

Students Alternative Conceptions in Science

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ABSTRACT

The child interacts with the environment family members and acquires considerable knowledge and ideas about the natural and technological world before his/her formal education. These ideas are extremely personal constructions, they may often be incompatible and contradictory and are often very stable and resistant to change. Sometimes, these students' ideas contradict scientifically accepted ideas. These erroneous ideas which contradict scientifically accepted ideas are not because of children misunderstanding the concept but their understanding differently. The ideas held by learners that differ from the scientifically accepted ideas are called alternative conceptions. This paper discusses the students' alternative conceptions, their causes, and how to address them.

Keywords: *Students Ideas, Alternative Conceptions, Constructivism, Conceptual Change*

Introduction

Effective learning of concepts and laws, constituting the basics of science, is essential for understanding and explaining the natural phenomenon. The learning process in science especially attracted various researchers' attention. A large number of studies have provided evidence that the students have great difficulties in understanding the basic concepts of science. Sometimes, despite good performance in science courses, students have not only difficulty in understanding the scientific concepts but are also unable to explain the concepts. Halloun (1998) is worried about those few students who choose science courses, pass them without an understanding of the subject matter, and are unable to differentiate among different concepts, as well as apply them to real-world situations. A lot of studies have been conducted by various researchers on students' ideas, beliefs about natural phenomena that are different from the scientifically

accepted ideas (Muthukrishnan, Doug, Bonnei & Miller, 1993). These ideas and beliefs have been variously described as "misconceptions" (Novak, 1983), "children's science" (Gilbert, Osborne & Frensham, 1982), "alternative frameworks" (Driver 1981, Hewson 1985), etc.

Alternative Conception

Some researchers have used the term 'misconception' (Masher 2000) but other researchers have criticized this term because of its negative connotation and argued that this term gives an impression that students' ideas are wrong and have to be eliminated (Driver 1981, Duit 1993). This means either student have or do have not a concept/idea. However, our evolving understanding in the area informs us that these ideas far from being unproductive hold significant implications for charting the future course of the teaching-learning process and need to be carefully considered and actively taken into account. The term 'alternative

conception' implies that students have constructed and ordered the information received and their personal experiences in such a way that they have come up with a serious alternative to the scientific conception (Kuiper, 1994).

Alternative conceptions may be formed in any field of knowledge/concept/idea. These Alternative conceptions are intuitive and found to be extremely resistant to change. For example- every day the child observes the sun rises in the east and he takes it to be granted that-sun is moving from east to west, however scientifically it is wrong. The truth is earth is moving and the sun is static/ fixed. The Earth is revolving around the Sun. This is a good example of an alternative conception. It is difficult to make the child understand this simple

scientific concept. In a similar way, "Air is everywhere" is a statement that every schoolchild learns. Childs may know that the earth's atmosphere consists of several gases, or that there is no air on the moon (NCERT,2005), but most of the children of this level may be confused to recognize that the air and oxygen both are different things. Even after many years of formal education, many adults possess such an alternative conception. In this situation, the intuitive conception is replaced or modified by the scientific concept. These ideas/ concepts of a student are very personal constructions, real, and valid, may seem incomplete or contradictory, often very stable and highly resistant to change, and context-specific. A list of some common alternative conceptions is:

Alternative conceptions

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Earth is larger than the sun. 2. Gravity cannot exist without air. 3. Rain comes from holes in clouds. 4. Water disappears when water evaporates. 5. When things dissolve, they "disappear". 6. Gases are not mattered, because most are invisible. 7. Cold can be transferred. 8. To see an object, light must travel from the eye to the object. 9. Without a screen there is no image. 10. Gravity cannot exist without air. 11. Water disappears when water evaporates. 12. When things dissolve, they "disappear". 13. Gases are not mattered, because most | <ol style="list-style-type: none"> 14. To see an object, light must travel from the eye to the object. 15. Moon and sun are about the same size. 16. Air and oxygen are the same gas.
Stars are smaller than the sun or moon. 17. An object at rest has no energy. 18. The terms energy and force are interchangeable. 19. If energy is conserved, why are we running out of it? 20. The distance traveled by a body is equal to 21. If an object has a speed of zero, it has no its displacement.
acceleration. 22. If a body is at rest, no force is acting on it. |
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3. Sources of misconceptions/alternative conceptions

