

An Escape Room for an alternative evaluation system

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DOI: <https://doi.org/10.5281/zenodo.7057733>

Abstract

Our traditional education system spins around evaluation and its traditional grading system: summative assessment. In that system, professors spend time and effort trying to be "fair" when they mark the exercises, while students' main concern is snatching enough points to pass. We believe learning should be at the center. Students should put their energy on learning and professors on facilitating this learning process. However, we are still required to give a mark. We propose a game to achieve formative assessment. Play is a source of motivation to both engage students and enhance learning. The aim is that students should learn and enjoy their learning. We have designed an escape room with different sets of questions, each set corresponds to one topic. The student is presented with one activity to solve correctly. There is no grading but feedback: the answer can either be correct or incorrect. If the answer is correct, the student moves on to the next set of questions, otherwise the student is challenged with another activity of the same set. This goes on until the student solves one exercise correctly of each set. The student can only escape the room if one exercise of each topic is solved correctly. All activities proposed are of a basic level and if the student escapes the room he has a pass. Another bundle of sets can be done with more advanced exercises and if the student escapes the room he would achieve a higher mark. The method emphasizes two fundamental (but neglected) aspects of education: (i) the joy of learning; and (ii) diversity, as we give students as many opportunities as they need to learn at their own pace without penalty.

Keywords: Active Learning; Engineering Education; Formative Assessment; Game based learning

1 Introduction

Our traditional grading system is based on the much-dreaded exams. The exam period is a time of the year when students are assessed on the knowledge they achieve during the term and it is a time usually marked by stress, late nights, sore eyes and lots of coffee. With the good intention to alleviate the stress sometimes there is a mid term exam, or even the so called continuous evaluation with its own shortcomings (Armengol, 2007).

In any case, the grading system is based on exams and summative assessment. Students are presented with exercises to solve in a limited time and professors check how well they have done and based on that they give a mark, if the mark is sufficiently high, the student passes the subject.

In this scenario, assessment does not support learning (Gibbs 2005):

- no feedback is given to the students to improve and facilitate their learning,
- Students may not have another chance to test their knowledge or in the best case scenario even if there is another chance they have already been punished with a bad mark, which means that essentially students are not allowed to make mistakes during their learning process. We believe it is by making mistakes and reflecting on them that we learn the most (Farreras 2021).

However, we are still required to give a mark, is there a better way to grade? Yes, Virginia (Linda B. Nilson, 2016).

We propose to challenge the students with a certain amount of exercises that they need to solve correctly to pass the subject - instead of grading the exercise(s) of a test with a mark. There are different sets of questions/activities/exercises (i.e., one set for every subject topic). The student is presented with one activity to solve correctly. There is no grading but feedback: the answer can either be correct or incorrect. If the answer is correct, the student moves on to the next topic, otherwise the student is challenged with another activity of the same set. This goes on until the student solves one exercise correctly off each set (or topic).

We present this evaluation method as a Game-based learning (GBL) activity: an escape room. The student can only escape the room if one exercise of each topic is solved correctly. By introducing Game-based evaluation (GBE) into our subject we aim to achieve the following:

- **Rescue the joy of learning.** Learning for the sake of learning is actually a very enjoyable and fulfilling activity. Joy and fulfillment are undermined by the pressure the traditional evaluation system puts on the students (Bofill, P. 2005). Learning should not be seen as a sacrifice but as a privilege.
- **Enhance learning.** Students will gain deeper knowledge as they engage in the activities with the purpose of solving them correctly, meeting the specifications of each problem. They will work on each problem until they complete it. As opposed to doing what they can and hopping the mark is over the pass line.
- **Engage students.** By engaging them on the challenges of the game, students will practice more and practice makes better.
- **Allow mistakes.** Enough exercises are provided so that they can have as many attempts as they need, allowing them to make mistakes without affecting their mark. Students can learn at their own pace, accommodating a diversity of learners.

Overall, this paper makes the following contributions:

- We present our **design and implementation of a escape room** for First Year students of Computer Structure I course in the Degree in Informatics Engineering curriculum. There are 50 students per course divided into 3 groups for the practice sessions.
- We present a novel form of **evaluation in the form of a game GBE** that is stress free, for students and professors, accommodates diversity of learners, engages students and enhances learning.
- We present our expectations and our plans and methodology to **evaluate the activity** (the escape room). The activity is taking place at the time this paper is being written so we have not had the chance to evaluate the outcomes yet. If the paper is accepted we plan to present the results at the conference.

