 points), and 3rd group = "Adequate Answer" badge (1point). Following the paper activities, the instructor asked questions about the weekly topic to students chosen at random from the Class Dojo and then, awarded each student answered correctly with Class Dojo badge and point: "Successful" badge (1 point).

In third lesson of each week, each group created a scenario in which they used the implementation steps of the weekly topic on learning and teaching approach in the most appropriate way. The scenario creation apps varied from week to week as Padlet, Pawtoon, or Storyboard.That. The members of each group needed to make more effort to create the most liked weekly scenario determined by votes of classmates. Each group uploaded the created scenarios to the Facebook page of the course. The classmates voted on all scenarios with Facebook "Like" button. The group members performing the more liked scenario than the other ones by classmates was awarded ClassDojo badge and point: "Team Working" badge (1 point).

In fourth lesson of each week, the instructor applied the Kahoot or Socrative questions about weekly topic to all students. The top three students individually getting the highest scores from the app were awarded ClassDojo badge and point: "Successful" badge (1 point * student's rank in the list). Furthermore, at the end of the fourth lesson on that topic, the best student with more positive behaviors considering instructor's weekly observation was awarded with various Edmodo badges: "Good Citizen", "Hard Worker", or "Participant" badges (1 point). It is also presented some examples of activity photos regarding the gamified course in Figure 5.

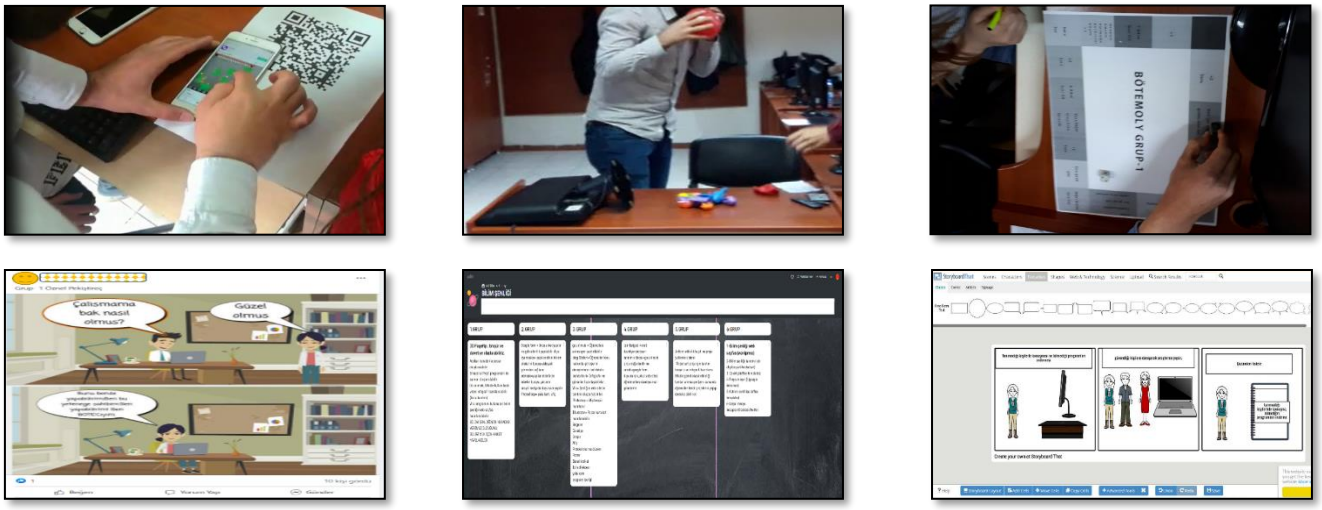


Figure 5. The gamified activity photos

Evaluation Process

The evaluation process continued throughout the gamified course, and various ClassDojo and Edmodo badges were given to students based on their weekly performance. Furthermore, the instructor determined the students who the most attendance the course, active participant, helpful, eager for performing the competition tasks in each week by observing, and then gave various Edmodo badges (1 point) to them for these positive behaviors. Moreover, the instructor did not announce to them which student earned which Edmodo badges on a weekly basis. In this way, the instructor tried to ensure continuity of their participation in the course by arousing curiosity among the students. The screenshots of ClassDojo leaderboard and Edmodo badges of the students at the end of the gamified process are presented in Figure 6.

© 2023, *Journal of Learning and Teaching in Digital Age*, *8*(1), 93-112

ClassDojo Leaderboard **Edmodo Badges**

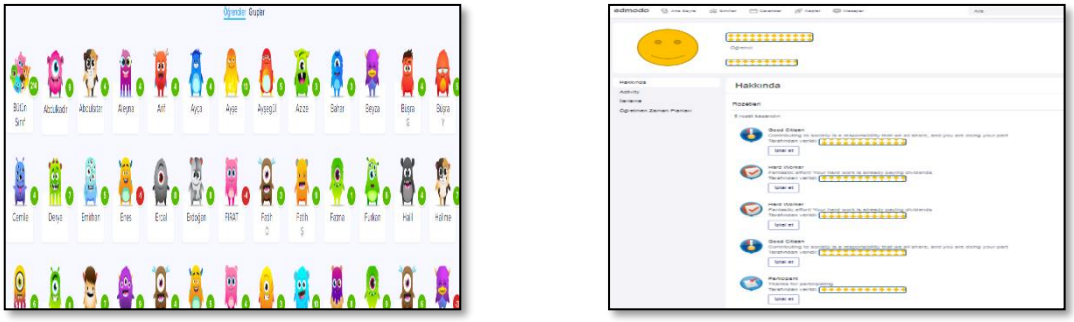


Figure 6. Screenshots of ClassDojo leaderboard and Edmodo badges

Finally, the instructor added each student's total points getting from ClassDojo and Edmodo badges throughout gamified course process to course score. At the end of the gamified course process, the instructor as the researcher applied the cognitive load and attitude scales to all participants. The volunteer students also fulfilled the online structured interview guide.

Data Analysis

For the quantitative data analysis was used SPSS 18. According to tests of normality, the dataset of students with CL_{Low} and CL_{High} were not a normal distribution, and Kolmogorov-Smirnov and Shapiro-Wilk results are presented in Table 1.

Table 1. Test of normality results

	Group	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Valuing	CL_{Low}	.140	40	.046	.866	40	.000
	CL_{High}	.164	26	.070	.870	26	.004
Resisting	CL_{Low}	.138	40	.053	.930	40	.016
	CL_{High}	.121	26	.200*	.974	26	.722
Positive Effects	CL_{Low}	.150	40	.025	.854	40	.000
	CL_{High}	.200	26	.009	.875	26	.005
Cost Belief	CL_{Low}	.160	40	.012	.955	40	.111
	CL_{High}	.138	26	.200*	.900	26	.016
Total Attitude	CL_{Low}	.090	40	.200*	.933	40	.020
	CL_{High}	.125	26	.200*	.968	26	.580
Cognitive Load	CL_{Low}	.310	40	.000	.838	40	.000
	CL_{High}	.220	26	.002	.872	26	.004

Considering test of normality results in Table 1, non-parametric tests were used for quantitative data analysis. For the first, second, and third research questions; Mann-Whitney U test was used to compare the attitude towards the gamified course of students with CL_{Low} and CL_{High}, as well as to examine cognitive load average of them. For the fourth research question, Spearman's rank correlation test was carried out to determine correlation between cognitive load and attitude of students with CL_{Low} and CL_{High}.

