HOW TO LEARN HAVING FUN: DRAG AND DROP QUESTIONS FOR BUILDING STRUCTURES

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Abstract

This article summarizes the work that the Innovation Group E4 (Exploración de Enseñanzas en Estructuras de Edificación) is currently developing at the School of Architecture of Madrid (ETSAM). Professors of this Group are continuously improving the methods of the Information and Communication Technologies (ICT) area focused in teaching of building structures. In this moment, a project about the use of “drag and drop” questions is being developed in order to introduce the game-based learning and serious games in the process of learning how to draw structures diagrams. This article presents the work done so far, the methodology currently used and the first feelings of the students.

Keywords: Innovation, ICT, Moodle, drag and drop, game-based learning.

1 INTRODUCTION

The group of innovation in education E4 has been researching about the automatic correction and self study for almost ten years. During that period, the contributions have evolved from the first versions of automatic self correction systems [1] to complex tools of educational assessment [2]. In that time authors of this work have learned that there is not an ideal methodology which will be always the most effective. Unfortunately, the educational applications reduce their effectiveness over the time, so they should be continuously improved.

In this work, a case-study is presented using a methodology that moves away from serious games and is closer to game-based learning. In this way, the question of Moodle “drag and drop” has been employed to study the mechanical behaviour of building structures.

2 METHODOLOGY

2.1 Particularities of teaching building structures

How to draw the diagrams of the structural behaviour, namely shear stress and bending moments, is the main difficulty for the students of building structures subject. These diagrams are determined by the external loads, the geometry of the structure and the boundary conditions. Also, these different diagrams are interrelated: shear stress comes from the integration of loads, and bending moments come from the integration of shear. In the same way, deriving the bending moments the shear stresses are obtained, and deriving them again the loads are obtained.

The main goal of this work is to create a game-based learning that allows students enjoy practicing with structural diagrams and having fun. In this way, the work is oriented to incorporate entertainment questionnaires to allow students to practice all they want and wherever they want using their smartphones. For this purpose, the drag and drop question type has been chosen.

2.2 Drag and drop

Drag and drop is a new question type of Moodle developed by the Open University [3]. It allows students to drag words, images or both from a list and drop them into pre-defined gaps on a base image. It is a very useful question type with several possibilities to explore.

2.2.1 Procedure for building structures

A selection of drag and drop questions are being developed to use them in the subjects Structures 1 and Structures 2 of the School of Architecture of Madrid (Universidad Politécnica de Madrid). At this time, there have already been developed three questionnaires. They are composed of questions about
simple beams, continuous beams and Gerber beams (beam with a structural joint in which the bending moment is null).

The ultimate goal will be to obtain a complete repertory of questionnaires with a high number of questions each one, classified according to their structural type. The high number of questions (around 400 for each questionnaire) is necessary to guarantee that the questions of each student are different with a simple random algorithm. In this way we also get enough variety of questions that allows the students to practice all that they want without repetition of the questions.

In the coming months we intend to develop complete questionnaires about cantilever beam, double cantilever beam, inclined beam, cantilever inclined beam, double cantilever inclined beam, frames, cantilever frames, double cantilever frames, double frames, etc.

Drag and drop question type is very suitable for practicing with PC, laptop, tablet or smartphone. Nevertheless, they are not comfortable for smartphone which small screen. For that reason, we also intend to develop the same questionnaires with the multi-choice question. It is an alternative for drag and drop questions in which the students select the answer instead to dragging it. This alternative version is proposed for students with non-touch devices or less versatile devices. However, this last alternative is less attractive than the original drag and drop question.

2.2.2 Drag and drop questions for building structures

The approach of the questions is essential to achieve an effective game-based learning in a technical subject at the university level. Since it is known that the structure diagrams of external loads, shear stress and bending moments, are interrelated (deriving or integrating, as appropriated). The drag and drop questions have been designed as a funny riddle, and they can be an appropriate alternative to previously systems with the same objectives as [4-6].

