A Gamification Module for BeA Platform

Fernando Mikic-Fonte, Martín Llamas-Nistal, Manuel Caeiro-Rodríguez and Martín Liz-Domínguez
atlanTTic Research Center for Telecommunication Technologies,
University of Vigo, Spain
{mikic,martin,mcaeiro,mliz}@gist.uvigo.es

***Abstract*— This paper presents a new module for the BeA (Blended e-Assessment) platform, aimed to be used in a higher education subject that combines the flipped classroom system and gamification features. Currently, this subject implements the flipped classroom methodology as well as intensive continuous assessment. Under this system, students are asked to watch videos that explain course contents, doing so as homework on a weekly basis. Then, students undertake an exam in the classroom covering the corresponding week's contents, counting towards the final grade of the subject. In a new approach, we decided to have students take exams every two weeks instead. However, this creates the need of maintaining a high level of student engagement, in order for them to keep watching the videos every single week. That is why we are developing a tool that allows us to apply gamification on days when students are not assessed. This tool consists of an online question system (as a multi-choice test) accessible through a web browser, which students can answer while being involved in a game.**

Keywords—gamification, flipped classroom, blended learning

I. INTRODUCTION

Gamification is an increasingly popular trend consisting in the application of game design elements in non-game contexts [1]. These contexts can be very diverse, and they often involve the use of some sort of software, in which gamification is implemented in order to increase user activity, attachment and retention.

One of the contexts in which the use of gamification is most prevalent is education. There is a large collection of studies involving the introduction of game-related mechanics in the design of an academic course, with the purpose of making the learning process more appealing to students [2]. The following are examples of authors using gamification in higher education scenarios:

- Domínguez *et al.* incentivized student progress throughout the course by awarding achievements for completing specific tasks and lessons, as well as for reaching certain participation thresholds. Additionally, they implemented a leaderboard as a mechanism to foster competitiveness. While overall scores increased with the introduction of these features, the system was negatively received by some students, who deemed the competitive aspect to be unnecessary or counterproductive [3].
- Stansbury and Earnest introduced roleplay elements in the design of an Industrial Organizational Psychology course. In this scenario, students were split into groups and asked to roleplay as actual members of a consultation team in order to solve the organizational problems that were issued as course assignments. Students earned "experience points" based on their performance, eventually leading to "level ups", representing their mastery of the course material. Both of these mechanics were directly related to the course grade. This cooperative system was well received by students, increasing their level of engagement and enjoyment of the course [4].

We see Gamification as an opportunity to improve the quality of our instruction in university courses. We will focus on a specific Computer Architecture course, a first-year engineering subject which uses the Flipped Classroom system, as well as an Intense Continuous Assessment method.

The purpose of this paper is to explain how gamification is implemented in the Blended e-Assessment (BeA) platform, which has been used in the aforementioned course for roughly a decade. This document will also highlight the game-related features that are offered from the viewpoints of both teachers and students.

Right after the introductory section of this paper, Section II offers some background information regarding the flipped classroom system and audience response systems, including details about how they are put into practice in our monitored course. Next, Section III provides an in-depth explanation of the new BeA gamification module. Finally, the conclusions and future work are provided in Section IV.

II. BACKGROUND

During the last academic years, we have developed and implemented a combination of flipped classroom (FC) and intensive continuous assessment (ICA) in the course "Informatics: Computer Architecture" using the tool BeA (Blended e-Assessment) [5]. This course belongs to the first year of the degree in Telecommunication Technologies Engineering taught at the Telecommunication Engineering School at the University of Vigo, Spain.

The FC system swaps learning activities that are typically performed in the classroom and at home. This implies that:

- Lectures, which are traditionally given by teachers in the classroom, are instead recorded in video and delivered to students online.
- Practical exercises and problems, which are usually sent to students as homework, are solved in face-to-face sessions in the classroom instead.

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In short, the FC is a learner-centered instruction system that seeks to make courses more engaging for students [6].