The rest of the paper is organized as follows: Section 2 presents the design of the escape room game; section 3 discusses the evaluation aspect of the game; section 4 shows its implementation; section 5 evaluates the outcome of the activity; and concluding remarks are written in section 5.

2 Theoretical framework

Recent research has applied gamification to many educational contexts, including Computer Science courses (Call, 2021)(Lopez-Fernandez 2021). However not all gamification strategies are equally fruitful. As in (Dave Eng, 2019), we make the distinction between gamification and Game-based learning (GBL). As opposed to gamification GBL does not encourage competition, which is not an intrinsic source of motivation. In GBL the students get involved in studying and solving subject matter problems to get the required hints to continue the game. In this sense, game-based learning is an instance of problem-based learning as it complies with the characteristics of PBL (Graaff, E. 2003).

PBL has long been proven to be an effective way to engage students and enhance learning (Yunita 2021) (Chevalier 2021) (Lima 2017).

According to (Bofill, 2007) learning takes place in five stages. Namely: motivation, information retrieval, understanding, application (or practice) and feed-back. We have chosen an escape room over other gamification activities because in an escape room (and in general in GBL) a challenge is set for the students (in the form of a game) and they have to learn the contents of the subject and apply them in order to solve the riddles to progress through the game and escape the room. In this way, GBL reinforces the autonomous realization of each of the learning stages.

Concerning assessment, we aim to achieve the conditions defined by (Gibbs G., Simpson C. (2005)) under which assessment supports learning. They can be summarized as: Providing the right activities and timely formative assessment which is used by the students and does not affect the grading. The escape room is a good framework as feedback is provided immediately at every attempt and there is always another chance. It also enables us to grade according to the system explained above.

3 Designing the game

The definition of an escape room: a game in which participants confined to a room or other enclosed setting (such as a prison cell) are given a set amount of time to find a way to escape (as by discovering hidden clues and solving a series of riddles or puzzles).

We have designed an escape room that seeks to have an epic mission, a clear goal, immediate feedback, another chance to prove it and a positive social dimension (McGonigal 2011). Careful consideration has also been given to each exercise so that students cannot escape without learning (Bofill, 2007).

3.1 The context

The escape room presented here was designed as a part of a Teaching Innovation Project to introduce Game Based Learning (GBL) into first year subjects with the aim of fostering (cooperative) learning, engaging students, and providing a positive social dimension. It is an interdisciplinary project that involves 3 different schools of Engineering education in our University where GBL has been introduced in 4 different subjects. The project involves 3 different schools of Engineering education in our University and GBL has been introduced in 4 different subjects. This paper focuses on the experience in the Computer Structure I course (ESC1), which belongs to the first year studies of the Bachelor's degree in Informatics Engineering curriculum offered by the Polytechnic School of Engineering of Vilanova i la Geltru (EPSEVG).

3.2 The set up or mise en place

The story line is as follows: there is a train at the platform about to take off when suddenly an urgent message arrives at the station office about a fallen down bridge on the route of that train. The train needs to be stopped! (epic mission). However it has already left the station and its communication system is broken. So you need to jump onto the last coach and make progress from coach to coach until you reach the locomotive engine at the driver's compartment where the driver is going to test you before taking your advice to stop the train (the goal).

Each coach has a security system: (i) first there is a password at the door that you need to guess; and (ii) an alarm that you need to deactivate in a given amount of time, before a bomb explodes and the train blows up. Each team needs to move ahead from coach to coach, and each coach is locked with a unique password that all teams need to figure out together.

Once they get to the engine, the teams meet the driver and there is one final challenge as the driver is a cautious person and gets suspicious when you break into the train engine's room and ask him to stop the train. So he locks each person alone into the room, from where you can only escape by answering correctly to 5 questions. Only then will the driver be convinced that you are a trustable person.

3.3 The challenges and the course timeline

The escape room is made of three types of challenges. It is a cooperative game, so the students work in teams of 2 or 3 students, chosen by themselves. Teams do not compete but work together towards achieving the goal. The games start in the classroom at the practice sessions, where the whole class is split into three smaller groups, and can be finalized at home.

The first session will be spent presenting the game, signing a contract to set up the rules and responsibilities and setting up the working environment for the practice sessions with the computer (lab sessions).

