New Learning Method for Structural Understanding in Architecture Based on Gamification.

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Introduction

Architectural students find physical and mathematical concepts challenging to understand; i.e. behavior of structural elements such as frames, bearing walls, slabs, etc.

E-learning is encouraged, thus the "Apprendestructo App " (1 and 2) was implemented. This App is a game-based learning method built on potential video games to improve understanding of structural design concepts: stresses, strain, flexural moment, etc.
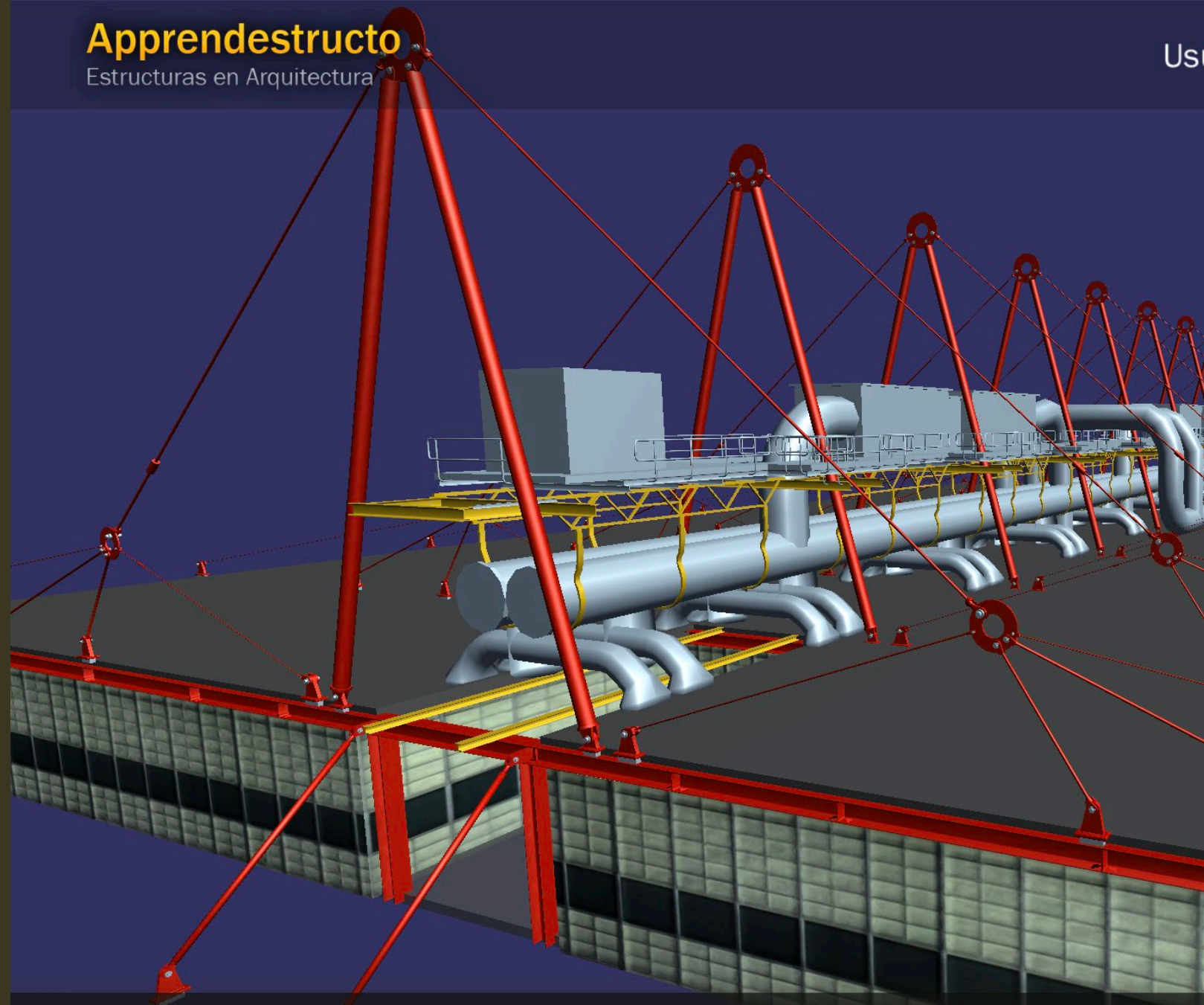
Introduction

The aim of this research is to design and measure the imact of a new learning method based on gamification to improve the structural understanding of architectural education from the teachers´ point of view.