As to fifth research question, for the qualitative data analysis was used NVIVO 12. The views of students with CL_{Low} and CL_{High} regarding in 14-week gamified course were revealed in-detail by content analysis. Accordingly, first of all, codes were determined, and themes related to these codes were presented by dividing positive and negative views categories. The frequencies of students with CL_{Low} and CL_{High} for each theme were shown in comparison with bar-charts. These themes were supported by quotations of students expressions with ID no (Students with low CL level = CL_{Low} X, Students with high CL level = CL_{High} X).

RESULTS

Cognitive Load Levels of Students in Gamified Course

First of all, it was determined the cognitive load average of all students participating in gamified course. It was classified the students with less than five point (<5) as having low CL level (CL_{Low}), and with five or more (>=5) as having high CL level (CL_{High}) considering the score range of cognitive load scale. The descriptive results are lied out in Table 2.

Table 2. Cognitive load average and level of the students

Group	n	M	SD	Min.	Max.
CL_{Low}	40	2.75	.142	1.00	4.00
CL_{High}	26	6.15	.181	5.00	8.00
General CL	66	4.09	.234	1.00	8.00

According to Table 2, it was found out that the number of students with CL_{Low} was more than students with CL_{High} (n_{Low}= 40, M_{Low}=2.75 <5, n_{High}= 26, M_{High}=6.15 >5). In addition, it was determined that the general cognitive load average of all students participating in the gamified course was at a low level (n=66, M= 4.09<5).

The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} in terms of cognitive load average. The test results are presented in Table 3.

Table 3. Mann-Whitney U test results of cognitive load averages of students with CL_{Low} and CL_{High}

Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p	η^2
CL_{Low}	40	20.50	820.00	.000	-6.967	.000	-.84
CL_{High}	26	53.50	1391.00				

The results in Table 3 indicated that there was a significant difference between the cognitive load averages of students with CL_{Low} and CL_{High}. Accordingly, it was compared the attitude towards the gamified course of these two different groups of students with CL_{Low} and CL_{High}.

Effects of Students' Cognitive Load Level on Attitude towards the Gamified Course

It was determined attitude averages of students with CL_{Low} and CL_{High}. Descriptive analysis results are presented in Table 4 according to total and sub-dimension of attitude average.

Table 4. Attitude averages of students with CL_{Low} and CL_{High}

Sub-Dimension	Group	M	SD	Min.	Max.
Valuing	CL_{Low} (n=40)	4.11	.113	1.30	5.00
	CL_{High} (n=26)	3.65	.149	1.00	5.00
Resisting	CL_{Low}	2.50	.122	1.29	4.43
	CL_{High}	3.25	.150	1.86	4.86
Positive Effects	CL_{Low}	4.27	.094	1.83	5.00
	CL_{High}	3.72	.172	1.00	5.00
Cost Belief	CL_{Low}	3.48	.104	2.00	4.75
	CL_{High}	3.67	.142	1.25	5.00
Total Attitude	CL_{Low}	3.63	.053	2.41	4.33
	CL_{High}	3.57	.107	2.15	4.85
General Attitude	All Students (n=66)	3.61	.052	2.15	4.85

According to Table 4, all students participating in gamified course had highly attitude towards the course (M= 3.61>3.4). In addition, it was determined that the attitudes of students with CL_{Low} were higher than students with CL_{High} (M_{Low}=3.63, M_{High}=3.57). On the other hand, it was found out that the averages of the attitude "Resisting" sub-dimension of students both with CL_{Low} and CL_{High} were lower than the other sub-dimensions (M_{Low}=2.50, M_{High}=3.25 <3.4).

The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} in terms of attitude average. The test results are presented in Table 5.

Table 5. Mann-Whitney U test results of attitude average of students with CL_{Low} and CL_{High}

Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p	η^2
CL_{Low}	40	35.31	1412.50	447.500	-.952	.341	-.12
CL_{High}	26	30.71	798.50				

The results in Table 5 indicated that there was not any significant difference between the attitude averages of students with CL_{Low} and CL_{High}. However, the attitude of students with CL_{Low} was higher than with CL_{High}.

Effect of Students' Cognitive Load Level on Attitude "Valuing" Sub-Dimension

The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} in terms of attitude "Valuing" sub-dimension average. The test results are presented in Table 6.

Table 6. Mann-Whitney U test results of attitude "Valuing" sub-dimension average of students with CL_{Low} and CL_{High}

Sub-Dimension	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p	η^2
Valuing	CL_{Low}	40	38.98	1559.00	301.000	-2.884	.004	-.35
	CL_{High}	26	25.08	652.00				

The results in Table 6 indicated that there was a significant difference between the attitude "Valuing" sub-dimension average of students with CL_{Low} and CL_{High} in favor of students with CL_{Low}. Accordingly, the effect of the cognitive load level on the "Valuing" sub-dimension of the attitude towards the course was moderate ($p=.004<.05$, $\eta^2= -.35 >0.3$).

The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} regarding average of each item in the "Valuing" sub-dimension of attitude scale. The test results are presented in Table 7.

Table 7. Mann-Whitney U test results regarding each item in "Valuing" sub-dimension of attitude scale of students with CL_{Low} and CL_{High}

Item	Group	M	SD	Likert Rating	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p
1. It is useful for teaching.	CL_{Low}	4.15	.893	Agree	37.73	1509.00	351.000	-2.539	.011
	CL_{High}	3.69	0.884	Agree	27.00	702.00			
3. It is in line with my perspective related to teaching.	CL_{Low}	4.03	.832	Agree	37.67	1507.00	353.000	-2.424	.015
	CL_{High}	3.58	.758	Agree	27.08	704.00			
5. I think it improves teachers.	CL_{Low}	4.02	1.097	Agree	37.13	1485.00	375.000	-2.072	.038
	CL_{High}	3.65	.892	Agree	27.92	726.00			
7. I care about using it.	CL_{Low}	4.13	.883	Agree	37.44	1497.50	362.000	-2.302	.021
	CL_{High}	3.73	.778	Agree	27.44	713.50			
9. I believe that it should be used in lessons.	CL_{Low}	4.23	.832	Agree	37.16	1486.50	373.500	-2.121	.034
	CL_{High}	3.81	.895	Agree	27.87	724.50			
11. I feel good when I use it.	CL_{Low}	4.05	.876	Agree	36.98	1479.00	381.000	-1.973	.049
	CL_{High}	3.62	.983	Agree	28.15	732.00			
13. The educational developments necessitate the use of it.	CL_{Low}	4.10	.810	Agree	37.78	1511.00	349.000	-2.496	.013
	CL_{High}	3.62	.852	Agree	26.92	700.00			
15. I think it is suitable for my personal characteristics.	CL_{Low}	4.07	.764	Agree	38.73	1549.00	311.000	-2.996	.003
	CL_{High}	3.38	.983	Agree	25.46	662.00			
17. I think using it professionalizes the teacher.	CL_{Low}	4.13	.853	Agree	37.39	1495.50	364.500	-2.173	.030
	CL_{High}	3.62	1.023	Agree	27.52	715.50			
19. It improves students' social skills.	CL_{Low}	4.18	.813	Agree	36.61	1464.50	395.500	-1.825	.068
	CL_{High}	3.85	.834	Agree	28.71	746.50			

According to the results for each item in the "Valuing" sub-dimension in Table 7, there was a significant difference between the students with CL_{Low} and CL_{High} in favor of students with CL_{Low}, except for item 19. However, the likert rating related to items of both students groups were "Agree".

Effect of Students' Cognitive Load Level on Attitude "Resisting" Sub-Dimension

The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} in terms of attitude "Resisting" sub-dimension average. The test results are presented in Table 8.