3.3.1 Challenge 0: Consult the reference book

The first (preliminary) challenge is to jump into the train before it leaves the station and unlock the door of the last coach. The riddle is a question which answer can be found in the reference book of the subject so teams need to visit the school library. Once they have the password they can begin.

Each coach represents a practice session at the lab. These sessions run every fortnight and there are 4 lab sessions during the course. Each lab session has two parts, that we have linked to our next two challenges:

3.3.2 Challenge 1: Deactivate the alarm

(i) First, there is a pre-assignment the students need to complete beforehand. Once in the classroom, answering correctly to a set of questions related to the pre-assignment will deactivate the alarm. These questions are the same for all groups and a limited amount of time has been given for them to answer the questions before the timer expires.

3.3.3 Challenge 2: Unlock the door to the next coach

(ii) During the rest of the lab session the students work on some codes to practice the topics that have been introduced into the theoretical lessons. They are presented with a problem to solve that is split into tasks of equivalent difficulty and educational content and each team takes one task (there is a riddle to solve to figure out which task each team needs to solve). The tasks need to be combined to solve the problem and only the correct answer to the problem will give the right password to unlock the door to the next coach. The teams need to work together making the game cooperative and providing a positive social experience.

After answering each question immediate feedback is provided and they have as many attempts as they need in the given time. Students work in teams in challenge 1 but in challenge 2 teams need to work together making the game cooperative and providing a positive social experience. All activities proposed for challenge 1 and 2 are of basic level and if the group reach the driver's compartment, they have a pass.

3.3.4 Challenge 3: The driver's test

This is a final individual challenge, students reach this point towards the end of the term. In this challenge another bundle of questions is used of a higher difficulty. There are 5 sets of questions which correspond to the 5 topics of the subject matter. In order to escape the room each student needs to respond correctly to one question of each set.

The student is presented with one exercise to solve correctly. If he succeeds in providing the correct answer (feedback is immediate), he moves on to the next set of questions, otherwise the student is challenged with another activity of the same set (mistakes are allowed!). The new activity will be a different one but equivalent in the sense that it relates to the same topic. All activities in one set cover the same educational content. This goes on until the student solves one exercise correctly off each set. In that way he has covered the full content of the course.

The students who pass the driver's test and escape the room will obtain a higher mark.

All challenges preserve our ethos, each team works at their own pace, formative assessment is given and the teams work in a cooperative way.

4 Game Based Evaluation

Using an escape room game for grading the students' progress is a novel form of evaluation as it shifts the focus from (a) a scenario where students try to solve a task(s) the best they can and are given points according to how well they did; to (b) a scenario where there is a set of tasks and students are asked to solve one of them correctly. In (b) they can have as many attempts as they need (limited only by the number of tasks on the set), for each attempt there is formative assessment so the student can progress.

The task can be a single one which covers the full content of the subject matter or several smaller tasks, one for each topic of the subject. And the level of the tasks may vary, there can be bundles of exercises at different levels (basic, medium, high) and the mark could be set depending on how many bundles the student can solve correctly. Students who complete the basic set correctly, but fail to complete the medium set, may have a pass, but students who complete the basic set plus the medium they may have a higher mark, and the highest mark can be achieved by completing the 3 sets.

As (Linda B. Nilson, 2016) states it: all assignments and tests are graded satisfactory/unsatisfactory (pass/fail), depending on whether the work meets its specifications. In this way the students need to correctly solve a certain amount of exercises in order to pass the subject instead of grading the exercise(s).

In this way, formative assessment is provided at every attempt and assessment is used to support the learning (Gibbs G., Simpson C. (2005)).

In our subject we have used the escape room to grade the practical work, which is part of the final mark of each student. It is a cooperative game, so even if there are teams, the full class (lab groups) either succeeds or fails. If they succeed to stop the train on time they will be graded the practical work with a pass (minimum). The students who also pass the driver's test will have a higher mark (7/10). Students have also delivered tasks which will be used to grade the teams beyond 7.

This is the first time we implement GBL in the subject, our set of questions covers the basic and intermediate levels, the former used for challenges 1 and 2, and the later for challenge 3. The game-based Evaluation methodology presented has only been used to grade the practical sessions for now.

5 The escape room implementation

For the implementation we looked at several available tools: Socrative, padlet, moodle questionnaires among others.