The work done is based on specific successful educational experience, but the methodology could be adapted to other areas.

Method for structural understanding in Architecture

Understanding the target audience and context: *the first strategy* revolves around verifying students´ abilities in structural análisis and setting the app tool and course dynamics.

Defining learning objectives: *the second strategy* is aimed at defining the learning objectives of structural design course in applying structural analysis concepts to propose architectural solutions.

Structuring the experience: *the third strategy* deals with structuring the students´experience hierarchically, from smaller to more significant task.

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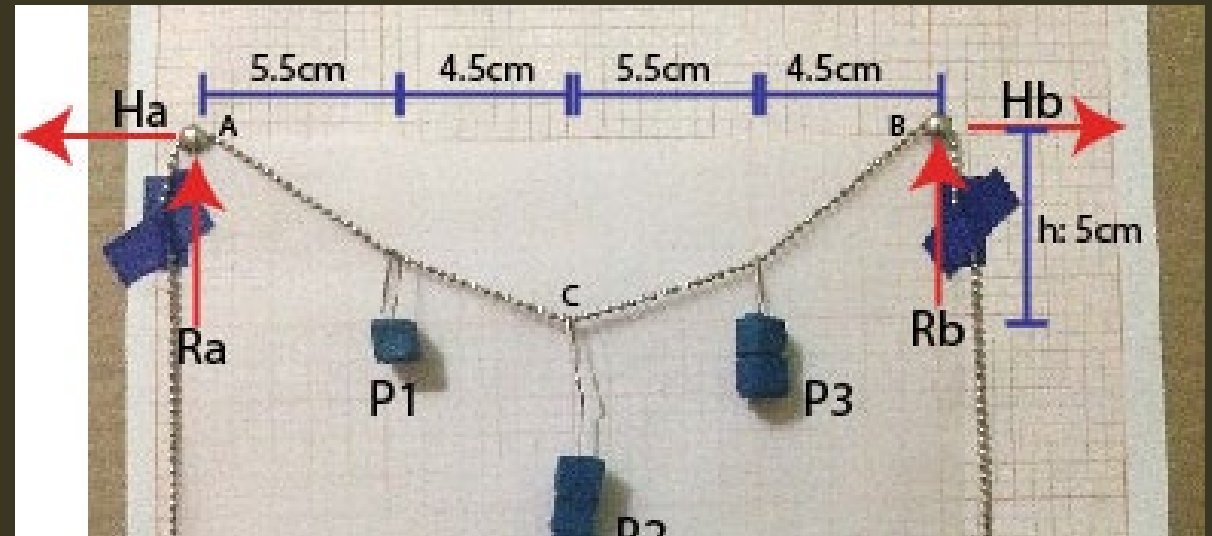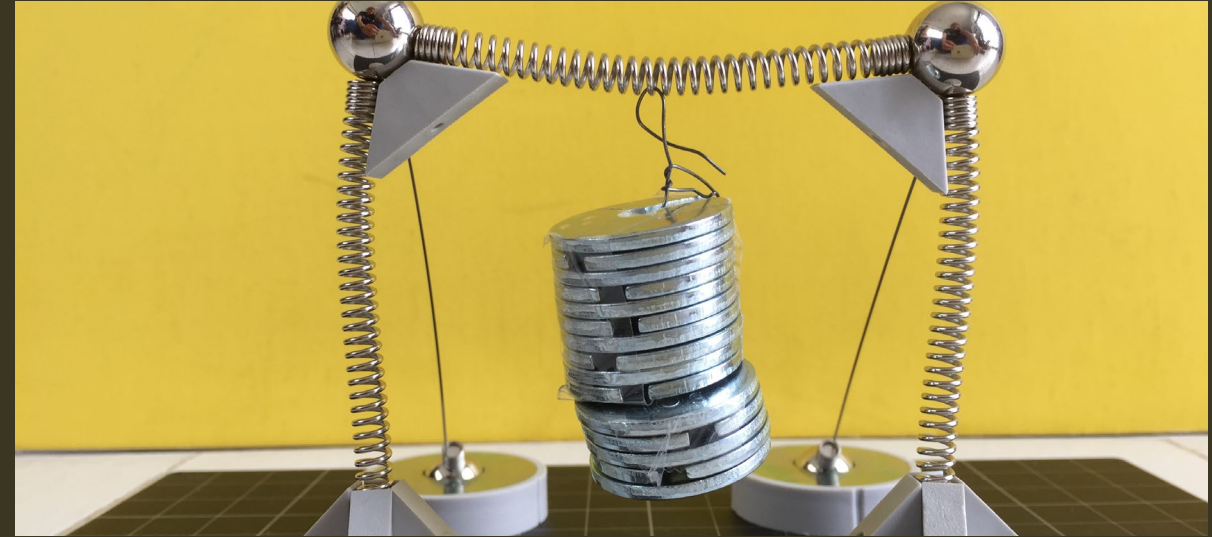
# Method for structural understanding in Architecture