Table 8. Mann-Whitney U test results of attitude "Resisting" sub-dimension average of students with CL_{Low} and CL_{High}

Sub-Dimension	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p	η^2
Resisting	CL_{Low}	40	26.54	1061.50	241.500	-3.662	.000	-.44
	CL_{High}	26	44.21	1149.50				

The results in Table 8 indicated that there was a significant difference between the attitude "Resisting" sub-dimension average of students with CL_{Low} and CL_{High} in favor of students with CL_{High}. Accordingly, the effect of the cognitive load level on the "Resisting" sub-dimension of the attitude towards the course was moderate ($p=.000<.05$, $\eta^2= -.44 >0.3$).
The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} regarding average of each item in the "Resisting" sub-dimension of attitude scale. The test results are presented in Table 9.

Table 9. Mann-Whitney U test results regarding the each item in "Resisting" sub-dimension of attitude scale of students with CL_{Low} and CL_{High}

Item	Group	M	SD	Likert Rating	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p
2. It is not suitable for this course.	CL_{Low}	2.17	1.107	Disagree	29.88	1195.00	375.000	-2.018	.044
	CL_{High}	2.73	1.151	Neutral	39.08	1016.00			
4. It is not suitable for my personal characteristics.	CL_{Low}	2.13	1.067	Disagree	27.43	1097.00	277.000	-3.325	.001
	CL_{High}	3.04	1.076	Neutral	42.85	1114.00			
6. I think it is quite difficult to apply it.	CL_{Low}	2.80	1.114	Neutral	27.96	1118.50	298.500	-3.005	.003
	CL_{High}	3.65	.977	Agree	42.02	1092.50			
8. I prefer to use what I know approaches rather than it.	CL_{Low}	2.70	1.285	Neutral	30.10	1024.00	384.000	-1.847	.065
	CL_{High}	3.27	1.116	Neutral	38.73	1007.00			
10. Using conventional approaches gives me confidence.	CL_{Low}	3.27	1.198	Neutral	30.36	1214.50	394.500	-1.706	.088
	CL_{High}	3.77	.992	Agree	38.33	996.50			
12. It does not fit my educational philosophy.	CL_{Low}	2.17	1.279	Disagree	27.55	1102.00	282.000	-3.222	.001
	CL_{High}	3.15	1.156	Neutral	42.65	1109.00			
14. It weakens the teacher's authority in the classroom.	CL_{Low}	2.25	1.256	Disagree	28.44	1137.50	317.500	-2.737	.006
	CL_{High}	3.15	1.287	Neutral	41.29	1073.50			

According to the results for each item in the "Resisting" sub-dimension in Table 9, there was a significant difference between the students with CL_{Low} and CL_{High} in favor of students with CL_{High}, except for item 8 and 10. However, the likert rating related to items of both students groups were mostly "Neutral".

Effect of Students' Cognitive Load Level on Attitude "Positive Effects" Sub-Dimension

The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} in terms of attitude "Positive Effects" sub-dimension average. The test results are presented in Table 10.

Table 10. Mann-Whitney U test results of attitude "Positive Effects" sub-dimension average of students with CL_{Low} and CL_{High}

Sub-Dimension	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p	η^2
Positive Effects	CL_{Low}	40	39.15	1566.00	294.000	-2.987	.003	-.36
	CL_{High}	26	24.81	645.00				

The results in Table 10 indicated that there was a significant difference between the attitude "Positive Effects" sub-dimension average of students with CL_{Low} and CL_{High} in favor of students with $CL_{Low.}$ Accordingly, the effect of the cognitive load level on the "Positive Effects" sub-dimension of the attitude towards the course was moderate ($p=.003<.05$, $\eta^2= -.36 >0.3$).
The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} regarding average of each item in the "Positive Effects" sub-dimension of attitude scale. The test results are presented in Table 11.

Table 11. Mann-Whitney U test results regarding the each item in "Positive Effects" sub-dimension of attitude scale of students with CL_{Low} and CL_{High}

Item	Group	M	SD	Likert Rating	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p
16. It provides more permanent learning.	CL_{Low}	4.43	.636	Strongly Agree	38.25	1530.00	330.000	-2.737	.006
	CL_{High}	3.88	.864	Agree	26.19	681.00			
18. It develops a sense of responsibility in students.	CL_{Low}	4.32	.764	Strongly Agree	37.67	1507.00	353.000	-2.450	.014
	CL_{High}	3.88	.864	Agree	27.08	704.00			
21. It creates a positive atmosphere in the classroom.	CL_{Low}	4.05	.876	Agree	37.66	1506.50	353.500	-2.365	.018
	CL_{High}	3.54	.989	Agree	27.10	704.50			
23. The class becomes more active when it is applied.	CL_{Low}	4.47	.784	Strongly Agree	40.64	1625.50	234.500	-4.136	.000
	CL_{High}	3.65	.977	Agree	22.52	585.50			
25. It allows the teacher to get to know the student better.	CL_{Low}	4.20	.883	Agree	37.81	1512.50	347.500	-2.426	.015
	CL_{High}	3.65	1.018	Agree	26.87	698.50			
27. It supports students to establish better relationships with each other.	CL_{Low}	4.15	.662	Agree	35.92	1437.00	423.000	-1.390	.164
	CL_{High}	3.73	1.116	Agree	29.77	774.00			

According to the results for each item in the "Positive Effects" sub-dimension in Table 11, there was a significant difference between the students with CL_{Low} and CL_{High} in favor of students with CL_{Low}, except for item 27. However, the likert rating related to items of both students groups were mostly "Agree".

Effect of Students' Cognitive Load Level on Attitude "Cost Belief" Sub-Dimension

The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} in terms of attitude "Cost Belief" sub-dimension average. The test results are presented in Table 12.

Table 12. Mann-Whitney U test results of attitude "Cost Belief" sub-dimension average of students with CL_{Low} and CL_{High}

Sub-Dimension	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p	η^2
Cost Belief	CL_{Low}	40	30.54	1221.50	401.500	-1.570	.116	-.19
	CL_{High}	26	38.06	989.50				

The results in Table 12 indicated that there was not any significant difference between the attitude "Cost Belief" sub-dimension average of students with CL_{Low} and CL_{High} ($p=.116>.05$, $\eta^2= -.19 <0.3$). However, the attitude "Cost Belief" sub-dimension of students with CL_{High} was higher than with CL_{Low}.

The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} regarding average of each item in the "Cost Belief" sub-dimension of attitude scale. The test results are presented in Table 13.

Table 13. Mann-Whitney U test results regarding the each item in "Cost Belief" sub-dimension of attitude scale of students with CL_{Low} and CL_{High}

Item	Group	M	SD	Likert Rating	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p
20. The use of it requires excessive preparation time.	CL_{Low}	4.15	.893	Agree	34.45	1378.00	482.000	-.539	.590
	CL_{High}	4.00	1.020	Agree	32.04	833.00			
22. It causes excessive noise in the classroom.	CL_{Low}	3.80	1.043	Agree	32.95	1318.00	498.000	-.305	.760
	CL_{High}	3.88	.993	Agree	34.35	893.00			
24. Applying it hinders the completion of the subjects.	CL_{Low}	2.82	.958	Neutral	30.44	1217.50	397.500	-1.675	.094
	CL_{High}	3.27	1.185	Neutral	38.21	993.50			
26. Discipline problems increase when it is applied.	CL_{Low}	3.13	1.067	Neutral	30.85	1234.00	414.000	-1.440	.150
	CL_{High}	3.54	1.104	Agree	37.58	997.00			

According to the results for each item in the "Cost Belief" sub-dimension in Table 13, there was not any significant difference between the students with CL_{Low} and CL_{High}. However, the likert rating related to items of both students groups were mostly "Agree".

