

Exploring the Difficulties of Acceleration Concept from the Perspective of Historical Textual Analysis

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Abstract : Kinematics is the beginning to learn mechanics in physics course. The concept of acceleration plays an important role in learning kinematics. Teachers usually instruct the conception through the formulas and graphs of kinematics and the well-known law $F = ma$. However, over the past few decades, a lot of researchers reveal numerous students' difficulties in learning acceleration. One of these difficulties is that students frequently confuse acceleration with velocity and force. Why is the concept of acceleration so difficult to learn? The aim of this study is to understand the conceptual evolution of acceleration through the historical textual analysis. Text analysis and one-to-one interviews with high school students and teachers are used in this study. This study finds the history of science constructed from textbooks is usually quite different from the real evolution of history. For example, most teachers and students believe that the best-known law $F = ma$ was written down by Newton. The expression of the second law is not $F = ma$ in Newton's best-known book Principia in 1687. Even after more than one hundred years, a famous Cambridge textbook titled An Elementary Treatise on Mechanics by Whewell of Trinity College did not express this law as $F = ma$. At that time of Whewell, the early mid-nineteenth century Britain, the concept of acceleration was not only ambiguous but also confused with the concept of force. The process of learning the concept of acceleration is analogous to its conceptual development in history. The study from the perspective of historical textual analysis will promote the understanding of the concept learning difficulties, the development of professional physics teaching, and the improvement of the context of physics textbooks.

Keywords : acceleration, textbooks, mechanics, misconception, history of science

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