Identifying resources. The fourth strategy is based on activities from the gamification process were introduced as part of everyday work in the classroom. Tasks are from the app, where scenarios are more real and displayed with the same topics. Students practiced one game per week.

Applying gamification elements. The fifth strategy builds on the previous experiences in using the app. The app selected must include one of the topics or the course.

Recap. Adapt the method´s strategies to the group´s needs and capabilities in order to get the best results in the learning process.

Learning experience at the classroom level
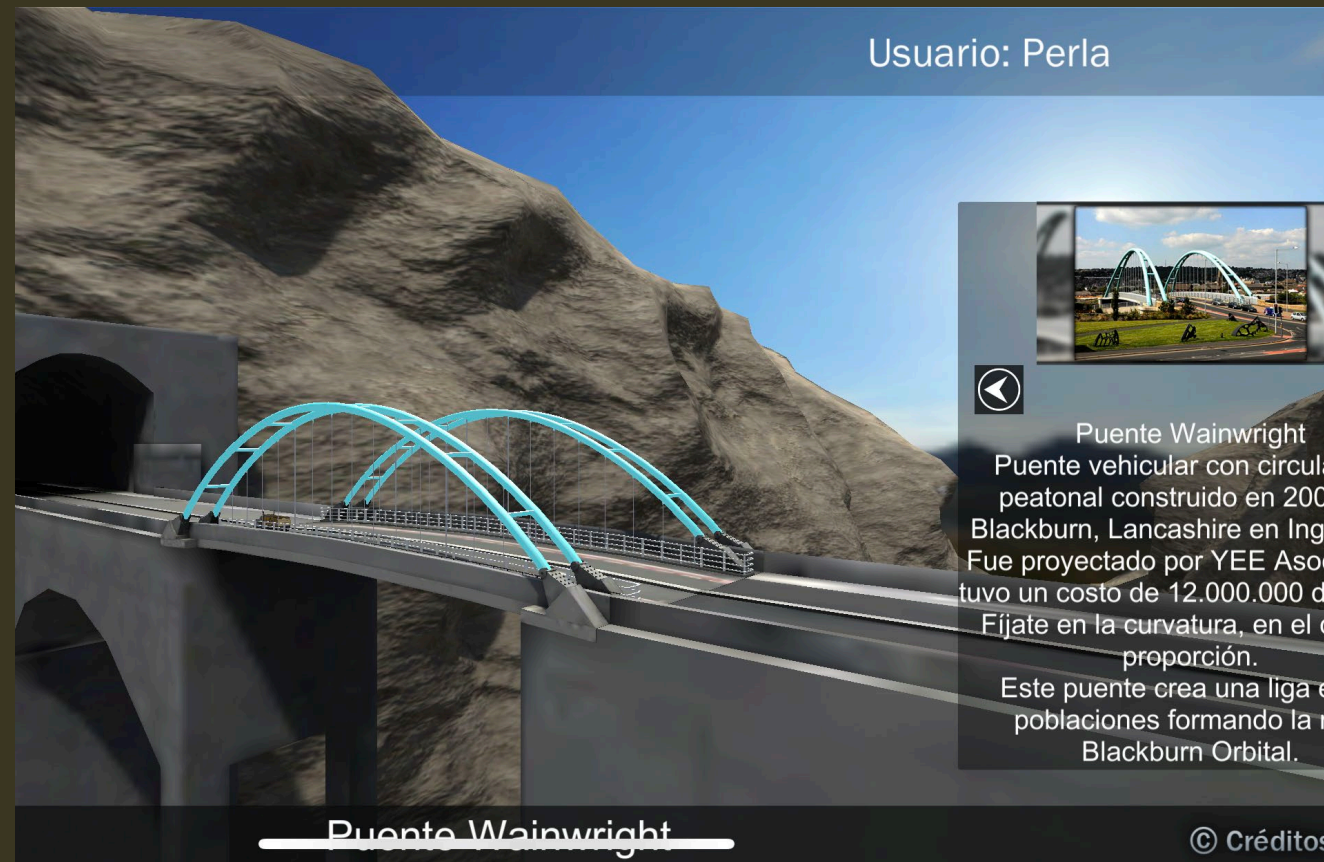
The courses where the method was applied: Design of Steel Structures and Design of Reinforced Concrete Structures.