Correlation between Cognitive Load and Attitude of Students with CL_{Low} and CL_{High}

Spearman's rank correlation test was carried out to determine correlation between cognitive load and attitude of students with CL_{Low} and CL_{High}. The detailed results in Table 14 indicated that a negative and medium level correlation was determined between cognitive load and attitude of students with CL_{Low} ($p<.05$). However, there was not a significant correlation between cognitive load and attitude of students with CL_{High} ($p>.05$).

Table 14. Correlations between cognitive load and attitude of students with CL_{Low} and CL_{High}

		Valuing	Resisting	Positive Effects	Cost Belief	Total Attitude	Cognitive Load
CL_{Low}	Valuing	1					
	Resisting	-.623**	1				
	Positive Effects	.789**	-.497**	1			
	Cost Belief	-.019	.367**	.066	1		
	Total Attitude	.596**	.080	.663**	.584**	1	
	Cognitive Load	-.236	-.071	-.159	-.154	-.332*	1
CL_{High}	Valuing	1					
	Resisting	.085	1				
	Positive Effects	.853**	.007	1			
	Cost Belief	.459*	.205	.551**	1		
	Total Attitude	.903**	.275	.885**	.614**	1	
	Cognitive Load	-.180	-.151	-.043	.109	-.117	1

*p<0.05. **p< 0.01.

Views of Students with Low and High Cognitive Load Level on the Gamified Course

The common themes emerged from views of total 51 volunteer students with CL_{Low} (n=31) and with CL_{High} (n=20) on the gamified course are presented in Figure 7.

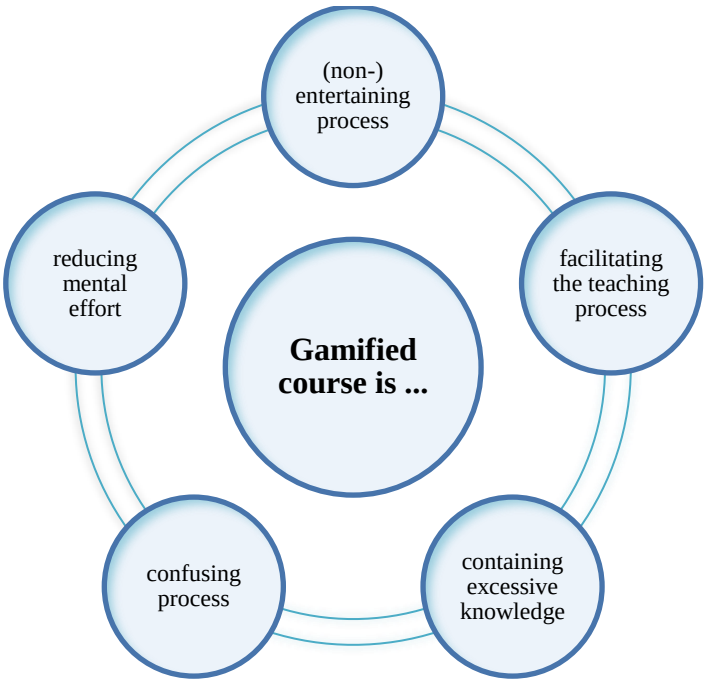
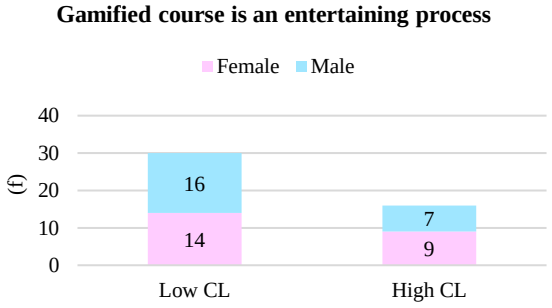
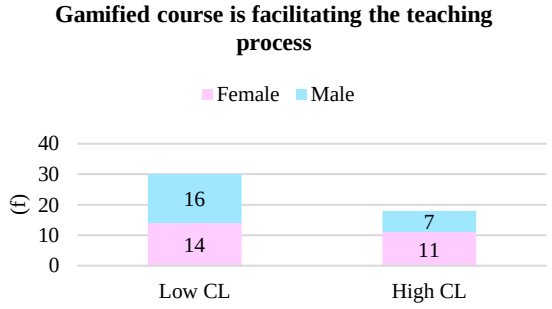


Figure 7. The common themes emerged from students' views

The themes in Figure 7 were presented by dividing positive and negative views categories. The frequencies of students with CL_{Low} and CL_{High} for each theme were shown in comparison with bar-charts. These themes were supported by quotations of students expressions with ID no (Students with low CL level = CL_{Low} X, Students with high CL level = CL_{High} X).

Positive Views of Students

According to "Positive Views" category, the bar-charts showing the frequencies of students with CL_{Low} and CL_{High} for the themes of "an entertaining process", "facilitating the teaching process" and "reducing mental effort", and quotations from students are presented in Figure 8.

Frequencies	Quotations
	*"I think that competitive activities using online tools make the lesson more fun and become us more active in the course." (CL_{Low} 26_Female)* *"I can say that we were more active in this course than in other courses. Because, the in-class activities were generally instructive and more entertaining, and the reward system was motivating." (CL_{High} 42_Female)*
	*"The activities made me better learn the subjects and helped me in the exams. Even if I forgot the information on the subject, I could answer the questions by remembering these activities. For this reason, I would like this learning method to be used in other lessons, and I think that a more permanent learning will be provided." (CL_{Low} 8_Female)* *"The competitive activities using web 2.0 applications were enjoyment and helped me to reinforce the subjects better. In addition, the ClassDojo made me ambitious to receive an award." (CL_{High} 65_Male)*

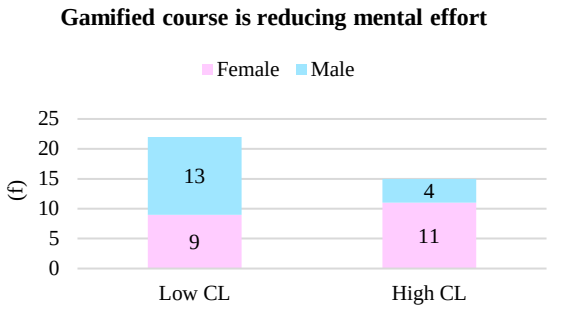
	*"I think that the group activities in this course are effective for learning and reduce mental effort." (CL$_{Low}$ 21_Male)* *"The competitive activities using web 2.0 applications made us better comprehend the subjects with less mental effort." (CL$_{High}$ 65_Male)*

Figure 8. Frequencies and quotations on themes in "Positive Views" category

The bar-charts in Figure 8 show that students with CL_{Low} stated positive views more than students with CL_{High}. While the frequencies of male students with CL_{Low} were higher than female students, the opposite results were observed in students with CL_{High}. On the other hand, the many students with CL_{Low} and CL_{High} stated that competitive activities made the learning process more fun, facilitated teaching and learning, and reduced the mental effort.

Negative Views of Students

According to "Negative Views" category, the bar-charts showing the frequencies of students with CL_{Low} and CL_{High} for the themes of "non-entertaining process", "containing excessive knowledge" and "confusing process", and quotations from students are presented in Figure 9.

