Je-LKS
Journal of e-Learning and Knowledge Society
The Italian e-Learning Association Journal
PEER REVIEWED PAPERS
GAMIFICATION AND SERIOUS GAME FOR LEARNING
Vol. 11, n.3, 2015
ISSN: 1826-6223 | eISSN: 1971-8829

THE DESIGN AND IMPLEMENTATION OF A GAMIFIED ASSESSMENT

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Keywords: Gamification, Gamified assessment.

In this research, a gamified assessment was designed considering the theoretical basis and implemented. The dynamics, mechanics and components defined by Werbach and Hunter (2012) for gamification were used in the design process. Eleven undergraduate students participated in the implementation. Learners' opinions about the implementation were collected by questionnaire and focus-group interviews. It was found that the design elicited enjoyment, motivation, flow, and learning. Additionally, it did not cause exam anxiety. Apart from these positive opinions, some learners complained about the visibility of the leader board during assessment and the presence of locked levels. It is believed that this study will serve as a model since it involves a detailed gamified assessment design that is in line with theoretical foundations and contains various gamification components, such as avatars, levels, content unlocking, the leader board, achievements, virtual goods, points, teams, and badges.

for citations:
Kocadere S.A., Çağlar S. (2015), *The design and implementation of a gamified assessment,* Journal of e-Learning and Knowledge Society, v.11, n.3, 85-99. ISSN: 1826-6223, e-ISSN:1971-8829

1 Introduction

Games that are commonly used in education enable individuals to have experiences and social interactions within meaningful and realistic situations (Gee, 2014; Prensky, 2003). It is known that games have positive effects of creating enjoyment (Bressler & Bodzin, 2013), increasing motivation (Huizenga *et al.*, 2009), ensuring the continuation of interest (Liao *et al.*, 2011), facilitating collaborative learning (Wong *et al.*, 2013), raising levels of engagement (Schwabe & Göth, 2005), creating the feeling of flow (Bressler & Bodzin, 2013), developing problem solving and critical thinking skills and improving learning outcomes (Sánchez & Olivares, 2011). However, educational concerns often cause serious games to lag behind other video games in terms of enjoyment and motivation (Prensky, 2004). To meet expectations for video games, some researchers have recently focused their attention on the notion of gamified learning instead of game-based learning.

Gamification is used in a variety of areas such as health, sports, marketing and education, and is defined as the use of game components in non-game contexts (Deterding *et al.*, 2011). From an educational standpoint, gamification is the use of game dynamics, mechanics and components in educational situations to enhance the effectiveness of learning and to promote the desired behaviors in learners (Deterding *et al.*, *op. cit.*; Kapp, 2012). Gamified learning environments contribute to the learning and teaching process by raising levels of engagement (Di Bitonto *et al.*, 2014), enhancing motivation (De-Marcos, Domínguez, Saenz-de-Navarrete & Pagés, 2014; Ibanez, Di-Serio & Delgado-Kloos, 2014; O'Donovan, 2012; Su & Cheng, 2015), providing the feeling of flow (Sillaots, 2014), creating an enjoyable learning environment (De-Marcos *et al.*, 2014), increasing achievement (Boticki *et al.*, 2015; De-Marcos *et al.*, *op. cit.*; Ibanez *et al.*, 2014; Su & Cheng, *op. cit.*) and ensuring active participation (Di Bitonto *et al.*, *op. cit.*).

The stage of assessment is one teaching step where gamification can be used. The main goal of assessment is to support learning. Thus, it should be kept in mind that learning should be central to assessment (Gardner & Gardner, 2012). For learning to take place in the assessment process, there needs to be a balance between assessment *for* learning and assessment *of* learning (Stiggins & Chappuis, 2012). For this reason, teaching should focus on assessment for learning, as much as on assessment of learning. However, it is known that, especially in high-stake tests, assessment of learning is given too much weight, and that tests that deepen students' anxiety barely support learning (Amrein & Berliner, 2002). It is thought that gamification might make it possible to accomplish assessment for learning.

The rewind function used in gamified assessment systems gives the learner

the freedom to lose, the chance to learn from mistakes and then to discover new techniques (Wood, Teräs, & Reiners, 2013). Moreover, the gamification components such as levels and badges offer feedback. It is known that feedback has great impact on learning and achievement (Hattie & Timperley, 2007). Thus, gamified assessment, which gives both formative feedback to improve learning and summative feedback about the results of the process (Wood *et al.*, 2013), can support learning.

