

# Students' Conceptions Of Physics And Learning Difficulties

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**Abstract:** A teacher communicates with students through words and gestures in an attempt to convey meaning, not the meaning itself. On the basis of these words, diagrams and symbols the child builds up a meaning for them. This meaning created by the child may not be the meaning intended by the teacher. This gap in learning process is attributed to the preconceptions and alternative conceptions of a child. Every child lives in a society and the interactions with other persons introduce him to an explanation of natural phenomena and events through concepts which may or may not be consistent with scientific facts. These are preconceptions. If the explanations embedded in the students' mind are not consistent with scientific facts, we call them alternative conceptions, i.e. these are alternative ways of understanding or explaining natural phenomena, not necessarily arising out of formal education.

A learner's mind with preconceptions learns comparatively smoothly the new scientific ideas and concepts. But the alternative conceptions, once formed, influence the learner's ability of further learning, are resistant to change and make them hold on to certain intuitive notions despite formal science education they receive. The origins of alternative conceptions bear their roots in the individual's previous experience and observation, language, cultural influence, religious beliefs and the way transmitted information from teachers and textbooks appear in his mind. Investigations in this field lead to conclusions that the alternative conceptions are common among similar age group of students across many countries. These alternative conceptions are so strong that even fresh teachers of high school and colleges have been found to hold on to a number of alternative conceptions in spite of their training. In a sense therefore, such minds are inhibited and lead to misconceptions though they are now exposed to class room learning. The student thus builds up a meaning not intended by the teacher. Misconceptions or alternative conceptions may arise in all branches of physics. Some examples from Mechanics are: i. Under the influence of constant force, objects move with constant velocity; ii. The velocity of an object is proportional to the magnitude of the applied force; iii. In the absence of a force, objects are either at rest or, if moving, are slowing down; etc. Similarly examples from other fields can be found out.

The way to refine the preconceptions, change the alternative conceptions, eliminate the misconceptions and thus remove the learning difficulties is suggested as:

- ✓ Only by directly confronting alternative conceptions can physics teachers hope to make any lasting change in conceptual understanding of students
- ✓ One must accept that learning is a process of the student, not the teacher. So a method of teaching must see the students as actors rather than spectators and accept the idea that knowledge is not "learned;" rather, it is constructed.

## I. INTRODUCTION

A teacher communicates with students through words and gestures in an attempt to convey meaning, not the meaning itself. On the basis of these words, diagrams and symbols the child builds up a meaning for them. This meaning created by the child may not be the meaning intended by the teacher. This gap in learning process is attributed to the *preconceptions*

and *alternative conceptions* of a child. These alternative conceptions are so strong that even fresh teachers of high school and colleges have been found to hold on to a number of alternative conceptions in spite of their training. In a sense therefore, such minds are inhibited and lead to *misconceptions* though they are now exposed to class room learning.

Every child lives in a society and the interactions with other persons introduce him to an explanation of natural

phenomena and events through concepts which may or may not be consistent with scientific facts. These are *preconceptions*. If the explanations embedded in the students' mind are not consistent with scientific facts, we call them *alternative conceptions*, i.e. these are alternative ways of understanding or explaining natural phenomena, not necessarily arising out of formal education.

A learner's mind with preconceptions learns comparatively smoothly the new scientific ideas and concepts. But the alternative conceptions, once formed, influence the learner's ability of further learning, are resistant to change and make them hold on to certain intuitive notions despite formal science education they receive. The origins of alternative conceptions bear their roots in the individual's previous experience and observation, language, cultural influence, religious beliefs and the way transmitted information from teachers and textbooks appear in his mind. Investigations in this field lead to conclusions that the alternative conceptions are common among similar age group of students across many countries. The student thus builds up a meaning not intended by the teacher.

## II. TEACHER'S ROLE IN CORRECTING THE PRE- AND MIS-CONCEPTIONS

A scientific knowledge in Physics is created by the researcher. This is not directly transmitted to the students. An intermediate knowledge, legitimized by the physics community, has to be engineered or reformulated so as to make it learnable by the students. Physics is that part of science which deals primarily with the inanimate world and which furthermore is concerned with trying to identify the most fundamental and unifying principles. A scientific truth in Physics is arrived at by the use of a number of tools. This toolkit would include observation, analysis, hypothesis, and theory on one hand, and experiment, testing, and instruments on the other. A scientific truth in the world of Physics is presented in the form of laws and equations. These are abstract in nature. But these are the scientific tools to understand and explain the physical processes around us. The preconceptions and misconceptions can be corrected with the help of a combination of the above.

## III. SCIENTIFIC MODELS

Alternatively, a teacher can use scientific models to effect a conceptual change in the minds of the students. The scientific models must not be too distant from students reasoning in order to be intelligible. Further, there should be coherence between the models to be taught and the corresponding real world phenomena. Thus, though the teaching models would be a hypothetical construct, this will necessitate a validation process in terms of real world processes as an essential ingredient for the development of

scientific knowledge. However, one has to accept the fact that the concepts of Physics can best understood by a student through proper experimental work in the laboratory.

## IV. SOME COMMON MISCONCEPTIONS

Misconceptions or alternative conceptions may arise in all branches of physics.

Some examples from Mechanics are:

- ✓ Under the influence of constant force, objects move with constant velocity;
- ✓ The velocity of an object is proportional to the magnitude of the applied force;
- ✓ In the absence of a force, objects are either at rest or, if moving, are slowing down;
- ✓ Inability to distinguish between  $v/t$  and  $\delta v/\delta t$ , etc.

Misconceptions about current, voltage, resistance, circuits are also very common. In fact, analytical class room experiences have exposed many misconceptions and alternative conceptions in different branches of Physics.

The way to refine the preconceptions, change the alternative conceptions, eliminate the misconceptions and thus remove the learning difficulties is suggested as:

- ✓ Only by directly confronting alternative conceptions can physics teachers hope to make any lasting change in conceptual understanding of students
- ✓ One must accept that learning is a process of the student, not the teacher. So a method of teaching must see the students as actors rather than spectators and accept the idea that knowledge is not "learned;" rather, it is constructed.

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