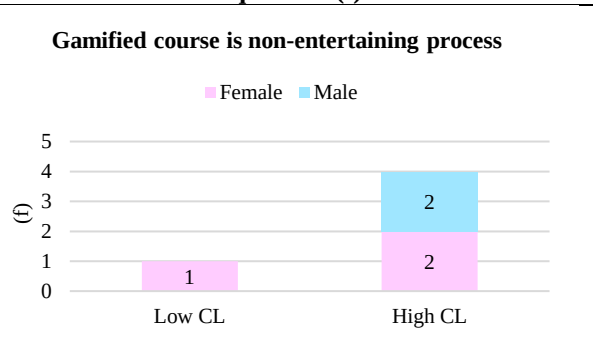
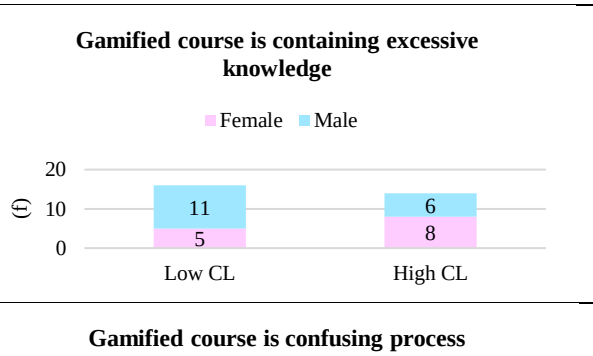
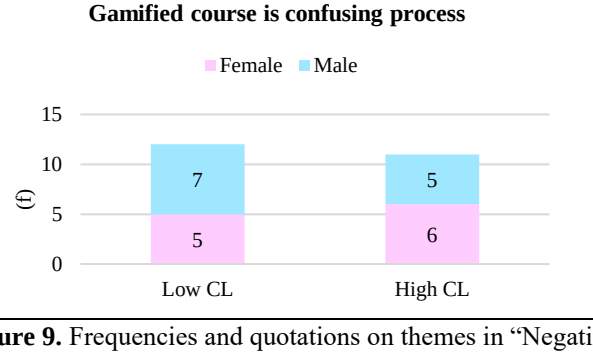
Frequencies (f)	Quotations
	*"I think that such activities negatively affected the interaction among students in the classroom by creating a very competitive environment. In addition, ranking of successful and unsuccessful students on the ClassDojo leaderboard decreased my attitude towards this course. Therefore, I did not enjoy this course in general." (CL$_{Low}$ 43_Female)* *"To be honest, the competition environment and group activities were boring and not enjoying for me." (CL$_{High}$ 18_Male)*
	*"Even though the time passed very quickly in this gamification-based course, I did not like the intensity of content and activities." (CL$_{Low}$ 43_Female)* *"The lessons in this course were very intense. I think this density should be reduced a little." (CL$_{High}$ 62_Female)*
	*"The lessons were confusing as the implementation process was so intense. I think that the activities should not be so intense in order to be more effective and efficient of this course." (CL$_{Low}$ 16_Male)* *"The excessive tasks caused cognitive load on the students, and the competitive learning environment complicated the learning process." (CL$_{High}$ 10_Female)*

Figure 9. Frequencies and quotations on themes in "Negative Views" category

The bar-charts in Figure 9 show that some students with CL_{Low} and CL_{High} had negative views of the gamified learning process at close frequencies. While the frequencies of male students with CL_{Low} were higher than female students, the opposite results were observed in students with CL_{High}. On the other hand, since the competitive activities negatively affected the interaction among students, it prevented some students from enjoying this process, even if they were few in number. In particular, the intensity of such

activities and the excessive content were important reasons for the negative views of some students. In addition, it was emphasized by some students with CL_{Low} and CL_{High} that this situation caused confusion.

DISCUSSION

In this study, it was found out that general cognitive load of all students participating in the gamified course were at low level as well as the number of students with CL_{Low} was more than students with CL_{High}. It is important to keep the cognitive effort and the working memory at optimal level for easily perceiving and encoding the knowledge in mind (Mavilidi & Zhong, 2019; Paas & van Merriënboer, 2020; Sweller, 2010). The simultaneous presentation of related content and materials may support this situation (Debue & van de Leemput, 2014). Accordingly, this finding was an indication that the majority of students made less mental effort in the gamification process. The positive views of both students with CL_{Low} and CL_{High} in the qualitative findings also supported this result. However, the necessity of performing gamified tasks may have created difficulties for some students (Sun-Lin & Chiou, 2019). Becker (2005) stated that multimedia materials and competitive activities in a gamified process may lead highly cognitive effort in some participants. In addition, Sevcenko et al. (2021) stressed that even if each student was performing the same task, they might make different mental effort. It can be said that the personal features of students are reflected in their mental efforts in the gamification process.

Although the attitudes of students with CL_{Low} were higher than students with CL_{High}, there was not any significant difference between the attitude averages of students with CL_{Low} and with CL_{High}. This result showed that all participants had high attitude towards the lesson, regardless of their cognitive load levels. Shaban et al. (2021) determined that the students who had generally optimum cognitive load during gamification, were eager to participate it. Philpott (2020) revealed that the leaderboard in the gamified course made the lessons fun and thus, especially, the high or middle ranking of students in leaderboard positively affected their performance, emotions, and attitude towards the gamified course. In addition, Bai (2021) reported that most students had a positive attitude towards the use of leaderboards in a gamified course with the potential to create a competitive environment. This result of the current study also proved that a course enriched with gamification elements significantly positive affected the students' attitude towards the course.

Wu (2018) concluded that learning materials including rich media in gamification had the potential to facilitate students' cognitive absorption and positively affected their emotions. Wu also revealed that cognitive absorption occurred in a positive way when effective stimuli were used to arouse the student's interest in learning and cognitive load level of students was lower in the gamified activities. Perhaps this was the reason why the attitudes of the students who were not cognitively challenged were higher than the others in this current study. In this current study, it was also determined a negative and medium level correlation between cognitive load and attitude of students with $CL_{Low.}$ Similarly, Shaban et al. (2021) found out that there was negative correlation between both learning performance and experience, and cognitive load of students as well.

There was a significant difference between the attitude "Valuing" sub-dimension average of students with CL_{Low} and CL_{High} in favor of students with $CL_{Low.}$ Accordingly, the effect of the cognitive load level on the "Valuing" sub-dimension of the attitude towards the course was moderate. Shaban et al. (2021) revealed that students with a lower cognitive load level were better learning performance, and enjoyed in the gamification activities. Erümit and Yılmaz (2022) determined that gamified course increased the active participation as well as competition. Öztürk and Korkmaz (2020) found out that students more liked the gamified lessons and their attitudes were higher. Sun-Lin and Chiou (2019) stated that students' attitude especially in the enjoyment dimension were higher in gamification. Accordingly, it can be said that gamification made learning activities more interesting to participate students in process.

These quantitative findings were also supported by qualitative findings of the current study. For example; students' views regarding participating in competitive activities using web 2.0 applications made the learning process more fun in gamified course supported the item 11 (I feel good when I use it). This perspective had more frequency in students with CL_{Low} than with CL_{High}. According to Öden-Sercanoğlu et al. (2021), using Kahoot gamified application in the course significantly increased the attitude of students towards the course. Özer et al. (2018) found out that students were more eager to participate in training and demonstrated positive attitudes after the implementation. Uz-Bilgin and Gul (2020) determined that the attitude score of students using Edmodo badges was higher in gamified course. Accordingly, the attention about various materials and activities may have triggered students' attitude towards the lessons in a positive way (Galbis-Córdova et al., 2017).