However, in the literature there are only a few studies about implementation of gamified assessment. One of them is Wang's (2015) gamified assessment research which is conducted using a quiz software tool, named Kahoot. Wang used only points and leaderboard in this design. Learners stated that they interacted with their friends, had fun, felt competitive and that they learned.

In their research, Moccozet, Tardy, Opprecht and Léonard (2013) examined how gamification should be implemented to support group work and collaboration. Learners gained different points according to individual contribution to group working. As a result, researchers concluded that gamified assessment supports collaborative learning.

Cheong, Cheong, and Flippou (2013) used a gamified quiz software tool, named Quick Quiz. This software gives points according to accuracy of answers, provides feedback, and shows the leaderboard. Results show that 77% of the students were engaged with the learning activity and 46% of the students had fun during the assessment process. Sixty percent of students in the study said they learned more effectively.

In brief, in studies in the literature about gamified assessment only scoring, feedback and leaderboard features were used together (Cheong, Cheong, & Filippou, *op. cit.*; Wang, *op. cit.*) and assessment processes were designed only to grade certain tasks (Moccozet *et al.*, 2013). None of the studies in the literature provide information about how to gamify an assessment. Also the potential effects of gamified assessment were not determined by any research. This study was conducted considering this lack of studies in the literature. A gamified assessment environment was designed on a theoretical basis and implemented. Student opinions about this gamified assessment were determined.

2 The Design of Gamified Assessment

The assessment was designed according to the gamification elements laid out by Werbach and Hunter (2012). We first selected the dynamics, then mechanics fitting the dynamics and then the components fitting the mechanics. However, in order to increase the readability of the study, first the components, then the mechanics, finally the dynamics will be explained. Dynamics in the

design, mechanics which served the dynamics and components which served those mechanics are summarized in Table 1.

Table 1
DYNAMICS -MECHANICS- COMPONENTS USED IN THE DESIGN

Dynamics	Mechanics	Components
Constraints	Challenge	Content Unlocking
Emotions	Challenge	Content Unlocking
	Reward	Badges, Achievements, Avatars, Content Unlocking
	Competition	Badges, Leader Board
	Cooperation	Teams
	Resource Acquisition	Points, Virtual Goods
	Feedback	Points, Content Unlocking, Badges, Leader Board, Levels
Progression	Reward	Badges, Achievement, Content Unlocking
	Resource Acquisition	Points, Virtual Goods
	Feedback	Points, Badges, Leader Board, Levels
Relationships	Cooperation	Teams

Components. Components are the smallest parts which directly affect the design of gamification. To integrate the dynamics and mechanics selected in this research, the following components proposed by Werbach & Hunter (2012) were used: avatars, levels, content unlocking, the leader board, achievements, virtual goods, points, teams and badges.

Avatars: These are the visual representations of the players in the game. In this study, avatars were presented to the learners in three different ways. Each learner who took part in the assessment process started off with a circle that included only their initials. As part of achievements, they were given the chance during the process to pick one of the available avatars and to create their own visual representation. The component of avatar was used to activate the mechanic of reward.

Levels: Levels show the player's position at any point during the game. In this design, they served the mechanic of feedback. The design had a four-level structure through which the players were to pass. Bloom's revised taxonomy was used to designate the levels and to formulate the questions. Bloom's revised taxonomy consists of six steps: remembering, understanding, applying, analyzing, evaluating and creating. This gamified assessment covered the levels of remembering (Level 1), understanding (Level 2), analyzing (Level 3)

and evaluating (Level 4). These four levels involved a total of 11 questions at graduated levels of complexity. Level 1 involved four questions with a total of 15 points. Level 2 included two questions with a total of 15 points. Level 3 involved three questions with a total of 30 points. Level 4 had two questions amounting to 40 points.

Content Unlocking: This refers to being unable to access content without meeting certain criteria. There are minimum points that a player needs to score to unlock levels and to access the set of questions that these levels include. All three levels except the first one are locked. Level 2 is unlocked if the player scores at least 5 points out of 15 on Level 1. Level 3 and 4 are similar to this. The component of content unlocking serves the mechanics of challenge, feedback and reward.

Leader Board: This is a list that shows the ranking of players according to their scores and collections. Throughout the assessment, the leader board was updated instantly, enabling the players to monitor their rankings. The leader board component was used to activate competition and feedback mechanics.

Virtual goods: These are valuable items that players purchased during the game in exchange for their points. The learners purchased *bulbs* (to get the opinion of a peer or the professor), *puzzle pieces* (to get the privilege of collaborating with others) and *books* (to consult course materials) in exchange for varying amounts of points. This component was used for the resource acquisition mechanic.