The ICA is defined as the summative assessment process in which assessment exercises are carried out at least once every two weeks. The key of this intensive continuous assessment is twofold:

- The exercises carried out for the continuous assessment must be done at least biweekly throughout the entire course.
- All of the exercises must have a summative character, that is, they count significantly towards the final grade of the course [7].

This experience has been described in [8], and basically consists in having students watching lectures in video format at home. This way, the in-classroom time can be dedicated to work on problems (individually or in groups), solve questions that the students may have on the topic of the last videos watched, highlight the main ideas of this lecture and, at the end, assess the students through a short exam, lasting 10-15 minutes, covering the contents corresponding to the present session and the previous one.

The experience described in [8] was performed during the course 2017/18 and in an experimental group in the course 2016/17 (16/17 EG), but we have continued to apply it in the 2018/19 academic year gathering similar opinions from the students. In these courses, the students widely agreed with this method, showing their agreement with the sentence "having an exam every week forces students to keep up to date with the subject, and the students learn more" and also with the sentence "I think I could achieve the same objectives (keep up to date with the subject and learn) with an exam every two weeks " (see Fig. 1). We are aware that this method imposes a great workload on students and also on teachers. Therefore, during the present 2019/20 academic year, we are implementing a format in which exams are performed every two weeks instead of every single one. Observing the first results of class attendance, there is a great reduction of attendance on the days without an exam (by about 40%). This fact leads us to focus on our plans of gamifying lectures, especially in the days without an exam, in order to engage the students and offering a way of formative assessment [7]. The difference between the exams and the gamification is that the exams are a form of summative assessment (exams scores are included in the final grade of the course), while the gamification represents a form of formative assessment. Therefore, gamification is performed mainly with the objective of knowing how the student is doing in his/her learning process and the scores are not included in the final grade of the course.

A. Audience Response Systems

During the last years, Audience Response Systems (ARS) have risen to popularity as a method to promote student involvement and feedback capture in classrooms. They can also be considered as a formative assessment tool. Essentially, these systems involve asking questions to students during the classroom that they have to answer individually, using some sort device, most commonly a smartphone nowadays. This is

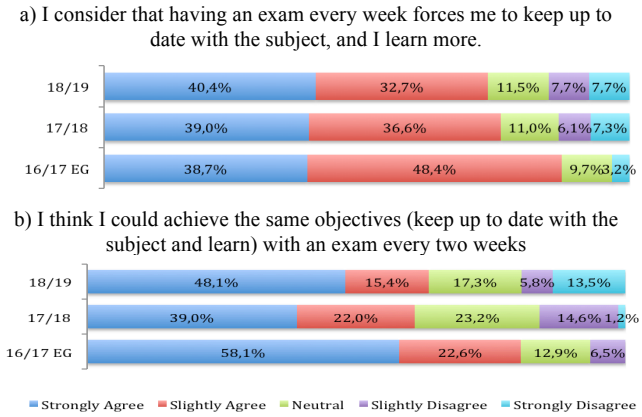

Fig. 1. Opinions of students regarding the method.

the adaptation to a digital scenario of the classic situation in which a teacher asks students a question with several options and students are required to raise their hands accordingly. In many cases, these situations cause students to feel nervous when answering in front of their teacher and their peers. As a result, they do not usually answer what they really think, or they even refuse to participate because they are afraid of what their peers or the teacher might say. The use of ARS reduces these bad feelings and facilitates participation.

In the past, the basic operation of ARS was based on the distribution of remote-control devices among students. Students using these devices can answer the questions and the system collects the responses, offering anonymity and reducing students' stage fright. The questions are shown to students using a video projector, and the results are collected and processed, being presented to the students as a graph or as a spread sheet. The teacher has direct access to the results and can modify the pace or contents of the class according to the data collected.

Nowadays, the procedure is much simpler. There exist several apps for smartphones that provide the functionality of an ARS (e.g. Poll Everywhere, Socrative, Kahoot). As all our students own a smartphone, it is not required to use proprietary remote controls to perform the digital inquiry of students during classroom time.

