

EMPIRICAL AND MATHEMATICAL MEANINGS OF CONCEPTS

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Abstract

The role of mathematics in physics instruction is discussed in the framework of the perceptual approach. Conceptual understanding is the main aim of physics. It is based on systematic creation of empirical meanings of observations and on the intuitive conviction that they truly represent entities and phenomena of Nature, their properties and causal relations. This experience of reality is the origin of the conceptual structure and understanding of physics.

Quantification transforms properties into quantities and causal relations into laws and leads to mathematics. This quantitative representation of empirical meanings is the origin of mathematics. The first steps of school mathematics reflect this idea when numbers and the fundamental arithmetic operations are introduced as numbers of objects of natural discrete sets and their properties.

In this scenario "pure mathematics" is an endeavor to isolate the conceptual structure from the ballast of empirical meanings. The mathematical meanings of concepts and their understanding is based on structural relations of concepts and on deductive reasoning.

The contradiction between the two different principles of understanding leads to doctrinal disputes on teaching of both mathematics and physics. Consequences are discussed in light of examples from curricula and text books.