First week: Theoretical structural analysis approach explanation. Excercises are based on real cases of buildings witht he same structural solution.

Second week: Problem solving assignment. Working in teams, students used the e-learning app to solve the class assignment. Avatars are part of the game modo, in order to allow students to feel part of the game.

Prizes for students with more app problems solved are included: game points and augmented reality tour given by the same app.

Assesment of the learning method results
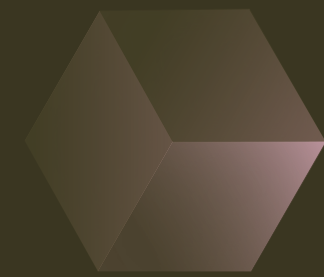
Students´ performance in the class improved, gettin better final evaluation grades.

Comparison of group first partial evaluation is presented. Red lines correspond to students that took the courses without gamification method, and blue lines are grades of students that took the same courses with the gamification method. Grades are higher in courses with gamification.

Final Exam Concrete and Steel Design Courses

Grade

■ With Gamification

■ Without Gamification

Number students
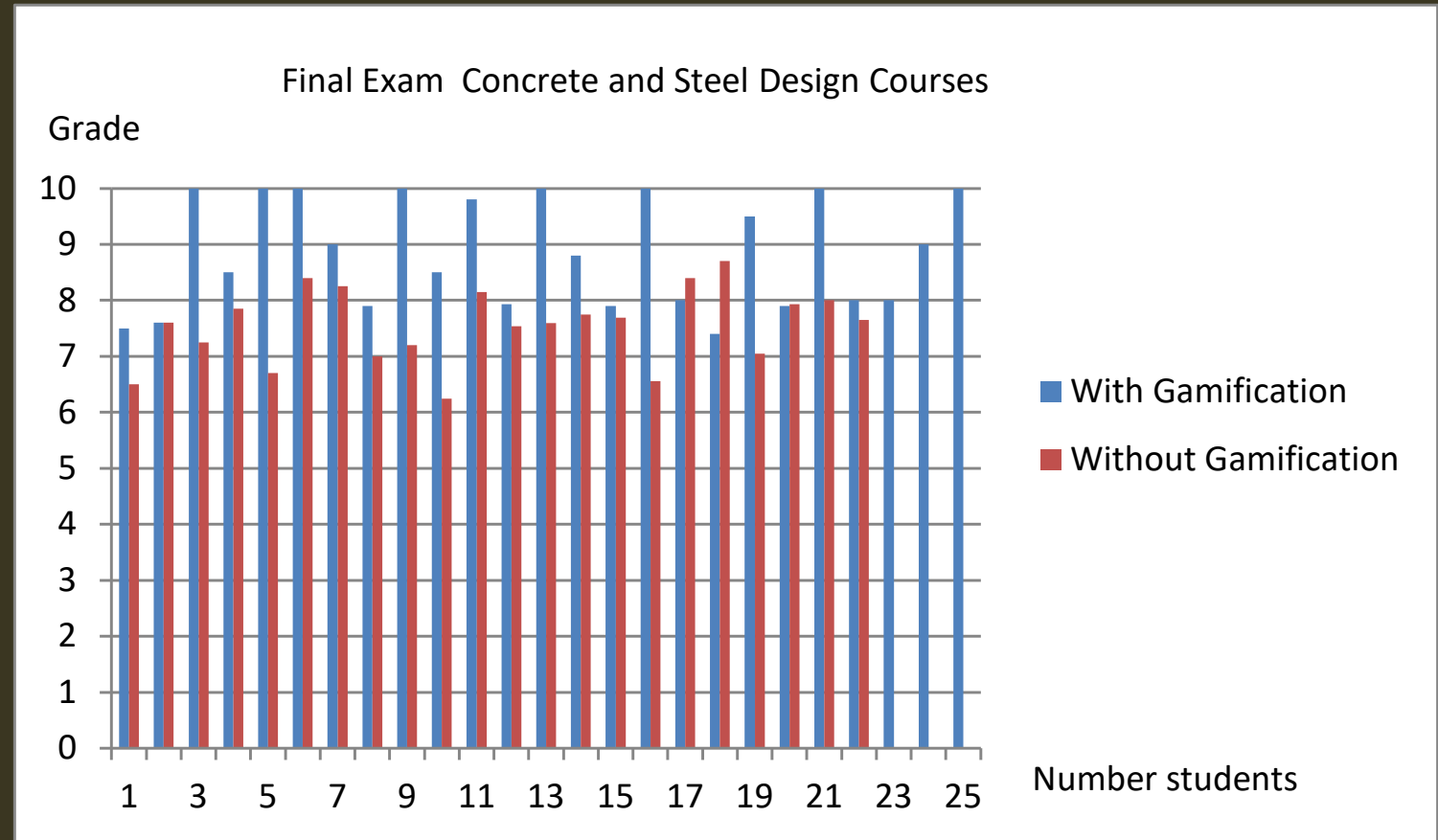
Students feedback regarding the new method
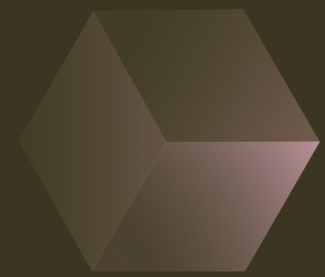
A questionnaire to analyze students´feedback was conducted.

