The use of the active methodology of teaching for braking study

O uso da metodologia ativa de ensino para o estudo da frenagem

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ABSTRACT
Kinematics is one of the most studied concepts in physics because its understanding is connected with the description of movements without caring about its causes. This branch involves the greatnesses: speed, space traveled, time, acceleration, among others. This article studies an actual application of kinematics, in which a motorcyclist travels on an avenue and is alerted about a speed radar. This work has the main objective of designing a mobile application to establish if the rider meets the speed of up to 40 km / h on the avenue. The *software* elaborated besides contributing to the teaching learning of the one who executes it, solves a very common situation nowadays. Based on the specific analysis of the application, there have been cases in which vehicles travel with speed within the tolerance limit of the place.

Keywords: Kinematics, Software, Physics.

RESUMO
A cinemática é um dos conceitos mais estudados em física porque seu entendimento está ligado à descrição dos movimentos sem se importar com suas causas. Este ramo envolve as grandes testemunhas: velocidade, espaço percorrido, tempo, aceleração, entre outras. Este artigo estuda uma aplicação real da cinemática, na qual um motociclista viaja por uma avenida e é alertado sobre um radar de velocidade. Este trabalho tem o objetivo principal de projetar uma aplicação móvel para estabelecer se o motociclista atinge a velocidade de até 40 km/h na avenida. O software elaborado, além de contribuir para o aprendizado didático de quem o executa, resolve uma situação muito comum hoje em dia. Com base na análise específica da aplicação, houve casos em que veículos viajam com velocidade dentro do limite de tolerância do local.

Palavras-chave: Cinemática, Software, Física.

1 INTRODUCTION

Everything that exists in the world is in motion, even apparently stationary objects [1]. Within the field of physics, kinematics is the segment of mechanics commissioned by the study of movements, with the purpose of describing mathematically the observed models [2]. The way in which kinematics is presented has harmful consequences for students' learning. The non-realization of experiments related to this subject causes a lack of visualization on the part of the students about the studied movements, and, which provides in learning formed only by the memorization of formulas [3].

Significant learning is the human mechanism used to acquire and contain a great deal of information. New information and ideas are learned and retained as adequately, clearly and comprehensively exposed in the individual's cognition [4].

The use of technologies to aid education increases over time. The main purpose of this is to instigate student learning. The need to use new active methodologies and teaching tools, makes the student feel more motivated by the subject studied, transforming learning into something increasingly stimulating, both for the teacher and for the student [5].

The model of learning as oriented research is based on the planning, from the student or the teacher, of problematic situations, with the intention of trying to solve them through several sequences of activities and strategies [6]. The student learns with exercises, which will be common in his profession in the future, becoming an active professional and able to solve the problems encountered in his daily life [7] and [8].

Therefore, the objective of this work is to contribute to the teaching-learning of users who use the developed application, facilitating a situation found in the reality in which they live, which includes a secure traffic system. In this case, the software checks whether the traffic safety system has been well planned or not, in order to determine if a vehicle is traveling within the speed limit.

2 COMPUTATIONAL PROCEDURE

Consider a traffic sign on a busy street to alert drivers to reduce traffic speeds by up to 40 km / h. This plate is located with a safe stopping distance from a radar located further ahead. In this situation, a motorcyclist is considered to be traveling with a known speed, and, alerted by the speed radar, follows his route in the avenue.

The principle of operation of the application developed in this work is intended for vehicles that use GPS systems. Thus, with the presence of radar at a certain distance, the *software* alerts the motorcyclist the moment of braking so that it will drive the bike with speed allowed by the radar. For this, it is necessary to use the concepts of kinematics to determine if the rider is actually complying with the speed limit of that place.

Under the conditions observed, it is important to say that the maximum acceleration for breaking the motorcycle has a negative value because it opposes the displacement movement, and when a force is applied to a body in such a way that a displacement occurs, work is generated. When the force is parallel to the displacement, the displacement vector and the force do not form an angle with each other, so the work is calculated as shown in Eq. 1:

$$\tau = F.d \qquad (1)$$

Relating the work and the kinetic energy variation to a conservative system results in Eq. 2:

$$\frac{1}{2}m.v^2 - \frac{1}{2}m.v0^2 = m.a.d \qquad (2)$$

Thus, to determine if the rider is within the appropriate speed limit, Eq. 3, it is important to know that:

$$v^2 = v0^2 + 2.a.\Delta S \qquad (3)$$

Where,

v: Final speed (km / h);

v_0: Initial speed (km / h);

a: Acceleration (m / s^2);

ΔS: Displacement variation (m).

When the velocity is isolated, we have Eq. 3 which expresses the desired condition in this work:

$$v = \sqrt{v0^2 + 2a\Delta S} \qquad (4)$$

The initial screen of the application developed in this work can be observed in Fig. 1. It is important to point out that the *software* was elaborated in the platform of MIT App Inventor 2, and this one is used for devices with Android operating systems.

Figure 1: Application Home screen

For the application to be used, all units of measure must conform to what is required in the application. In the initial screen, the user provides all input data for the program to calculate what is desired. In this case, the blank spacing corresponds, respectively, to the distance from the vehicle to the radar, to the acceleration of the vehicle and to the speed of the vehicle when it starts braking.

