

The use of analogies in the heuristic method of Galileo

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Abstract. The last work of Galileo, entitled *Discourses and Mathematical Demonstrations Relating to Two New Sciences* (1638), marks the birth of modern science of mechanics. This writing is an incalculable asset for education. As is known, it deals with foundational topics in physics as the study of uniform motion and uniformly accelerated motion with elementary mathematics suitable for upper secondary school students.

In his time, Galileo was not provided of the modern experimental means necessary to test his theories. Therefore, in his work on mechanics, he made much use of exemplifications (i. e. thought experiments), analogies between similar physical systems and reasoning at the limit all of which are useful tools in the heuristic method of Galileo for the acquisition of new knowledge. The best known example is certainly that of the study of motion of free fall of bodies that being too quick to be studied, was suitably slowed using an inclined plane.

In this work, I introduce inductive reasoning which includes both purely imagined that actually conducted experiments and which lead Galileo to formulate the laws of motion and several theoretical relationships of particular importance.

Also his famous principle of inertia that could never be verified experimentally by him for the impossibility of finding moving bodies not subject to any force, found an indirect verification in the study of motion of parabolic projectile that is subject to the weight force only in the vertical direction and which therefore is not affected by any force in the horizontal one. By means of analogical arguments, Galileo also established that the period of oscillation of the pendulum motion is proportional to the square root of its length just as the free fall time of a body is proportional to the square root of the distance. Nowadays these experiments can be performed in a very simple and interesting way by using motion sensors and the latest technology, but the reasoning and similarities identified by Galileo have a superior educational value because they will help the students understand the methods that science uses to go beyond the limits of knowledge already acquired.

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