The Theory of Relativity in Primary Education(*).

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Abstract

The main object of this study is to investigate, initially, whether the students of the sixth grade of primary school are in position to comprehend the basic concepts and elements of the Theory of Relativity.

Keywords
Relativity, time, velocity of light, gravity, primary education

Introduction

In the latest years, intense changes have been made in the textbooks of physics in primary school. However, it has been pointed out/ detected that sections which are referred in more far-fetched matters/ subjects/ issues as the Theory of Relativity of Einstein are absent.
Therefore, the anniversary year of 2005, as the year of Einstein and, also, the conviction that we can carry out and incorporate in the curriculum a series of courses, with a different subject from the already existed, gave rise to this study.

The necessity

The study of this specific cognitive subject causes great interest since, as we have to mention, it has not been incorporated in other country's curriculum. Also, it has to be mentioned that it is a very interesting subject of teaching and that the concepts of relativity beside the fact that they are very important, they may related to the daily routine of the children, therefore it helps in the better conception of their environment.

The sample

The class, in which this study will be carried out, will be the sixth grade of the primary school and will be consisted of eighteen to twenty pupils. The pupils will be divided in groups of four to five, with every group to be able to study and comment the worksheets given, so that they could participate and cooperate significantly to the conversation which will be conducted in the classroom.

Lessons' Plans

The way, in which the instructive part of the study will be realized, includes three lessons that aim to the presentation of the basic concepts covering the Theory of Relativity.

Primary Valuation

Before referring to the cognitive subject of the Theory of Relativity, the teacher must beware of his class' level around the concepts of physics that are essential for the teaching of the subject to be held. This will be done with the use of a structured questionnaire which the pupils should be able to complete within 20 minutes.

First Lesson

During this lesson, the pupils will be taught the concepts of velocity, velocity of light while also they will become aware of certain basic elements about the light and its characteristics
Additionally, during this lesson, the concept of gravity will be incorporated.

The pupils will have to study and take notes about the concepts that will be referred during this lesson, while they form the central axis of the concepts of the Theory of Relativity.

Second Lesson

The Instructional objective of this section is the study of the particular Theory of Relativity and the comprehension of its postulates from the children; nothing can run faster than the light despite the activity of the source.

The radiomeasure will be used as the nucleus of this section. By having as our purpose, during this lesson, the grasp of the corpuscular nature of the light by the pupils, they will also be asked what causes the rotation of the laminas that consequently rotate. Additionally, the pupils will be asked if they believe that there is anything that runs faster than the light. The answer to this question will ensue from the screening of a relevant video. It will be clarified to the pupils that all the conceivable experiments that Einstein did were referred to systems that were moving with or close to the velocity of light.
From the ending of the previous lesson, a three- page text, where the curvature of time is being presented in simple words, will be already distributed, in order to be studied by the pupils as an introductive knowledge for the current one. Inside the classroom, a digital experiment will be presented where a spaceship that sets out from earth moves to another planet and comes back later on. The surveillance, which the pupils will make on this, is to interrelate the text they studied and give an explanation for the results of the chronometers of the digital experiment. Furthermore, the experiment with the twins will be presented and commented.

The contraction of space will be taught through a series of digital experiments and there will be asked from the pupils to comment the disfigurements that happen to the objects as they approach the velocity of light. They will observe the reason for which the objects lose their regular size. If we were in a spaceship, which was moving in such velocity, would we realize the difference on us?

During the continuation of the lesson we will talk about the relativity of motion. Among others, the basic reasoning will be the following: “If your father is driving the car and you watch a fly on the mirror, what kind of movement do you think that the fly does? If you meet a friend on the street while you are moving and you greet him and he sees the fly, what kind of movement will the fly do regarding your friend?”. Later on, a video referring to the relativity of the motion, according to Einstein perceptions, will be presented.
In the end of this lesson, a number of questions to be answered will be distributed to the pupils just like in the previous lesson.

Third Lesson

During the last lesson the pupils must comprehend the general theory of relativity. The point is to conceive the relation between the gravity and the acceleration, the way a black hole is created and their attributes and the cosmogonic theory as well.
The instruction will be focus around an experiment that will be accomplished in a construction, which will be composed of a little car that will be tied on its one side with a weight, which will pass through a pulley. The pupils will be asked to keep notes concerning the movement that the little car does, while the weight pulls it to the end of the construction as it fells on the floor. Additionally, they will have to observe what does happen while the weight has reached the floor, if this is related to the movement of the little car.

Afterwards, the pupils will be asked if does gravity exist on earth, and then if does gravity exist on the moon and for what reason does the moon revolves round the earth. At this point, an experiment will be occurred, while an electronic car is tied up alongside with a rope, which is steady on a big weight. The cyclical route that the

little car will follow can be interrupted only in case that someone cuts the rope. In the same way, the power of gravity on the celestial bodies is explained. Furthermore, they will be asked about the reason for which the earth revolves round the sun and they will be required to draw them on the board. A picture of our galaxy will be presented and the pupils will be required to give several interpretations concerning the principle of the universe. Afterwards, an experiment will be accomplished, with a balloon on which there will be a dot, which begins to enlarge as the balloon inflates. That occurs in order to parallel the dot with the universe.

The pupils will be asked if they have seen black holes. If not, why do they think that it is possible to see. Do the black holes have gravity? Starting this conversation, we will talk about the position of the stars, and how does that influents their position on the map the curvature that causes the journey of light the mass of the sun. Since we cannot see where are the black holes it means that because of the great gravity that their mass creates, they change the direction of the light.

At last there will be an experiment in which, from a specific height we will let a square box to fell. Then, we will ask the opinion of an exterior observer concerning the movement that the box did while fallen and the person why declare that is inside the box as well. Then, we ask how does the observer who is inside the box conceive the fall, according to our opinion.

As a final point of this lesson, the pupils will answer a questioner that re- examine this instructional section.

Final Valuation

During a following didactic period, the pupils will be required to answer a paper with questions related to the subjects they studied through those three lessons. The duration of the test will be 40 minutes and its aim will be the valuation of the total lessons.

Conclusion

The Theory of Relativity spread a fear, through its words, for what it concerns its content and how far can easily become comprehensible from the teacher as much as from the pupil.
There is the strong conviction, that from a series of three lessons, the pupils can completely take in basic elements and concepts of Einstein around the two relative theories he formulated.

Related Litterature

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