The logistic requirements of the game are: (i) possibility to play online (if necessary); (ii) engaging for students, it involves an stimulating and appealing graphical interface; (iii) and it should be possible (and fairly straightforward) to implement our challenges (escape room style).

We finally settled on a combination between genially (<https://genial.ly/>) and moodle questionnaires (<https://docs.moodle.org/>). Challenge 1 was fully implemented on genially with a nice graphical interface. Challenges 0 and 2 were synchronizing moodle and genially. And Challenge 3 was fully implemented using moodle questionnaires.

Figure 1 shows two of the introductory screens of the game; (a) presents the mission and (b) is the interactive map of the train that they can use to navigate for every lab session. All lab sessions are locked until the password is obtained, in due course.



Figure 1. Image of the first screens of the game (a) the mission; (b) the interactive map

We found that Genially gave us a nice graphical interface but the type of questions was limited. *Multiple choice* question type is available by default (shown in Figure 2 (a)); and we have installed a plugin to support the *Short answer* type of questions (shown in Figure 2 (b)). On the contrary moodle has a richer repertory of question forms which allowed us more elaborate questions (https://docs.moodle.org/400/en/Question_types).



Figure 2. Image of the two types of question we used in genially (a) single choice; (b) short answer

Figure 3(a) shows the password page that locks each lab session (the key to open the coach door), which at the same time, allowed us to synchronize with the timeline of the course using a single genially. Figure 3(b) shows the final page after challenge 1 is completed on couch 2. In this page we give a small riddle which allows us to synchronize with the moodle platform.



Figure 3. Image of (a) password that locks the door of coach 2 on the left; (b) Final pages after succeeding to disconnect the alarm.

Figure 4 shows what happens if things go wrong. Figure 4(a) shows a train accident, the train falling down on the broken bridge, and 4(b) shows a bomb explosion when failing to disconnect the alarm. The good news is that this is a game and the student can always go back and have another chance.



Figure 4. Image of (a) a falling down train, when a question is answered incorrectly; and (b) the bomb explosion if the timer expires.

6 Outcomes and evaluation

At the time the paper is being written we are halfway through the term and the students are carrying on the activity. At this point all we can say is that they seem to be enjoying themselves with the game and fully

engaged with it, we have full attendance to the classroom and we have not had any student withdrawing the course up to this point.

In order to evaluate the activity and improve it for later editions we have prepared a questionnaire based on the Student Evaluation of Educational Quality (SEEQ) Standardized Instrument. Table 1 below shows the questions related to the game and the evaluation methodology. We will ask the students to fill the questionnaire and if the present paper is accepted we pretend to present the results at the conference.

Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The game has been a motivation to start working on the subject	1	2	3	4	5
The game has engaged me to have more practice	1	2	3	4	5
I have enjoyed learning through play	1	2	3	4	5
The game has helped me to acquire a deeper level of understanding	1	2	3	4	5
I like the fact that I can have as many attempts at the exercises as I need	1	2	3	4	5
I think the evaluation methodology of the lab is adequate and fair	1	2	3	4	5
Mention three positive aspects that you have enjoyed of benefit from regarding the game (lab sessions)					
Mention three shortcomings of things that you would improve on the game (lab sessions)					

Table 1. Summary of the questionnaire based on SEEQ regarding GBL and evaluation methodology

7 Conclusion

This paper presents a Game Based Learning (GBL) activity where we use an escape room not only to engage students and enhance learning but also as a form of evaluation (Game Based Evaluation). We present the students with a set of challenges that they need to solve correctly in order to escape the room, save the train and pass the subject. If they fail to complete one exercise another opportunity is given, with another exercise covering the same educational content. In this way the students need to correctly solve a certain amount of exercises in order to pass the subject instead of grading how well they have completed the exercise(s).

GBE provides a stress free evaluation methodology that emphasizes two fundamental (but neglected) aspects of education: (i) the joy of learning; and (ii) diversity, as we give students as many opportunities as they need to learn at their own pace without penalty.

8 Acknowledgement

This work has been supported by the Institut de Ciències de l'Educació (ICE) Convocatòria de projectes d'innovació docent 2021 (Acord CG/2021/02/34, de 9 d'abril de 2021) and by Escola Tècnica d'Enginyeria de Telecomunicació (upc telecos-Barcelona Tech).

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