

Didactic proposal to re-signify the differential equation by modelling simple harmonic motion with the support of digital technology.

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INTRODUCTION

According to Kwon (2020), differential equations (DE) are ubiquitous in applied mathematics and constitute an important component of the mathematics curricula of most universities. Rowland and Jovanoski (2004) mention in a study that in the teaching and learning of differential equations they suggest that, for students, the connections between a differential equation, its solution and what each of them can represent physically are not significant. In this research, we focused on simple harmonic motion, and more specifically on the analysis of the physical concepts involved, such as magnitude, time, velocity, acceleration, and energy, to model this phenomenon using a second-order differential equation and thus obtain a new meaning for this mathematical object.

THEORETICAL FRAME

Posner et al. (1982), characterize conceptual change as the modification of students' previous ideas so that they are replaced by those concepts accepted by the scientific community. The CUVIMA methodological model (Cuevas et al., 2017) is applied in our work for the organization of didactic activities that promote the understanding of simple harmonic motion and is composed of four frameworks, which are: 1) Reality framework in Physics, 2) Modelling framework in the device, 3) Conceptual analysis framework in Physics, and 4) Mathematical, conceptual analysis framework.

The objective of this research work is to contribute to find ways to promote the concept of differential equation in engineering students, through the modelling and interpretation of simple harmonic motion. How do engineering students re-signify the concept of differential equation through modelling simple harmonic motion?

METHODOLOGY

Phase 1.- Preparation and design

A pre-test was designed in order to collect previous ideas about simple harmonic motion, for this activity we used the Google Forms platform.

The context used to introduce mechanical vibrations consists of the movement of a spring in a bicycle that has a linear spring incorporated in its structure to dampen the movement. The main objective of this didactic activity is that the student is able to

characterize the linearity property of the force applied to a spring that obeys Hooke's Law.

Phase 2.- Teaching experience

The research was carried out with two engineering students from a public university in Mexico. The activity was carried out in a single session which lasted 80 minutes.

RESULTS

In this paper, we present the results of a student with the pseudonym Andy, who was randomly selected from the sample. In the "Simple Harmonic Motion (SHM) Pre-test" activity, Andy answered all seven multiple-choice questions correctly. Andy's answer shows that he has knowledge about (SHM) and describes that one of its features is periodicity. Activity 1 consists of 12 multiple choice questions and two open questions, and the last exercise is to build a graph. Andy correctly answers all 11 multiple-choice questions. In particular, his answers to questions 1, 2, and 3 show that he manages to interact and interpret the simulated situation in the applet. Question 6 prompted Andy to explore the Activity 1 applet with more care and time. His answer shows that he can identify that a change in the value of the elastic constant, k , implies that the force applied to the spring will have a different magnitude, resulting in an increase or decrease in the length of the spring. Spring, that is to say, stretches or compresses with more or less difficulty.

DISCUSSION AND CONCLUSIONS

The activity was applied remotely, due to public health conditions and confinement. However, the results of the investigation are positive, since it shows us that Andy managed without difficulty to characterize the linearity property of the force applied to a spring that obeys Hooke's Law. This indicates that Andy has correct previous ideas about simple harmonic motion, and that activity 1 promoted in ratifying such ideas. In addition, the results obtained allow us to see that Andy can continue without objections with the rest of the activities to complete the investigation.

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