Especially some expressions of students with CL_{Low} that the gamified process facilitated learning also supported item 1 (It is useful for teaching.). In the study of Sánchez-Mena & Martí-Parreño (2017), some teachers thought that gamification was fun and facilitates learning as well as providing active participation. According to Galbis-Córdova et al. (2017), the fear of failure is important for students. The students state that gamification activities facilitate learning and reduce mental effort. This result indicates that students believe they will be successful in gamification activities. This situation may have affected their attitudes positively. Smith (2017) revealed that gamification reduced students' belief on difficulty of the course (the sub-factor of attitude) and facilitated learning. In summary, the students in this study may have high attitude towards the course because they believe that gamification will contribute to increasing the achievement of the course.

On the other hand, there was not any significant difference between students with CL_{Low} and CL_{High} for item 19 (It improves students' social skills.) with "Agree" likert rating in the "Valuing" sub-dimension. This finding shows that most students have the opinion

that gamified activities affect the interaction among students positively. Uz-Bilgin and Gul (2020) stressed that gamification was a positive effect on students' in-group interaction as well. However, contrary to this quantitative finding, qualitative findings showed that since the competitive activities negatively affected the interaction among students, it prevented some students from enjoying this gamified process. This indicate that the negative emotions may also emerge while students try to overcome this effort and challenge (Mullins & Sabherwal, 2020).

It was found out that the averages of the attitude "Resisting" sub-dimension of students both with CL_{Low} and CL_{High} were lower than the other sub-dimensions. In addition, there was a significant difference between the "Resisting" sub-dimension average of students with CL_{Low} and CL_{High} in favor of students with CL_{High}. Accordingly, the effect of the cognitive load level on the "Resisting" sub-dimension of the attitude towards the course was moderate. Philpott (2020) stated that for some students, the leaderboard used in gamified course was not fun and comparing peers with each other on this leaderboard caused negative feelings such as anxiety, and this situation negatively affected the attitude. Perhaps this situation was the reason why students with CL_{High} had lower attitude "Resisting" sub-dimension towards the gamified course than others.

The qualitative findings strengthened these results. For example; students' views related to not like this implementation which caused them to compete with each other supported the item 4 (It is not suitable for my personal characteristics.) and item 12 (It does not fit my educational philosophy.). This perspective had more frequency in students with CL_{High} than with CL_{Low}. According to Buckley et al. (2017), some students were unwilling towards the competitive activities in this course, and so they did not enjoy it. Ding et al. (2017) determined that a few participants indicated negative attitude towards the gamified course.

Moreover, some expressions of students with CL_{High} that the gamified process caused confusion and excessive intensity supported item 6 (I think it is quite difficult to apply it.) and item 14 (It weakens the teacher's authority in the classroom.). According to Dominguez et al. (2013), some students had a negative attitude towards the gamified course as the leaderboard created a competitive learning environment. They also stated that this reaction was more likely to cause poor performance compared to the positive one. Sánchez-Mena and Martí-Parreño (2017) stated that teachers did not like gamification because it took too much time and negatively affected the classroom atmosphere.

On the other hand, there was not any significant difference between students with CL_{Low} and CL_{High} for item 8 (I prefer to use what I know approaches rather than it.) and item 10 (Using conventional approaches gives me confidence.). However, the likert rating related to items in the "Resisting" sub-dimension of students with CL_{Low} and CL_{High} were mostly "Neutral". This finding shows that most of them have an undecided point of view in this sub-dimension of the attitude. The negative views in the qualitative findings also confirm this result as well. According to Sun-Lin and Chiou (2019), the requirement to perform the gamified tasks might have lead a challenge to students, and caused not positively respond to the confidence dimension of attitude scale. As pointed out by Buckley et al. (2017), it can be said that gamified intervention was not appropriate for students who preferred traditional teaching approaches.

There was a significant difference between the attitude "Positive Effects" sub-dimension average of students with CL_{Low} and CL_{High} in favor of students with $CL_{Low.}$ Accordingly, the effect of the cognitive load level on the "Positive Effects" sub-dimension of the attitude towards the course was moderate. The expressions of many students in qualitative findings strengthened the item 16 (It provides more permanent learning.) and item 23 (The class becomes more active when it is applied.) in attitude "Positive Effects" sub-dimension. This perspective had more frequency in students with CL_{Low} than with CL_{High}. Öztürk and Korkmaz (2020) revealed that the gamification significantly increased students' total attitude as well as love, interest, motivation, and trust sub-dimensions. In addition, Galbis-Córdova et al. (2017) figured out that perceived attention, relevance, and confidence affected directly and positively the attitude of undergraduate students towards gamified course.

On the other hand, there was not any significant difference between students with CL_{Low} and CL_{High} for item 27 (It supports students to establish better relationships with each other.) with "Agree" likert rating in the "Positive Effects" sub-dimension. This finding is an important indicator for most students that gamified activities positively affect the interaction among students. Sun-Lin and Chiou (2019) determined that the gamification significantly increased students' total attitude as well as enjoyment, motivation, and perceived value sub-dimensions towards the course. However, according to qualitative findings of the current study, a few students with CL_{Low} and CL_{High} claimed the opposite of these findings. These students stressed to not enjoy the learning process as competitive activities negatively affected the interaction among them. Accordingly, since the award leads to ambition due to heavy competition, it may lead negative feelings for students who are at the bottom of the leaderboard, or while them try to overcome this challenge (Hanus & Fox, 2015; Mullins & Sabherwal, 2020).

Although the attitude "Cost Belief" sub-dimension of students with CL_{High} was higher than with CL_{Low}, there was not any significant difference between this sub-dimension averages of the students. Accordingly, both students with CL_{Low} and CL_{High} mostly had a negative point of view regarding "Cost Belief" sub-dimension of attitude. The negative views of students in qualitative findings also confirmed the item 20 (The use of it requires excessive preparation time.) and item 22 (It causes excessive noise in the classroom.) in attitude scale. In particular, the intensity of gamified activities and the excessive content were important reasons for the negative views of some students. It was also emphasized by some students with CL_{Low} and CL_{High} that this situation caused confusion. Hanus and Fox (2015) determined that students' satisfaction tended to decrease over time in 16-week gamified course process. Accordingly, it can be said that the duration of gamification can affect the attitude. Moreover, Luo et al. (2021) revealed the teachers' anxiety

regarding management of gamified process in classroom. For this reason, it is critical to pay attention to the development and design of gamification learning content (Su, 2016).

CONCLUSION, LIMITATIONS, AND SUGGESTIONS

In this study with a long-term (14-week) implementation process, it was obtained both quantitative and qualitative data regarding the effect of cognitive load on attitude towards the gamified course. Accordingly, the cognitive load level of the students did not have a significant effect on the attitude towards the gamified course, and both students with CL_{Low} and with CL_{High} had highly attitude towards the gamified course. According to the qualitative results, the competitions and awards made in the gamified course aroused positive emotions in many students CL_{Low} and with CL_{High}, facilitated the learning of the subjects, and ensured their active participation in the lessons. As emphasized in the literature (Bai, 2021; Öztürk & Korkmaz, 2020; Philpott, 2020; Öden-Sercanoğlu et al., 2021; Sun-Lin & Chiou, 2019), these results in current study reveal that gamification is how a powerful and effective teaching and learning approach.

