A GAMIFICATION PROPOSAL TO INTRODUCE STUDENTS TO GRAPHICAL ANALYSIS

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Abstract

Data analytics is a required competence for students in almost all knowledge areas, however, undergraduates find the learning of this ability quite difficult and tedious. Although they usually do not seem to have any trouble doing a graphical representation of a set of points, frequently they are not able to conclude anything apart from the possibility of a relation between the represented quantities. Consequently, they are not able to make a quantitative analysis of the results and, conclusions based on the graphical analysis lack important information.

This problem is particularly decisive in experimental work, where measured data must be thoroughly analysed in order to achieve valid conclusions. It has been shown that specific introductory laboratory sessions designed to introduce these basic concepts and abilities are very useful, but, nevertheless, this topic is not appealing for the students, and the training results are not as good as they should ideally be.

Gamification of lessons takes advantage of the predisposition of students for the game, and therefore a gamification of the introductory session devoted to graphical analysis could overcome this situation. In this work, a gamification design is described and the students’ valuation of the activity is reported. The basis of this proposal is the transformation of the introductory lab-session into a quest where a mystery must be resolved by means, among others, of graphical analysis. In addition, students compete in groups to find the answer, and they achieve different scores according to the chronological order of the finding of the solution.

Keywords: Serious Games, Gamification, Data analytics, Graphs.

1 INTRODUCTION

Gamification is usually defined as the use of game design elements in non-game contexts [1]. The final purpose is to stimulate the action of the participants and promote the use of the skills required for the game in different contexts. There is a wide range of gamification dynamics [2]. Some of them are complex and require a meticulous design to include elements as competition, cooperation, narrative (history), feedbacks, etc.

This methodology has been chosen to introduce students to data analytics due to the verification that during the last years there has been a change in the learning paradigm of the new generations. The new digital generation has developed a lower capacity for abstraction than the previous ones, as well as a more superficial view of information [3]. In contrast, they are much more social and need to obtain gratification and social recognition instantaneously [4]. They have difficulties with subjects that need to generate complex knowledge structures or that demand a lot of work and practice, requiring more motivation and predisposition to learning [3,4].

The multiple benefits that have been associated with the use of gamifications with educational objectives have been also taken into account. The immediate feedback and rewards motivate greater involvement and participation of students in the learning process [5] and they must work in groups acquiring, in consequence, the required skills for that kind of work [6]. The game dynamics promote experimentation and the search for creative solutions to problems [7], as well as the development of communication skills. In addition, they have the potential to promote deeper learning [8]. The social game for educational purposes has been highlighted as a future trend for education in several Horizon Reports [9-11].

In this work, a gamification design for an introductory lab-session devoted to data analysis is described. Gamification situations should be as close as possible to the professional context in which the student
will develop in the future [12] and a contextualization in which students are presented with a realistic scenario of work has been carried out. Students have worked in small groups and have been proposed a challenge that must be solved, for which they must learn to use the skills that have been set as objectives, that is, graphical analysis in this case.

2 METHODOLOGY

For the success of a good gamification, it is necessary to identify which processes and activities result in meeting the objectives and therefore, in developing the most appropriate game mechanics for each one of them. In this work two objectives have been set: (1) that students understand the advantages of using graphical representation of data, and (2) that they use the graphical analysis to extract qualitative and quantitative conclusions about the obtained experimental results.

According to this, an introductory lab session has been designed as a quest competition where students work in groups to find the correct answer by means of graphical analysis. The following situation is proposed: the remains of an abandoned laboratory have been found. It is not known what kind of research they were carrying out, but they have found a calculus spreadsheet printed, half blurred, where some data are appreciated. The double objective is: to deduce what physical quantity is hidden in the data of the tables and to determine what physical phenomenon was being investigated at the research center.

The worksheet is provided to the groups. The half blurred data consist of two incomplete tables of the position and the speed in different instants of time of a free-falling body. No physical quantity name or unit is indicated and random errors have been added to these “experimental” values of position and speed, making impossible to deduce a clear relationship between the values in each table if no graphical representation is carried out (objective 1).

The answer to the quest is achieved by means of the quantitative analysis of the graphical representations (objective 2). The position-time data fits best to a parabolic function and the speed-time one is clearly linear function and fits to a straight line. In addition, the slope value of this second fitting is approximately the value of the acceleration of gravity on the surface of the Earth. Further calculation of the fitting coefficients of the position-time data reveals that the fitting curve is the position function of a free falling body and the quest is resolved.

Students achieve different scores according to the chronological order of the finding of the solution, and, in consequence, the teacher can not help a particular group if students get stucked. In order to avoid this situation, clues are provided at the same time to all the groups periodically. In addition, they may opt to access some specific tutorials about data analytics as extra help. These tutorials consist of short videos in which the graphical representation analysis is briefly explained highlighting the most important aspects.

Finally, students have evaluated this lab-session by means of an anonymous survey. Results are presented in the next section.

3 RESULTS

As it has been previously mentioned, students’ satisfaction with the implemented methodology was evaluated by a simple survey with several questions: (i) do you like the new working approach in the laboratory?, (ii) do you prefer to work in the laboratory in a traditional way?, (iii) have you learned anything in the lab-session?, (iv) what level of difficulty has the lab-session had?

The first two questions are related with the satisfaction of students with this new approach. The questions (iii) analyzes the students feeling about their learning and the last question evaluates the students estimation of the level of difficulty of the session. The results are summarized in the Figures 1-4.
As it can be seen in these students responses, most of them like the new working approach in laboratory (83%) and only 19 % prefer to work in a traditional way. The feeling about learning is also satisfactory for most of the students (78 %) and the work done was estimated as medium difficulty.

4 CONCLUSIONS
Gamification of laboratory sessions is feasible and opens the possibility of working in more realistic environments. In addition, students are much more satisfied learning with these kind of dynamics and take part more enthusiastically in the training process.

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