Every student has some ideas. If his ideas are not synchronized with scientifically accepted ideas after receiving the formal information and instruction, then the student's idea is called misconception or alternative conception. Students' alternative conceptions have proved surprisingly difficult to shift and can offer a serious barrier to effective learning. The alternative conceptions arise

from various causes such as (1) if the phenomenon is not observable, then it possible to lead alternative conceptions (such as heat, atom, molecules, potential energy, etc.), (2) everyday observable phenomenon and use of everyday experiences to solve it, (3) use of everyday languages, such as *Garmin, Sardi, bahar*, etc. most of the time people says that loss of energy in calorie- but in reality, it is in kilocalorie, and (4) use of formula centered

problem-solving approach. After studying various studies, the major source of alternative conceptions can be:

Textbook as the source of misconceptions:

The textbook is one of the major sources of alternative conception among the students. Nelson (2003) focused on the many basic chemistry concepts that are difficult to teach because the definitions of these concepts given in textbooks either lack precision, or invoke ideas that beginners are not familiar with, and have to accept on trust. Sometimes the language of the book also creates alternative conceptions.

Teacher as a source of alternative conceptions:

In many cases, the teachers become the main sources of alternative conceptions among the students. If a teacher is not competent, qualified, and has not sound experience how to deal alternative conceptions, can create alternative conceptions by his instruction in the classroom.

Everyday knowledge:

Everyday knowledge is one of the main sources of alternative conception among the students. Anderson (1992) and Taber (1998) point to the strong preference of most of their subjects for Common-sense reasoning, everyday analogies, visible effects and changes, and common (non-scientific) word usage. They observed that students actively rejected the use of scientific words in favor of colloquial speech, which led the students into many misunderstandings.

Use of language:

Use of everyday language such as heat, weight, mass, current, power, etc. This type of word has various meanings in the local language such as force is used for various meanings in the Hindi language. In this same way, most people use the calorie as a unit of energy and say... I burn 200 calories today; he burns 250 calories today. But the unit is a kilocalorie, not a calorie.

Conceptual change:

It is interesting to examine how pupils construct their concepts about particular natural phenomena and how the conceptual change takes place. The conceptual change is a social process by which students make sense of their experience in terms of extant knowledge. These terms usually carry the implication, that learners' particular conceptual structures can be changed to more sophisticated ones that can account for phenomena where previous conceptions failed to do so. The process of conceptual change has been studied from several theoretical perspectives. In the earlier stage the Piagetian assimilation and accommodation and at later stage constructivist ideas that developed with the merging of various standpoints of cognitive psychology and Piagetian theory and finally Vygotskian ideas carried forward the thought process. There are two important models for conceptual change, the first conceptual change model introduced by Posner *et al.*, and the second cognitive conflict theory propounded by Lee & Kwon (2003).

According to Posner *et al.* (1982), the process of doing normal science is similar to assimilation. Students can sometimes successfully use their existing conceptions to explain and interpret new phenomena. According to this model, students cannot change their alternative conceptions until and unless dissatisfaction is not created with the prior conception. If an available concept is intelligible, plausible, and fruitful then the accommodation of a new concept may be taken place. An intelligible conception is sensible if it is non-contradictory and its meaning is understood by the students, plausible means that in addition to the students knowing what the concept means, She/he finds the conception believable, and the conception is fruitful when it helps the learner to solve others problems or suggests new research direction (Duit & Treagust, 2003). Thus, it would seem that the following conditions must be met for a conceptual change;

There must be dissatisfaction with existing conceptions.

A student will not be motivated to make an effort to understand a new conception until he/she can see it bring adequate change which helps understand an unfamiliar situation. This happens when a situation present in front of the student leaves him/her dissatisfied with the old conception.

The new concept must be intelligible

This entails not only the understanding of terms and symbols and syntax of the mode of presentation but also the construction of the coherent representation of the new concept (Duit & Treagust, 2003).