Achievements: These are the rights and rewards given to the player in return for accomplishing an objective, and they serve the mechanic of reward. Players were given the right to choose an avatar among available options at 10 points and to create their own avatar at 60 points.

Badges: Badges define the individual's performance by symbolizing desired outcomes in the game (Abramovich, Schunn & Higashi, 2013). In this design, badges serve the mechanics of reward, competition and feedback. Badges are employed for different purposes. They can be used for setting goals, providing explanations about learning activities, identifying players who have shared experiences, providing them with status and giving them the right to brag (Antin & Churchill, 2011). This design used them to set goals, impart status and give the right to brag. We gave out badges during the assessment and at its end. The student who got the fullest points was given the badge of *the most hardworking player* of the hour. The student who unlocked the most content was given the badge of *the fastest player* of the hour, and the student who got the highest score in an hour was given the badge of *leader* of the hour. During the assessment, *bronze medal* badges were given to students with 50 points, *silver medal* badges to those with 70 points and *gold medal* badges to those with 85 points. Finally, the following badges were given according to the total

score received at the end of the assessment: *super* to students with 90 or higher scores, *great* to students who scored between 80 and 89, *good job* to students who scored between 70 and 79, *wow* to students who scored between 60 and 69 and *smiley* to students who scored between 50 and 59.

Points: These quantify the player's progress. In this research, players earned points if their responses were correct. This component serves the mechanics of resource acquisition and feedback.

Teams: These are the groups that cooperate to accomplish a common objective in the game. In this design, the players who purchased *puzzle pieces* got the opportunity to answer questions in teams that they formed. This component serves the mechanic of cooperation.

Mechanics. A gamified environment consists of mechanics, which are used to create player engagement and involve essential processes (Werbach & Hunter, 2012). To highlight the dynamics selected for this design, the mechanics of challenge, rewards, feedback, resource acquisition, cooperation and competition, as outlined by Werbach and Hunter (*op. cit.*), were deployed.

Challenge: This study's design was intended to incline the learners to make an effort with the component of content unlocking. Another main component that posed a challenge was time limits. The mechanic of challenge was used to activate the dynamics of constraints and emotions.

Rewards: This is the indicator of the player's success. The mechanic of rewards serves the dynamics of progression and emotion. Zichermann & Cunningham (2011) divided rewards into four categories: status, access, power, and goods. In this study, status rewards were given in the form of badges and avatars and access rewards were given as content unlocking. Also the component of achievement was used to activate the mechanic of rewards.

Feedback: This is information given to the players about their status during the game. The mechanic of feedback served the dynamics of progression and emotion. Both formative and summative feedback was given. Formative feedback was given during the game in the form of badges, levels, the leader board and content unlocking. Summative feedback was given at the end of the assessment as total scores, badges earned, final levels, ranking on the leader board and unlocked content.

Cooperation: This refers to the joint effort that players make to achieve a common objective. For the cooperation mechanic, which served the dynamics of relationship and emotion, the team component was used.

Competition: This mechanic serves the dynamic of emotion. The players compete with each other during the assessment. The leader board and the badges given hourly were components that incited competition in this study.

Resource Acquisition: This refers to collecting useful tools for the purpose

of making progress in the gamified assessment environment. This mechanic, which serves the dynamics of progression and emotion, was included in the design as points and virtual goods components.

Dynamics. A gamified environment consists of dynamics, which are not directly included in the process, yet make it possible to look at the design from a broader perspective (Werbach & Hunter, 2012). Among the dynamics proposed by Werbach and Hunter (*op. cit.*), constraints, emotions, progression and relationships were used in this study.

Constraints: This is the dynamic that defines the limitations of the player within the process. To implement this dynamic in the design, the challenge mechanic was used.

Emotions: In a gamified environment, players may have various emotions such as curiosity, excitement, sadness, or happiness. This study's design was intended to give players the feeling of enjoyment and prevent anxiety. Therefore, the mechanics of rewards and challenge were used to evoke the dynamic of emotion. However, since it is believed that each mechanic used in the design causes feelings in the players, competition, cooperation, resource acquisition and feedback were considered other mechanics that evoke the dynamic of emotion.

Progression: This dynamic is the indicator of the player's progress. This study adopted a design that would allow the players to progress and be aware of their level of progress. The mechanics of resource acquisition, rewards and feedback were used to achieve this.

Relationships: This dynamic denotes the player's interactions with others. Although a gamified assessment was designed in this study, it was possible for players to cooperate with each other, since the mechanic of cooperation was deployed.