The gamified course had a positive effect on the "Valuing" and "Positive Effects" sub-dimensions of the attitude in favor of students with CL_{Low}. The positive views of many students in qualitative findings also strengthened these results. Wu (2018) stressed that using learning materials as an effective stimuli in gamification had the potential to facilitate the cognitive absorption of students and affected their emotions in positive way. Shaban et al. (2021) determined that students with a lower cognitive load level were better learning performance and perceived experience in the gamified activities. While gamified course had a negative effect on the "Resisting" sub-dimension in favor of students with CL_{High}, it did not have any significant effect on the "Cost Belief" sub-dimension. A few negative views of students in qualitative findings supported the items in these dimensions of attitude scale. That's why, even if it is perceived as a useful approach to facilitating learning, it should be taken into account that gamification may pose a potential risk to the classroom environment and some students (Kim & Werbach, 2016; Luo et al., 2021; Sánchez-Mena & Martí-Parreño, 2017) and should be applied the learning activities by considering the critical importance to manage cognitive load regardless of the reason of it (Ayres, 2020; Sevcenko et al., 2021). Accordingly, it is important to prefer the suitable gamification tools and elements considering the context of learning process to stimulate positive feeling and desired behavior of students (Adams & Preez, 2022; Kapp et al., 2014; Werbach, & Hunter, 2012).

Consequently, the results of this current study reveal that gamified process is an important opportunity for students to have a positive attitude towards the course, even if they have different cognitive loads level. Many studies about gamification focus on students' affective aspect, while just a few studies underline that it needs to be considered cognitive aspect (Sevcenko et al., 2021; Shaban et al. 2021; Su, 2016; Wu, 2018). In this context, the results of this study will strengthen the few studies related to effect of gamified course on the cognitive and affective aspect. However, further studies need to confirm these results. Moreover, it is necessity to highlight that integrating the gamification elements into the learning environments may not guarantee positive effect on learning outcomes (Dominguez et al., 2013; Kapp et al., 2014; Uz-Bilgin & Gul, 2020). In this line, the gamification need to change attitude and behavior of students in a positive way to be effective in a learning process (Dichev & Dicheva, 2017). For this reason, it is recommended to carry out such studies that reveal all the situations which can affect the attitude in the gamified course in order to achieve positive outcomes of students with different cognitive load levels.

On the other hand, this study without a control group is limited to comparing the attitudes of students with CL_{Low} and CL_{High} participating in a gamified course. During the implementation, scoring system was based on points and badges by rewarding weekly in-class activities to prevent to dropout students from the 14-week course process. Moreover, it was not examined to effect of the using gamification tools and elements on cognitive load of students in this gamified course. These are the limitations of this study. In future studies, it can be investigated which gamification elements, tools or activities may cause high and low cognitive load level.

Ethics Committee Approval Information: Ethics committee approval was obtained from Atatürk University Sciences and Humanities Ethics Committee (2022-SBB-08/14, 05/07/2022).

REFERENCES

Adams, S. P., & Du Preez, R. (2022). Supporting student engagement through the gamification of learning activities: A design-based research approach. *Technology, Knowledge and Learning*, *27*(1), 119-138. https://doi.org/10.1007/s10758-021-09500-x

Ayres, P. (2020). Something old, something new from cognitive load theory. *Computers in Human Behavior*, *113*, 106503. https://doi.org/10.1016/j.chb.2020.106503

Bai, S., Hew, K. F., Sailer, M., & Jia, C. (2021). From top to bottom: How positions on different types of leaderboard may affect fully online student learning performance, intrinsic motivation, and course engagement. *Computers & Education*, *173*, 104297. https://doi.org/10.1016/j.compedu.2021.104297

Becker, K. (2005, July). *Games and learning styles.* Presented at IASTED international conference on education and technology-ICET. Calgary, Alberta, Canada. https://prism.ucalgary.ca/bitstream/handle/1880/46706/Games_Learning_2005.pdf?sequence=1

Buckley, P., Doyle, E., & Doyle, S. (2017). Game on! Students' perceptions of gamified learning. *Journal of Educational Technology & Society*, *20*(3), 1-10. https://www.jstor.org/stable/10.2307/26196115

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th Ed.). Thousand Oaks, CA: Sage.

da Rocha Seixas, L., Gomes, A. S., & de Melo Filho, I. J. (2016). Effectiveness of gamification in the engagement of students. *Computers in Human Behavior, 58*, 48-63. https://doi.org/10.1016/j.chb.2015.11.021

Debue, N., & van de Leemput, C. (2014). What does germane load mean? An empirical contribution to the cognitive load theory. *Frontiers in Psychology, 5*, 1–12. https://doi.org/10.3389/fpsyg.2014.01099

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, September). From game design elements to gamefulness: defining "gamification". In *Proceedings of the 15th International Academic Mindtrek Conference: Envisioning Future Media Environments* (pp. 9-15). Tampere, Finland. ACM. https://dl.acm.org/doi/abs/10.1145/2181037.2181040

Dichev, C., & Dicheva, D. (2017). Gamifying education: What is known, what is believed and what remains uncertain: a critical review. *International Journal of Educational Technology in Higher Education*, *14*(1), 1-36. https://doi.org/10.1186/s41239-017-0042-5

Ding, L., Kim, C., & Orey, M. (2017). Studies of student engagement in gamified online discussions. *Computers & Education, 115*, 126-142. https://doi.org/10.1016/j.compedu.2017.06.016

Domínguez, A., Saenz-de-Navarrete, J., De-Marcos, L., Fernández-Sanz, L., Pagés, C., & Martínez-Herráiz, J. J. (2013). Gamifying learning experiences: Practical implications and outcomes. *Computers & Education, 63*, 380-392. https://doi.org/10.1016/j.compedu.2012.12.020

Ertan, K. (2020). *Investigating achievement, attitude and motivation in a gamified English course* (Master's Thesis). Retrieved January, 07, 2022 from Council of Higher Education database in Turkey. (Thesis No. 633889). https://tez.yok.gov.tr/UlusalTezMerkezi/tezSorguSonucYeni.jsp

Erümit, S. F., & Yılmaz, T. K. (2022). The happy association of game and gamification: the use and evaluation of game elements with game-based activities. *Technology, Pedagogy and Education, 31*(1), 103-121. https://doi.org/10.1080/1475939X.2021.2006077

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Reading, MA: Addison Wesley. https://people.umass.edu/aizen/f&a1975.html

Galbis-Córdoba, A., Martí-Parreño, J., & Currás-Pérez, R. (2017). Higher education students' attitude towards the use of gamification for competencies development. *Journal of e-Learning and Knowledge Society, 13*(1), 129-146. https://www.learntechlib.org/p/188128/

Hanus, M. D., & Fox, J. (2015). Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. *Computers & Education, 80*, 152-161. https://doi.org/10.1016/j.compedu.2014.08.019

Huang, B., & Hew, K. F. (2021). Using gamification to design courses: Lessons learned in a three-year design-based study. *Educational Technology & Society, 24*(1), 44-63. https://www.j-ets.net/collection/published-issues/24_1

Kapp, K. M., Blair, L., & Mesch, R. (2014). *The gamification of learning and instruction fieldbook: Ideas into practice*. John Wiley & Sons.