3 RESULTS AND DISCUSSIONS

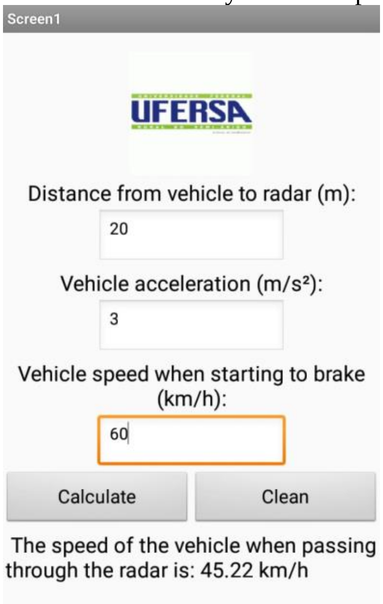
For this work, it was necessary to formalize a daily situation in order to identify if the motorcyclist travels within the required condition of the traffic until arriving at the velocity radar. Below is the written situation for a better understanding of the reader, so they can use the software in the right way.

The situation is as follows:

- The distance from the vehicle to the radar is 20 m;
- The acceleration of the vehicle is 3 m / s²;
- The speed of the vehicle when starting braking is 60 km / h.

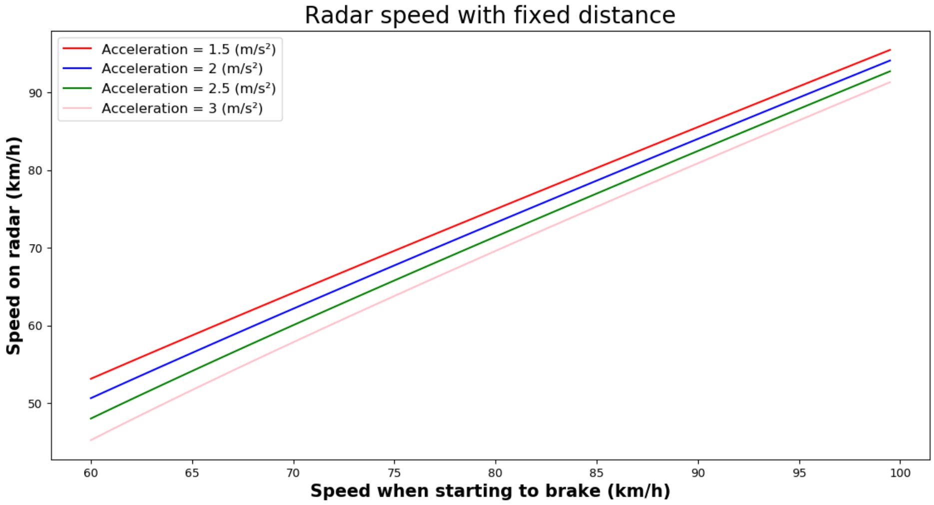
The *software* calculated the speed at which the motorcyclist reached the radar, which was 45.22 km / h, Fig. 2. That is, the motorcyclist surpassed the top speed of 40 km / h, violating the traffic law of that place.

Figure 2: Speed value calculated by the developed application.



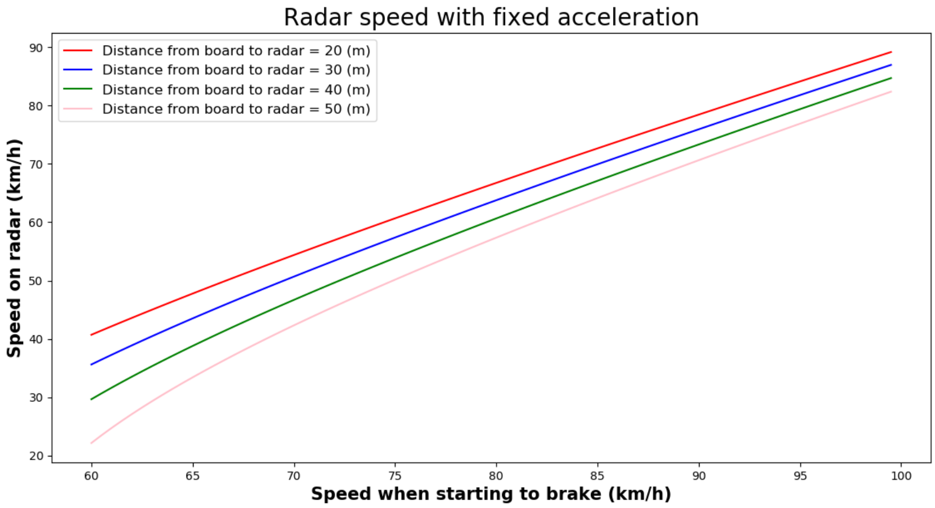
Some graphs were plotted to verify the speed behavior of the motorcyclist when passing through the radar. In the first graph, shown in Fig. 3, the speed of the vehicle varied when starting to brake. Different curves were plotted for acceleration of the vehicle, and increasing curves were obtained in which the velocity when passing through the radar reduces twice the acceleration and its distance.