In the past, we have developed an ARS solution in the context of the Pi2E [9] project. This project was focused on providing an e-learning system over iGoogle. The iGoogle platform allowed a user to compose his/her own personalized Web page using gadgets and RSS readers. Within this framework, we developed a set of educational OpenSocial gadgets both for teachers and for students, aiming to support educational activities from their personal iGoogle page, which could involve performing tasks such as answering a questionnaire. Using this platform, we extended some gadgets and developed a new specific one called Edu-GAR [10] to support ARS functionality in Pi2E. Teachers were able to create and control the questions they wanted to ask students during a presentation, and the students could answer these questions. The Edu-GAR questionnaires may involve one or more questions of different types: multiple-choice questions, text input, sort, inline choice, etc.

Regretfully, the iGoogle platform was discontinued and we were not able to continue using the Edu-GAR ARS. In any case, as our experience was very positive we decided to develop this functionality based on the BeA platform and focused on gamification, as it is described in next section.

III. SYSTEM DESCRIPTION

As aforementioned, the tool presented in this paper will be part of the BeA platform as a new module, and will have two main parts, both accessible through a web browser:

- Classroom tool: Tool intended for its use in the classroom by the teacher and students.
- Management tool: Tool that allows the teacher to manage a games repository, that is, groups of questions and answers (with their associated characteristics), for possible reuse.

In the following subsections we will focus on each of these features.

A. Classroom tool

The classroom tool (accessible through a web browser) is the one that both the teacher and the students will use in the classroom to conduct the game (teacher) and answer questions (students). That is why this tool consists of two parts, directed at the teacher and the students respectively.

1) Teacher tool

The teacher, through this tool, will be in charge of starting and controlling the question and answer system in class, that is, the game itself. Once the teacher is within the game system in BeA, s/he will choose the option to start a game. This will bring up a list of all the games s/he has available to play in her/his browser. By choosing one of them, it will be automatically enabled for all the students of the course, so that they can connect to the game through their own student tool.

Once the teacher checks that all the students are connected, the game begins. From this moment, and until the end of Question Time, the teacher's work will be as follows:

1. Ask a new question: This will be shown in the teacher's browser, which should be visible for the students in the class (for example, through a screen placed for this purpose). In addition to the question itself, the possible answer options will be seen, which will be easily identifiable so that students can choose them on their own devices.
2. View the answer summary: After the time available to answer the question has expired, information regarding the answers chosen by the students will appear in the teacher's browser. Specifically, you can see the number of responses chosen for each of the possible responses.
3. Explanation: At this time, the teacher will use that feedback to make comments and give explanations related to the question.
4. View score: In the teacher's browser, information will be displayed regarding the score accumulated by those students who at that point occupy the top positions in the ongoing game (see section III.A.3 for the game's scoring mechanics).
5. Return to point 1 or end Question Time: In case there are no more questions in the game, Question Time will end, otherwise the next question will proceed.
6. End the game: Return to the main menu of the game system in BeA.

2) Student tool

Through this tool, students will be able to access a game when the teacher has started it and is open for students to connect to it. Once connected to a game, and each time the teacher asks a new question, each student will see the possible answers to choose from on their device. Their task will be to choose, from among the possible answers, the one they consider correct within a limited amount of time.

3) Game scoring mechanics

The game will award points to the students depending on chosen answers and the time they took to answer as follows:

- Correct answer: Positive score (previously assigned by the teacher for that question). This score will be weighted by the response time (higher weighting factor the faster the student has answered) and by the number of correct answers in a row chosen by the student (the more questions in a row answered correctly by the student, the higher the weighting factor).
- Incorrect answer: Negative score (previously assigned by the teacher for that question). This penalty will be fixed (and may be null) and will not be affected by response times or by the number of previous correct or incorrect answers. In addition, incorrectly answering a question ends the streak of successive questions answered correctly (thus affecting the corresponding weighting factor).
- Unanswered question: Null score. The overall score of the game is not affected by an unanswered question, although not answering a question causes, as in the previous case, the end of the streak of correctly answered questions (thus affecting the corresponding weighting factor).

B. Management tool

The management tool (accessible through a web browser) is exclusively aimed at the teacher, and through it s/he will be able to create and edit games to be used in classroom, as well as the feedback generated by them.