3 The Implementation of Gamified Assessment

This assessment was performed as the midterm exam of the course. All the elements were integrated within an interface like a game board and a profile card. The game board helped learners to see all the levels and the questions that these levels contained. The board also showed the minimum score for learners to advance to levels which were locked, so that they would know their objective. The players' avatars were shown on the question to which they were replying, so that the players were able to see each other's levels.

The gamified assessment was carried out in a computer lab over four hours. All students were able to see the instantly updated game board, profile card and leader board. The learners were informed about their progress with profile

cards. A profile card included information about the learner, their avatar, their scores on each question, the virtual goods they purchased, badges they earned, and their achievements. These profile cards were also shared on social networks periodically so that the learner's achievements could be acknowledged socially. The responses given by players to questions were scored instantly, and thus, the learners could see their score at the end of each question. Each learner was given the chance to replay each question. They were able to respond to the question again by consulting the course materials, asking each other or the professor, collaborating or simply rethinking their response on their own.

4 Method

Eleven undergraduate students who took the Educational Game Design course participated in this implementation of gamified assessment. This research was designed as qualitative research. Data were collected using a questionnaire and a focus-group interview. All the participants responded to the questionnaire, which included open-ended questions:

1. What do you think of this gamified method of assessment?
2. Would you prefer your assessments to be gamified? Please explain.
3. What were the positive aspects of the gamified assessment?
4. What were the negative aspects of the gamified assessment?
5. If you were to participate in a similar assessment, what do you think should be done differently?

Besides the questionnaire, 8 of the 11 students voluntarily participated in the focus-group interview. In this semi-structured interview, the questions on the questionnaire were brought up for discussion. Since the responses given to the first two questions of the questionnaire were entirely positive, the first, second and third questions were evaluated together. Similarly, the fourth and fifth questions were evaluated together. The positive and negative opinions from the questionnaire are presented thematically in the findings section and summarized in Table 2. An expert was asked to encode the questionnaire responses to ensure the reliability of our coding. The expert's codes overlapped with ours.

The results of the focus-group interview were found to be consistent with the positive and negative opinions that emerged from the questionnaire. The opinions expressed during the interview that differed from the questionnaire are presented in the section on suggestions for gamified assessment.

5 Findings

5.1 Positive Opinions about Gamified Assessment

The positive opinions about the process were grouped under the following five themes: enjoyment, flow, motivation, learning, and low anxiety. These themes are explained below along with an example opinion for each one of them.

Enjoyment: All the participants reported that they enjoyed the assessment process.

"*It was an enjoyable assessment. I don't remember enjoying any midterm exam until this one*" (#2).

Flow: Seven participants reported that they were so absorbed in the process that they did not notice the passage of time.

"*We got carried away when trying to move up through the levels, and we did not get bored*" (#10).

Motivation: Nine participants stated that the assessment method motivated them.

"*Thanks to this, I had a good time and the points I scored motivated me. I can also say that another motivational factor was the rewards given during the assessment process*" (#11).

Learning: Seven participants reported that they learned during the assessment process.

"*One of the positive aspects of the gamified assessment was the possibility of learning while taking an exam*" (#6).

Low Anxiety: Two of the participants stated that they did not stress about the assessment, and that their exam anxiety was low. This, according to them, increased their success.

"*I think we were able to perform better since we were not stressed during the exam.*" (#2)

5.2 Negative Opinions about the Gamified Assessment

The negative opinions about the process were grouped under the following two themes: the leader board and content unlocking. These themes are explained below with the help of example opinions:

Leader board: Three of the participants suggested that being ranked low

on the leader board might bother students or cause them to disconnect from the exam.

"*Students who are ranked lower on the leader board might lose motivation or give up on the exam.*" (#1)

Content Unlocking: Four of the participants preferred open questions instead of locked levels.

"*The levels should not be locked or they should at least require fewer points to unlock because I would like to see all the questions (...). Every student has the right to see the questions.*" (#7)

While nine of the eleven students stated that they would prefer gamified assessment, two of them said that they might not always prefer it. One of them (#6) complained about the long duration of the assessment, and the other one (#4) complained about not being able to see all the questions.

5.3 Suggestions for Gamified Assessment

In the focus-group interview, two main points stood out as different from the opinions expressed in the questionnaire: time and assessment for learning.

Time: During the exam, the professor of the course graded each answer instantly. However, some students had to wait a couple of minutes before learning their grade (to unlock the next level), since more than one student submitted their answers at the same time. These students complained about this problem since there was a badge for being fastest. They suggested that this problem should not be repeated.

