Game-based Learning **in Computer Engineering**: A **Workshop**

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Abstract

Gamification has gained popularity in the last years, it is used in primary and secondary schools, as well as in companies and universities (Call, 2021). Along with this growth in popularity the number of available computer tools that facilitate the implementation of quizzes, competitions, simulations, WebQuests etc. has also grown.

Play engages students and enhances learning, however not all sorts of games are equally fruitful. As in (Dave Eng, 2019), we make a distinction between gamification and game-based learning (GBL). An example of gamification is a contest where students get points for solving the usual exercises of the subject matter. An example of game-based learning is an escape room where 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 (PBL) [Lima, 2017]. An interesting reflection on GBL can be found in [Valero, 2018].

The main objective of GBL is to provide an active learning environment, where students need to learn and apply the subject matter in order to participate and eventually solve the game. Compared with frontal lectures, active learning has been shown to provide higher motivation and deeper learning [Call, 2021] [Lopez-Fernandez, 2021].

From a general point of view, we can say that learning takes place in five stages [Bofill, 2007]. Namely: motivation, information retrieval, understanding, application (or practice) and reflection or feed-back. GBL, then, reinforces the autonomous realization of each of these stages.

An escape room is a game where players must solve different puzzles and riddles in order to finish the game (in order to *escape* from the room). Escape rooms have been used extensively in education, since they allow for the organization of subject matter exercises in a pleasant way [Veldamp, 2020].

Learning outcomes

We present a workshop session where we expect the participants to:
(i) Notice the difference between gamification and GBL and reflect on it (see activities below).
(ii) Learn how a well designed escape room reinforces the autonomous realization of the five stages of learning defined by (Bofill, 2007)
(ii) Finish the workshop session with some ideas on how to introduce GBL into their subjects.
We hope that this workshop will inspire participants and, maybe, engage them in proposing GBL activities for their own students.

We propose the workshop to include the following **activities**:

1. A short introduction: GBL and gamification are introduced and the timelines of the workshop are presented.
2. Participants engage in a gamification activity: they will be required to solve a simple questionnaire, and we will monitor their progress using Socrative tool (socrative.com)
3. Participants will be invited to participate in a GBL activity: an escape room where they will be required to solve simple computer programming exercices to obtain the keywords to progress on the game and exit the escape room. Notice that we do not expect the participants to know computer programming so they will be allowed to use other means (like google) to provide the answers to the riddles. In a real situation, the students are required to write the programs to solve the questions.
4. A reflection in small groups to compare the strength and weaknesses of both approaches.
5. We will continue with an open debate, where we may discuss topics such as: assessment, comparing game-based learning versus gamification strategies, strategies and tools for applying such gaming techniques in the classroom and online. The debate will be aimed to formulate conclusions and get feedback and ideas to improve our game-based activities.
6. Finally to end the session participants will be invited to take home the design of a simple escape room situation involving problems for their own courses.

Inspirational questions to open debate:

-Which sort of gaming experience provided higher motivation?
-What differences can you see between gamification and GBL?

-Think of ways to introduce GBL into your subject
-Regarding the quality or level of understanding, which experience do you think provides a deeper understanding?
-Does GBL encourage creativity? critical thinking?

Requirements

Participants are expected to bring their own laptop (or tablet, or phone) to the workshop and a headset.

Results

In this section we present the reflections of the participants to the workshop.

Strengths of the gamification strategy:
- Increased student motivation
- Quick gain
- Creates competitive learning environment between groups
- Direct and quick feedback
- "Kids" nowadays are more used to games

Weaknesses of the gamification strategy:
- The activity can be stressful.
- Focusing on the quiz without actually learning
- Only one try. It should have the option of more than one answer.
- It could be a distracting activity
- The motivation is external
- Risk of losing part of the student population
- Rewards are trivial, students may not be interested.

On the other hand, the strong points expressed about the game-based learning activities were:
- Diverting
- Focused on the topic
- Immediate application of the knowledge
- Group work (twice)
- Immersive
- More motivating than gamification
- The moments of success are rewarding
- Less risk of gender issues
- Engaging by story
- Can be very engaging
- Can foster further self-directed learning
- Learned lessons:
  - for life or
  - for community
  - for the next stage

And as weak points:
- The escape room could be run presentially, rather than digitally.
- Complex usability of the escape tools.
- Not balanced knowledge among the team members
- Too much distraction
- Different computer literacies of students
- The game should include some reflection (what have you learned, how dit you do it,...)

Acknowledgement

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