1) Searching games

This option allows the teacher to search for games in the system. The tool keeps a repository that stores all the necessary information regarding the games that the teacher can use in her/his classes.

When the teacher wants to use one of these games in one of her/his classes, s/he can find it using this tool (by performing a parametric search). S/he can enable the game to appear in the list of games available in the classroom tool. In case of having

a non-enabled game, this will be considered to be in a draft state that cannot be used to play.

2) Creating a new game

This option allows the teacher to introduce a new game in the system. For this, s/he will have a tool in which s/he must give a name to the game, indicating whether it is enabled or not, as well as provide the associated score weighting factors for: (i) the response time of a student when s/he answers correctly; and (ii) the number of correct answers in a row answered by a student. In addition, the teacher will need to introduce the questions (each with their possible answers) that will make up the game.

Through this tool, and during the creation of the game, the teacher must introduce the text of each question, as well as the possible answers associated with it (between 2 and 5), indicating the correct answer in the process. In addition, for each question the teacher must enter: (i) the score for correct answer; (ii) the penalty for incorrect response; and (iii) the maximum response time. Finally, and in case the teacher considers them necessary, a multimedia element (image or video) may be introduced to complement the question (Fig 2.).

3) Modifying a game

This option allows the teacher to modify a game that is already in the system. This option will consist of a combination of the search and creation tools. Through the search, the teacher can find the game that s/he wants to modify, then, a tool similar to that for creation is used, in which all the fields that the teacher must enter will already appear with the values of the game found in the search. This way, to make the game modification, the teacher will only have to update those fields that s/he considers necessary.

4) Deleting a game

This option allows the teacher to delete a game that is already in the system. In order to do this, s/he will use a tool similar to that for searching games. Once the desired game has been located, the teacher can confirm its deletion from the system.

5) Accessing game data

This option allows the teacher to consult a history of the data that was generated during the execution of a certain game, together with a series of statistical graphs about it.

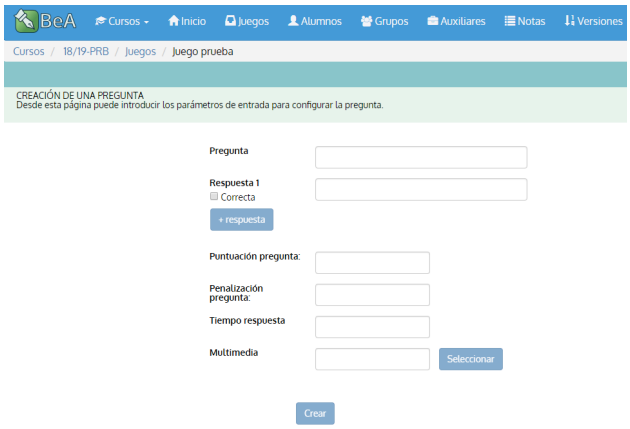

Fig. 2. Creation of a question (the tool is being developed in Spanish).

The data saved for each game is associated with each question, and includes information regarding the answers given by each of the students, the time it took for each student to answer, and the number of questions in a row answered correctly by each one. With these data, a series of individualized statistical graphs are obtained for each student (remember that each student must be logged into the system when playing, so that their performance in the game is easily traceable), as well as for the whole class.

This information is extremely valuable for the teacher to know first-hand those topics in which each student, as well as the class as a whole, present knowledge deficiencies, and therefore need more attention from the teacher.

IV. Conclusion and Future Work

This paper shows our proposal for a new tool in the BeA e-assessment system. This system is being used to support a flipped learning approach. It is an attempt to promote the engagement of students and keep them motivated towards the performance of the proposed activities. In conjunction with the rest of functionalities available in BeA this will enable us to support all the subjects by the same system.

As future work, we have yet to finish the full development of the tool as well as its implementation in a real environment next year in Telecommunication Engineering School at the University of Vigo, Spain. We intend to perform an in-depth assessment of the performance and usefulness of the system, considering both quantitative metrics, such as the effect over class attendance and exam grades; and qualitative ones, by surveying students and teachers regarding their impressions on the use of this tool.

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