An example of drag and drop question is represented in figure 1. Each question is composed of a main figure (“A” in figure 1) in which only one diagram is represented which is chosen randomly. It may be the scheme of external loads or the diagram of shear stress or the diagram the bending moments. Also the question has other five images (“B-1”, “B-2”, “B-3”, “B-4” and “B-5” in figure 1) that correspond to random diagrams of loads, shear and moments. Only one of the five options is the correct one and students should be able to detect it. When the solution is found, they should drag and drop it into the pre-defined gap (“C” in figure 1).

It is important to note that figures of these questions do not specify what type of diagram is represented. It is very easy to distinguish the scheme of the loads from bending moments and shear stress, as can be observed in the left question of figure 2. However, it is not obvious to realize that one image corresponds to a diagram of shear stress (as occurs in the question of figure 1) or to a diagram of
bending moment (as occurs in the right question of figure 2). This issue is part of the own question. Students should also realize that linear laws are colored in blue and parabolas are represented in red color, as can be observed in the question of figure 1.

The aspect of a drag and drop question using a regular smartphone can be observed on the left of figure 2. The aspect of the alternative of multiple choice option can be observed on the right of the figure 2.

3 RESULTS

At present, three questionnaires have been developed and they are in use in the subject Structures 1. Each questionnaire has 385 drag and drop questions. It is proposed to continue performing questionnaires to apply them in both Structures 1 and Structures 2 subjects.

The first impressions of the students are satisfactory and the times and duration that are recorded in Moodle prove the continuous practice of students with this new type of questions. It is important to emphasize that students refer to the questionnaires as “the game” and, by the moment they practice continuously and highly motivated.

The first quantifiable results obtained using this type of questions in the subject Structures 1 are exposed below.

3.1 Learning results

Despite of it is yet soon to evaluate the effectiveness and acceptance of using this type of questions in on-line questionnaires, Moodle have recorded several data that could be able to start evaluating the experience.

Figure 3 shows the time spent by the same students in two different questions. It can be observed that students are faster in the second questions (right graph of figure 3) than in the first one (left graph of figure 3). It may be because students get more familiar or because the question is easier than the first one. In fact, the degree of difficulty can vary enormously and the questions are continuously generated so it is easy that these events using this random system. In both graphs can be observed the same trend, namely most of the students are able to solve the questions in reduced times.
A representation of the relationship between the time that students spend in the questions and the score obtained is shown in figure 4. Instead this image is extracted from the data of a certain question of a particular questionnaire, this behavior is representative of the general results observed until date.

As can be observed in figure 4 most students have spent low times to obtain a good score while there are a minor part of the students that need more time to obtain the same score.

A representation of the score obtained in relation with the spent time is shown in figure 5. As can be observed in that figure, when students use more than one attempt there are less density of low scores. As mentioned before, students probably get more familiar with the educational system presented in this work so they become more motivated to continue with the “game”.
It is important to note that when a student fails a question the program automatically generates a new version of the question randomly.

4 CONCLUSIONS

At present, three questionnaires have been developed and they are in use in the subject Structures 1 although a repertory of questionnaires of drag and drop questions are being developed by the Innovation Group “E4” from the Universidad Politécnica de Madrid and will be soon applied. These questions are absolutely innovative and are designed as a funny riddle for students to learn how to draw the diagrams of shear stress and bending moments.

As stated before, the motivation of the students is one of the main forces that impulse this study. In fact, the general first impressions of the students are satisfactory and the times and duration that are recorded in Moodle prove the rising in the practice of students with this new type of questions. In fact students refer to the questionnaires as “the game” and compare results and scores to each other.

At this time, it is soon to get final conclusions of this work because it is still in progress. However, with the experience carried out so far we can affirm that the questionnaires like the ones presented in this work have been welcomed by students of the School of Architecture of Madrid, with incredible reception.

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REFERENCES