Likert scale was used ranging from 1= not all characteristic to me, 5= very characteristic of me.

Table I presents the Evaluation of students course engagement questionnaire.

Results: students using the gamification method were por engaged with the course, and more inclined to using the e-learning software app after class.

No.	Evaluation		
	Behavior, thoughts and feelings	*Control group*	*Experimental group*
1	Participating in class	3	4
2.	Asking questions to instructor for a better understanding	3	5
3.	Asking quesiones to instructor to get application game done	0	3
4	Playing the application game after class	0	3
5.	Putting forth effort	3	4
6.	Desire to learn the material using the application game	1	3
7	Playing in teams the application	0	4
8	Explaining the solution to solve the app quest between companions	0	4

Students feedback regarding the new method

TABLE I.   EVALUATION OF STUDENTS METHOD PERFORMANCE

No.	Evaluation	
	Phrases	*Evaluation*
1	Performance of the course	4
2.	The application game helps to understand structural behavior	4
3.	Playing the application in the classroom was challenging but fun	4
4	The application clarifies the theory applied to real cases	4
5.	Getting badges and points is adequate	4

Evaluation of students satisfaction was made. Scores were based on Likert scale in five-point grade, five being the best score.

Student´s experience using gamification was positive: students were motivated, considered interesting the combination of strategies during the course and were grateful for the extra time allowed for finishing the app tasks.

Visit Apprendestructo´s site   *https://sites.google.com/fa.unam.mx/structurelab*

Ampliación Museo Isabella Stewart

Este museo ubicado en Boston Massachusetts, Estados Unidos, data de 1903 su cuerpo principal.
En 2012 se construyó la ampliación del museo (6,500m2) realizando el proyecto el arquitecto Renzo Piano generando el nuevo acceso, salón de música, galerías

Conclusions and future work

Gamification method proposed is more tan game points or and e-learning app. It is a strategy where the profesor gets more acquainted with the student, giving confedence while learning how to solve real-life problems.

The virtual environment experimentation offers students a better understanding abour the mathematical solution and its application over real architectural projects.

Teachers may find the following difficulties using the method proposed: finding the best app for each subject; the app must exist for IOS and Android system; time should be programmed in order to give the student theory and its application.