"*We had to wait for a while until our answers were graded. It was not a long time, but it was important since we were racing against the clock.*" (#3)

Assessment for learning: The students stated that learning when having an exam was something that they had never experienced before. They reported that the most significant features of the implementation were being able to replay and accessing course materials. They also stated that they were able to learn during the exam by collaborating and taking advantage of the option to consult with their peers or the professor. They suggested that gamified assessment should definitely offer these features.

"*The best feature was the replay option, which allowed us to rethink the question. Along with replay, I also used the option of consulting the course materials and managed to answer a question from which I had received a very low score the first time. Not only did I improve my exam score, I also learned*

the correct answer to that question." (#5)

Table 2
STUDENTS' OPINIONS ABOUT GAMIFIED ASSESSMENT

	Positive					Negative	
	Enjoyment	Flow	Motivation	Learning	Low Anxiety	Leader Board	Content Unlocking
#1	+	+	+	+		+	
#2	+	+	+		+		
#3	+	+	+				
#4	+						+
#5	+		+	+	+		
#6	+			+			
#7	+		+				+
#8	+	+	+	+			+
#9	+	+	+	+		+	
#10	+	+	+	+			
#11	+	+	+	+		+	+
	11	7	9	7	2	3	4

Conclusion and discussion

The aim of an educator is to ensure that the learner benefits from the learning environment to the maximum degree at all stages of the teaching process. However, the failure to strike a balance between assessment *of* learning and assessment *for* learning reduces the effectiveness of the assessment stage of the learning process. The gamified assessment is capable of assessment *for* learning.

As Wood, Teräs, and Reiners (2013) suggest, it is possible to contribute to learning during assessment by allowing the learner to make mistakes and try different options using the replay function. On the other hand, components of gamification such as points, content unlocking, badges, leader board and levels provide feedback to the learner. Given that feedback is the most effective factor in learning (Hattie & Timperley, 2007), using it in assessment will enhance learning.

A gamified assessment was designed in this study and learners' opinions about this process were obtained using a questionnaire and a focus-group interview. In the design, we followed the process proposed by Werbach and Hunter (2012) for integrating the game's dynamics, mechanics and components in a gamified environment. In this process, we went from the most general to the most particular. Thus, we started with the dynamics. Then, we determined the

mechanics, which are more particular formations that are expected to concretize the dynamics. Finally, we defined the components (avatars, levels, content unlocking, the leader board, achievements, virtual goods, points, teams, badges), which are the most specific elements of a gamified system. We integrated all of these components into a game board, leader board and a profile card, with which the learners could monitor their and others' progress during the assessment, as well as their overall achievements afterwards.

Our findings demonstrate that this assessment process was an enjoyable one for all the students. Also, students reported that they were motivated, had the feeling of flow, learned and had lower exam anxiety during the assessment. The relationship between these themes was also addressed by Csikszentmihalyi (2014), who suggested that an individual will have the feeling of flow if they find an activity enjoyable. He also maintained that among the preconditions of the feeling of flow are setting clear targets, giving instant feedback and defining tasks that are suitable for a person's abilities. Csikszentmihalyi (*op. cit.*) found that anxiety is reduced by flow. Flow boosts motivation, which has repeatedly been found in the literature to have a positive effect on learning. All of these ideas support the themes of enjoyment, flow, motivation, low anxiety and learning that our gamified assessment revealed.

The learners found the options of replaying and consulting the course material very compelling. They stated that they learned during assessment. These opinions can be taken to indicate that we managed not only to create an enjoyable learning environment, but also to achieve an assessment that allowed for learning as desired.

We also received several negative opinions about the process. These negative opinions pertained to the themes of the leader board and content unlocking. The leader board is the gamification component most often criticized in the literature because it increases competition (De-Marcos *et al.*, 2014). Some students stated that being ranked low on the leader board may cause anxiety. However, eight of eleven students did not agree with this opinion. These findings are in line with the relevant literature in that they indicate the necessity of further discussion of the subject.

The presence of locked levels concerned some students as they were not able to see all the exam questions. However, since these levels were formulated according to Bloom's revised taxonomy, there is no advantage in a student seeing the questions at a higher level if they are unable to overcome the problem at the previous level. Thus, it may be recommended to lower the score required to unlock a level rather than removing them altogether.

The findings obtained from the questionnaire and the focus-group interview indicate that an assessment that involves learning can be attained using gami-

fication. We believe that the positive opinions obtained in this study resulted from the fact that we produced a design with a strong theoretical foundation. There are numerous studies in the literature that emphasize the importance of design on the effectiveness of the gamified environment (De-Marcos *et al.*, 2014; Hanus & Fox, 2015).

This study involved a specific design. Creating different designs by combining the components differently and investigating their outcomes will contribute to the literature.

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