The New Concept must be plausible

The new concept must be seen to be consistent with the student's past and present experiences. Furthermore, it should fit into the student's overall view of the environment. It must conceptualize the working of physical reality.

According to Tsagliotis (1997), these four conditions of conceptual change have been schematized by Swift (1984) in light of Hewson's (1981) contribution to this theoretical perspective. Swift used Hewson's notion of conceptual *exchange* to refer to Posner et al's (1982) notion of *accommodation* or radical conceptual change (see figure-1.2).

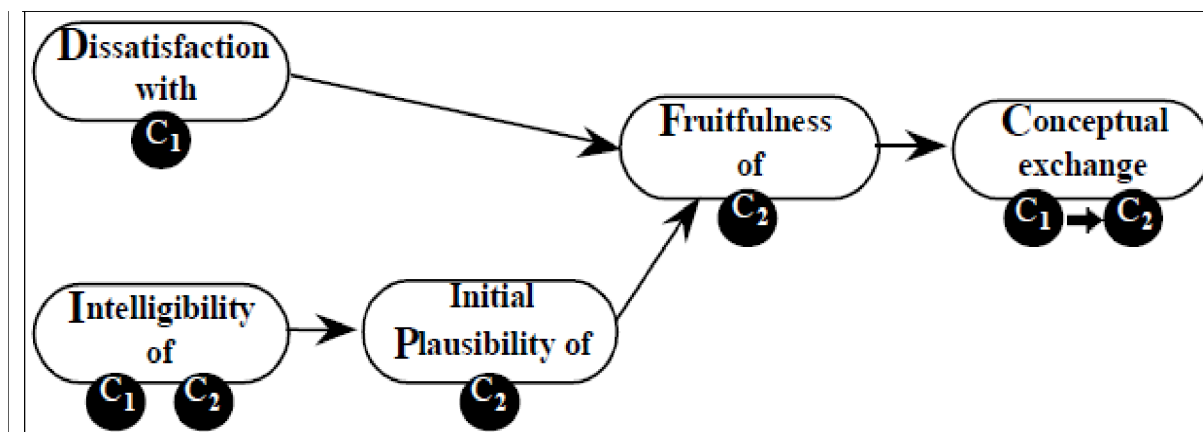


Figure-1.2. Schematized representation of four conditions of conceptual change with a combination of conceptual exchange (Tsagliotis, 1997).

Another important model for conceptual change is the cognitive conflict model, which is based on the Piagetian account of cognitive development. The eternal experiences which oppose contradictions are part of cognitive development. Cognitive conflict is a perceptual state in which one notices the discrepancy between one's cognitive structure and environment (external information), or among the different components (e.g., conceptions, beliefs, substructure, and so on) (Lee & Kwon 2001). Cognitive conflict occurs if a learner's new experience does not fit into his/her current understanding which creates a

disturbance in the student's mental balance. This disturbance in mental balance is cognitive conflict. Lee & Kwon (2001) explained the cognitive conflict process by which learners change their conception (Figure-1.3). This model has three stages:

1. Recognition of the anomalous situation; the learner with his/her pre-existing conceptions accepts an anomalous situation that is genuine.
2. Learners express anxiety or interest to resolve the cognitive conflict.
3. At the end, the learner engages in the cognitive reappraisal of the situation.

