

Conferencia Interdisciplinaria de Avances en Investigación



Gamification, Flipped and Collaborative Learning in Mathematics Teaching with Engineering Students

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CIAI
2018

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DOI: 10.24275/uam/lerma/repinst/ciai2018/000110/Silva

Introduction

Students who start their degree studies, often they lack mathematical bases necessary for their studies in engineering. Therefore, it is necessary to offer leveling courses to help cover these deficiencies.

When performing an analysis of the state of the art, were found works that show importance of the use of videos as methodological instruments for the initial training of teachers who teach mathematics classes, in addition, leaning on new technologies, teaching strategies are proposed to build Online educational material.

In this paper we present results of having integrated a combination of pedagogical strategies of gamification, flipped and collaborative learning to motivate the student in the learning of mathematics, contemplating basic concepts of arithmetic, algebra, geometry, analytical geometry and trigonometry.

To achieve this, 68 multimedia educational resources were developed with concepts explanation and examples solved, online exercises, self-assessments and games (see Table 1).

Table 1. Multimedia Educational Resources Quantity.

Topic	Multimedia Educational Resources
Arithmetic	9
Algebra	30
Geometry	5
Analytical geometry	20
Trigonometry	4

Methodology

Methodology used is based on the instructional design called TNPS (Techno Neuro Pedagogical Instructional System), composed of eight stages, namely: analysis, design, development, testing, implementation, documentation, maintenance and evaluation, incorporating the iterative-incremental process, which allow results in the short and medium term.

The methodology for the construction of the educational context is integrated by the following phases, as shown in Fig. 1.

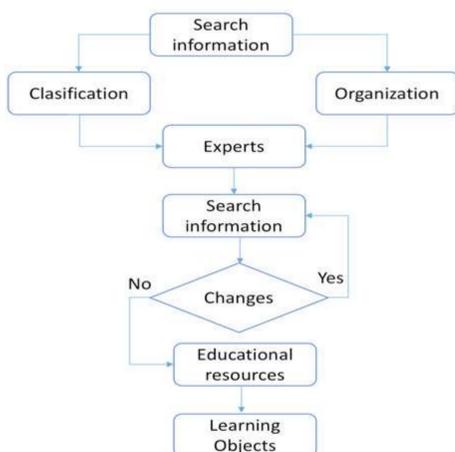


Figure 1. Stages for the construction of the educational context.

Results

A total of 68 multimedia educational resources were integrated into an LMS platform, as established in the TNPS, thereby encouraging results.

Application of TNPS

TNPS has eight stages and are described below.

- 1) Analysis.
- 2) Design.
- 3) Development.
- 4) Testing. The learning object built for each topic, is integrated with a set of subtopics as shown in Fig. 2, taking the case of arithmetic as an example.
- 5) Implementation.
- 6) Documentation.
- 7) Maintenance.
- Evaluation.



Figure 2. Structure of the learning object for arithmetic.

Gamification strategies for learning mathematics

The objective of pedagogical strategy of Gamification is to motivate the student to learn mathematics by considering basic concepts of arithmetic, algebra, geometry, analytical geometry and trigonometry, following a thematic structure as shown in Fig. 3.

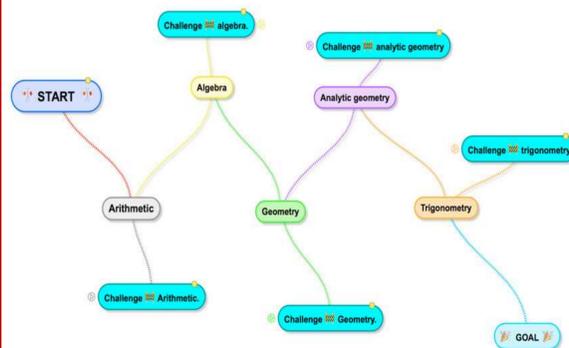


Figure 3. Thematic structure of the mathematics workshop game.

Student earns points according to progress in the units established in time and form according to the corresponding challenge. He obtains surprises and awards according to his performance and pays infractions in case of delays. (See Fig. 4)

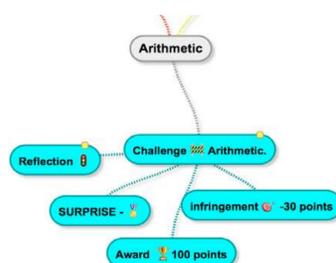


Figure 4. Ludic elements of each challenge.

Work developed was applied to a pilot group of 14 students. The benefits of integrating different pedagogical methodologies were: high percentage of approval (see Fig. 5, the 93% approval course of students and 7% reprobation), also increase student interest in course topics, have fun with programmed activities, learn to share their knowledge with other students.

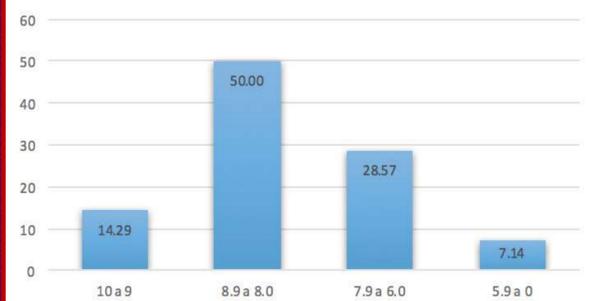


Figure 5. Approval percentages in the pilot group.

Conclusions

As a result of the present work a proposal for the construction of multimedia resources was designed, as well as the pedagogical strategy of gamification, flipped and collaborative learning for the teaching and learning of mathematics, taking into account topics of arithmetic, algebra, geometry, analytical geometry and trigonometry. The proposed pedagogical strategy considers the game as a motivator for the student to learn basic mathematics.

The pilot group was 14 students and there was a 93% approval rate as shown in figure 8. Given the results obtained with the pilot group, it is expected that the online course will support about 200 engineering students of DCBI in UAM campus Lerma and it will help to regulate knowledge of the students of new entrance of Engineering in the trimesters of Spring (17-P) and Fall (17-O),

On the other hand, the application of the instructional design methodology called the Techno Neuro Pedagogical Instructional System, facilitated the contents organization and collaboration with experts for the review of educational resources in its early stages, which minimized re-work. It also facilitated the implementation of the course in the selected platform.

References

The content of this poster is a summary of the article:

R.B. Silva-López, J.U. Ocampo García, J.A. Rodríguez Hernández (2017) GAMIFICATION, FLIPPED AND COLLABORATIVE LEARNING IN MATHEMATICS TEACHING WITH ENGINEERING STUDENTS, EDULEARN17 Proceedings, pp. 4385-4391.

More information:

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doi: 10.21125/edulearn.2017.1947