

Analyzing the upper secondary school students' difficulties in the rotation of rigid body

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Abstract. Previous studies have shown that students have difficulties in understanding some concepts related to circular motion of particles. However, there are few studies on rigid body rotational dynamics. In this study, we have studied difficulties that Upper secondary school students have about the rotation of a rigid body. We have designed an 8 questions open-ended questionnaire. In designing the questions, we took into account the key concepts that students have to know in order to understand the rotation of rigid body in a proper way. We conducted a study with 85 Upper secondary school students after their Mechanics course and the analysis has been performed using phenomenography, which is focused on the explanations rather than in the correctness of the answers. The results suggest that students have several difficulties in understanding some concepts of rigid body rotation and that there are significant alternative ideas among them.

1. Introduction

The literature has shown that Upper secondary school (16-18 year old students) and university students present some difficulties in understanding particles' rotational movement. The research reveals that a significant amount of students think that a particle describing a uniform circular motion does not have acceleration, that no force is needed to produce circular motion and they consider centrifugal forces as "real" even for an inertial frame of reference [1]. Students show difficulties distinguishing between linear and angular acceleration and between linear and angular velocity. Moreover, they also show difficulties distinguishing between centripetal force and acceleration [2,3]. Taking into account all those difficulties, we expect that the gap in the comprehension of the concepts will grow up when the particle is substituted by a rigid body.

1.1. Difficulties in understanding rigid body rotation

The research on University students' understanding of rigid body rotation has shown many difficulties. Frequently, students mix the concept of torque with the concept of force. In the same way, they do not establish any relation between the torque and the angular acceleration, they think that a constant torque results on a constant angular velocity and they show difficulties when taking into account the line of action of a force besides its point of application [4,5].

In relation to the moment of inertia of a rigid body, literature reports that many university students do not establish the dependence of the moment of inertia regarding the mass or its distribution around the axis of body rotation in a proper way. Others consider that the moment of inertia is proportional to angular acceleration of the body [2,6]. The research about university students' difficulties regarding the angular momentum reveal that students do not recognize its



In future research, we propose to pass the questionnaire to students of introductory physics courses at University to contrast the learning progression achieved and to establish improvements in instructional materials.

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7. References

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