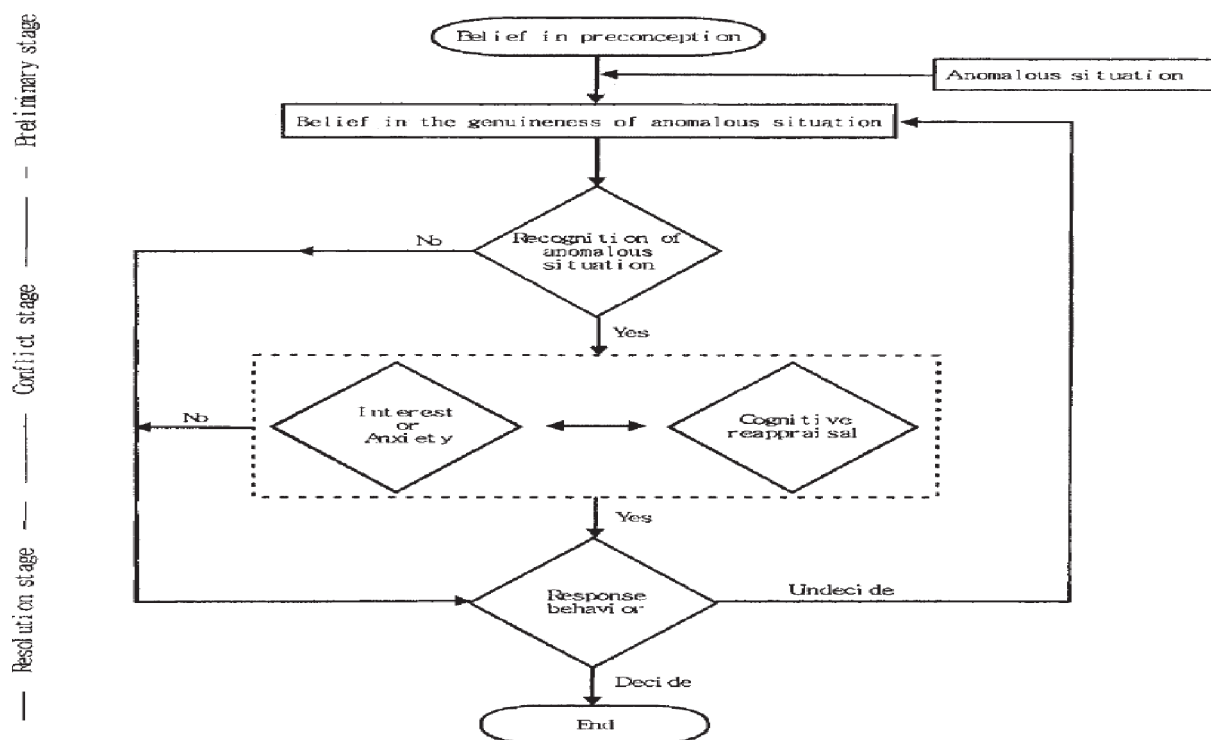


Figure-1.3. Cognitive conflict process model (Lee & Kwon, 2003)

Thus, in this model, there are four important psychological constructs: recognition of an anomalous situation, interest, anxiety, and cognitive appraisal. Every theory has its limitation and so does this one. This theory only works when a learner recognizes an anomaly clearly, shows strong interest and appropriate anxiety, and reappraises the cognitive conflict situation deeply. However, if a learner does not recognize the anomaly, ignores it, or experiences a negative feeling of interest or if he/she does not want to be in a conflict state, then in this situation cognitive conflict will have negligible experience or even destructive one.

Conclusion :

This article discusses the students’ alternative conceptions and what are the important models to address these alternative conceptions. The above discussion on students’ ideas/concepts, alternative conceptions, and how to change the concepts indicate

that no child enters in a class devoid of concept, which means the child’s brain is not tabula rasa but have some concepts/ ideas which they learned/experienced at home, society and other sources of information. The above discussion revealed that the students hold conceptions about natural phenomena, which are different from what they are told in the textbook or what they are taught by the teacher (NCERT, 2006b). these ideas of students are not false but based on logic and their experience. The child actively constructs their own knowledge, understanding, and experiences. Their prior experiences play very important roles in the construction of new experiences. Piaget’s stage independent theory, where he advocates that acquisition of knowledge by the child goes through the processes of assimilation, accommodation, and equilibration, and the model of Schema supports the above finding. The child’s alternative conceptions control the degree and quality of knowledge

construction and hence the degree and quality of meaningful learning. There are different models to address the students' alternative conceptions but two models, the first conceptual change model (Posner *et al.* 1982), and the second conceptual conflict model are very famous to address the students' alternative conceptions. Both models have their pros and cons, and it depends upon the user which model they want to use in their study.

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