Figure 3: Speed when passing through the radar in relation to the braking speed at a distance of 20m.



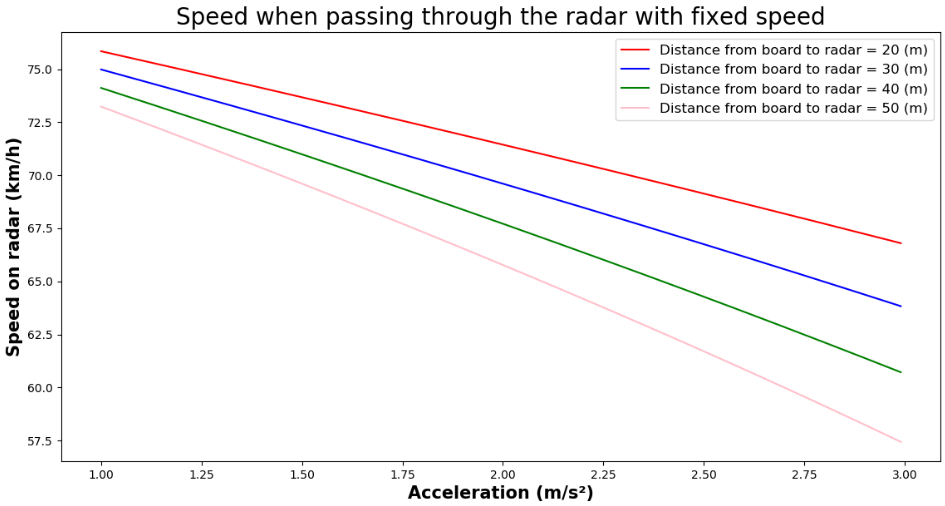
In the second graph, shown in Fig. 4, it was generated showing variations for the speed when starting to brake the vehicle. This time, curves were plotted for different values of the distance from the plate to the radar. For this reason, the graph is shown as Fig.3.

Figure 4: Speed when passing through the radar in relation to the braking speed with an acceleration of 3 m/s²



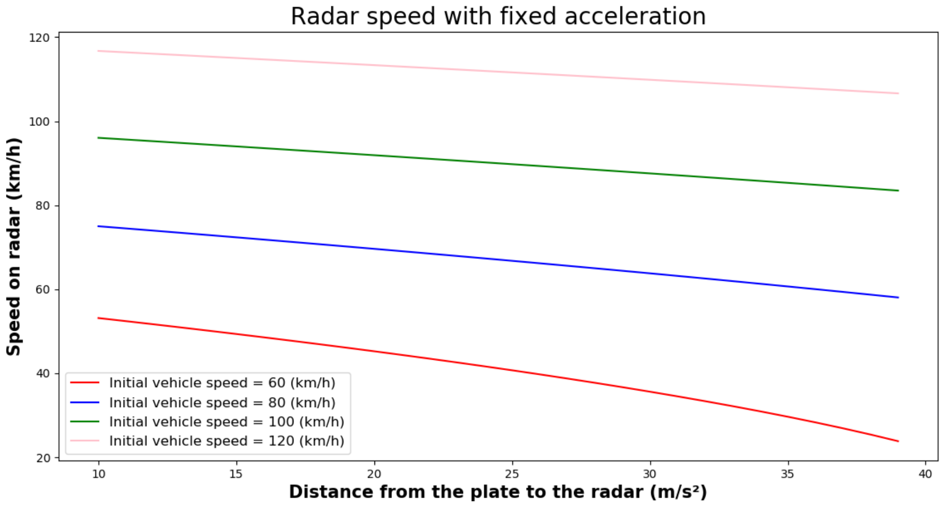
In the third graph, Fig. 5, the acceleration of the vehicle was varied and plotted curves for different values of the distance from the vehicle to the radar. Thus, the formation of decreasing curves is observed, since the greater the distance from the vehicle to the radar, the longer the vehicle deceleration time.

Figure 5: Speed when passing through the radar in relation to the acceleration for the speed of 60 km / h.



In the fourth graph, Fig. 6, varying the distance of the plate to the radar and the curves plotted for different values of the initial speed of the vehicle to start braking. It was observed the formation of descending lines, since the greater the distance of the plate to the radar, the larger the deceleration of the vehicle.

Figure 6: Speed when passing through the radar in relation to the distance of the plate to the radar for acceleration of 3 m / s.



4 CONCLUSION

The application provides a great advantage for the teaching-learning of those who execute it, mainly, for dealing with a rather didactic subject for the discernment of the students. The user has a more practical knowledge of science, besides obtaining ideas about the foundations in which physical knowledge is historically assimilated.

In view of the results obtained, it was observed that the velocity when passing through the radar is dependent on some other variables, these being influenced by the behavior change of this parameter. The graphs in Fig. 3 and Fig. 4 were shown with increasing curves for acceleration of the vehicle when the distance from the plate to the radar was varied. The graphs in Fig. 5 and Fig. 6 showed decreasing curves due to the increase in distance from the vehicle to the radar.

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