Kim, T. W., & Werbach, K. (2016). More than just a game: Ethical issues in gamification. *Ethics and Information Technology, 18*(2), 157-173. https://doi.org/10.1007/s10676-016-9401-5

Koç, C. (2014). Scale of attitudes towards using student-centered teaching methods and techniques: Validity and reliability study. *Electronic Journal of Social Sciences, 13*(49), 150-170. https://dergipark.org.tr/tr/download/article-file/70541

Luo, Z., Brown, C., & O'Steen, B. (2021). Factors contributing to teachers' acceptance intention of gamified learning tools in secondary schools: An exploratory study. *Education and Information Technologies*, *26*(5), 6337-6363. https://doi.org/10.1007/s10639-021-10622-z

Martí-Parreño, J., Seguí-Mas, D., & Seguí-Mas, E. (2016). Teachers' attitude towards and actual use of gamification. *Procedia-Social and Behavioral Sciences, 228*, 682–688. https://doi.org/10.1016/j.sbspro.2016.07.104

Mavilidi, M. F., & Zhong, L. (2019). Exploring the development and research focus of cognitive load theory, as described by its founders: Interviewing John Sweller, Fred Paas, and Jeroen van Merriënboer. *Educational Psychology Review*, 1-10. https://doi.org/10.1007/s10648-019-09463-7

Mee, R. W. M., Pek, L. S., Von, W. Y., Ghani, K. A., Shahdan, T. S. T., Ismail, M. R., & Rao, Y. S. (2021). A conceptual model of analogue gamification to enhance learners' motivation and attitude. *International Journal of Language Education*, *5*(2), 40-50. https://doi.org/10.26858/ijole.v5i2.18229

Moreno, R. (2010). Cognitive load theory: More food for thought. *Instructional Science, 38*(2), 135-141. https://doi.org/10.1007/s11251-009-9122-9

Mullins, J. K., & Sabherwal, R. (2020). Gamification: A cognitive-emotional view. *Journal of Business Research*, *106*, 304-314. https://doi.org/10.1016/j.jbusres.2018.09.023

Newby, T. J., Stepich, D. A., Lehman J. D., & Rusell, J. D. (2000). *Instructional technology for teaching and learning designing instruction, integrating computers and using media* (2nd Ed.). New Jersey: Prentice-Hall Inc.

Öztürk, Ç., & Korkmaz, Ö. (2020). The effect of gamification activities on students' academic achievements in social studies course, attitudes towards the course and cooperative learning skills. *Participatory Educational Research*, *7*(1), 1-15. http://doi.org/10.17275/per.20.1.7.1

Özer, H. H., Kanbul, S., & Ozdamli, F. (2018). Effects of the gamification supported flipped classroom model on the attitudes and opinions regarding game-coding education. *International Journal of Emerging Technologies in Learning (iJET), 13*(1), 109-123. https://doi.org/10.3991/ijet.v13i01.7634

Paas, F., & van Merriënboer, J. J. (1994). Variability of worked examples and transfer of geometrical problem-solving skills: A cognitive-load approach. *Journal of Educational Psychology, 86*(1), 122. https://doi.org/10.1037/0022-0663.86.1.122

Paas, F., & van Merriënboer, J. J. (2020). Cognitive-load theory: Methods to manage working memory load in the learning of complex tasks. *Current Directions in Psychological Science*, *29*(4), 394-398. https://doi.org/10.1177/0963721420922183

Philpott (2020) Philpott, A. (2020). *Examining EFL students' motivation and attitudes toward a gamified course using leaderboards and quests at a Japanese university* (Doctoral Dissertation, University of Southern Queensland). https://eprints.usq.edu.au/39865/

Rahman, R. A., Ahmad, S., & Hashim, U. R. (2018). The effectiveness of gamification technique for higher education students' engagement in polytechnic Muadzam Shah Pahang, Malaysia. *International Journal of Educational Technology in Higher Education*, *15*(1), 1-16. https://doi.org/10.1186/s41239-018-0123-0

Sánchez-Mena, A. A., & Martí-Parreño, J. (2017). Drivers and barriers to adopting gamification: Teachers' perspectives. *The Electronic Journal of e-Learning*, *15*(5), 434-443. https://academic-publishing.org/index.php/ejel/article/view/1850/1813

Öden-Sercanoğlu, M., Bolat, Y. İ., & Göksu, İ. (2021). Kahoot! as a gamification tool in vocational education: More positive attitude, motivation and less anxiety in EFL. *Journal of Computer and Education Research*, *9*(18), 682-701. doi: 10.18009/jcer.9224882

Sevcenko, N., Ninaus, M., Wortha, F., Moeller, K., & Gerjets, P. (2021). Measuring cognitive load using in-game metrics of a serious simulation game. *Frontiers in Psychology*, *12*, 572437. doi: 10.3389/fpsyg.2021.572437

Shaban, A., Pearson, E., & Chang, V. (2021). Evaluation of user experience, cognitive load, and training performance of a gamified cognitive training application for children with learning disabilities. *Frontiers in Computer Science*, 58. doi: 10.3389/fcomp.2021.617056

Simões, J., Redondo, R. D., & Vilas, A. F. (2013). A social gamification framework for a K-6 learning platform. *Computers in Human Behavior*, *29*(2), 345-353. https://doi.org/10.1016/j.chb.2012.06.007

Smith, T. (2017). Gamified modules for an introductory statistics course and their impact on attitudes and learning. *Simulation & Gaming*, *48*(6), 832-854. https://doi.org/10.1177/1046878117731888

Su, C. H. (2016). The effects of students' motivation, cognitive load and learning anxiety in gamification software engineering education: a structural equation modeling study. *Multimedia Tools and Applications*, *75*(16), 10013-10036. doi: 10.1007/s11042-015-2799-7

Sun-Lin, H. Z., & Chiou, G. F. (2019). Effects of gamified comparison on sixth graders' algebra word problem solving and learning attitude. *Journal of Educational Technology & Society*, *22*(1), 120-130. https://www.jstor.org/stable/10.2307/26558833

Sweller, J. (2010). Element interactivity and intrinsic, extraneous, and germane cognitive load. *Educational Psychology Review*, *22*(2), 123-138. https://doi.org/10.1007/s10648-010-9128-5

Sweller, J., van Merriënboer, J. J., & Paas, F. (2019). Cognitive architecture and instructional design: 20 years later. *Educational Psychology Review*, *31*(2), 261-292. https://doi.org/10.1007/s10648-019-09465-5

Tan, M., & Hew, K. F. (2016). Incorporating meaningful gamification in a blended learning research methods class: Examining student learning, engagement, and affective outcomes. *Australasian Journal of Educational Technology*, *32*(5). https://doi.org/10.14742/ajet.2232

Turan, Z., Avinc, Z., Kara, K., & Goktas, Y. (2016). Gamification and education: Achievements, cognitive loads, and views of students. *International Journal of Emerging Technologies in Learning*, *11*(7). http://dx.doi.org/10.3991/ijet.v11i07.5455

Türkmen, G. P., & Soybaş, D. (2019). The effect of gamification method on students' achievements and attitudes towards mathematics. *Bartın University Journal of Faculty of Education*, *8*(1), 258-298. https://doi.org/10.14686/buefad.424575

Uz Bilgin, C., & Gul, A. (2020). Investigating the effectiveness of gamification on group cohesion, attitude, and academic achievement in collaborative learning environments. *TechTrends*, *64*(1), 124-136. https://doi.org/10.1007/s11528-019-00442-x

Werbach, K., & Hunter, D. (2012). *For the win: How game thinking can revolutionize your business.* Philadelphia: Wharton Digital Press.

Werbach, K., & Hunter, D. (2015). *The gamification toolkit: Dynamics, mechanics, and components for the win*. Wharton Digital Press.

Wu, Y. L. (2018). Gamification design: A comparison of four m-learning courses. *Innovations in Education and Teaching International*, *55*(4), 470-478. https://doi.org/10.1080/14703297.2016.1250662

Yang, Y., Asaad, Y., & Dwivedi, Y. (2017). Examining the impact of gamification on intention of engagement and brand attitude in the marketing context. *Computers in Human Behavior*, *73*, 459-469. http://dx.doi.org/10.1016/j.chb.2017.03.066

Yildirim, I. (2017). The effects of gamification-based teaching practices on student achievement and students' attitudes toward lessons. *The Internet and Higher Education*, *33*, 86-92. http://dx.doi.org/10.1016/j.iheduc.2017.02.002

Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps*. O'Reilly Media.