RESEARCH ARTICLE

A STUDY OF MISCONCEPTIONS IN BIOLOGY AT SECONDARY SCHOOL LEVEL

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ARTICLE INFO	ABSTRACT
	Misconceptions popularly known as students' conceptions, children's science alternative conceptions or alternative frame works, private concepts, naive theories and half truths, naive conceptions or naïve knowledge and as commonsense beliefs interfere with learning when students use them to interpret new experiences. A research was conducted to study the misconceptions among secondary school students with respect to biological concepts in the unit of environment of 9th class text book prescribed by Punjab School Education Board. In the study a three tier test was constructed to identify the misconceptions among students about the seven conceptual areas of "adaptations, habitat, biosphere, ecosystem, food chain and food web, functions of ecosystem, biomass and biodiversity". On the basis of the responses written by students in the second tier of the test the common misconceptions prevalent among students are discussed in this paper which will help the teachers to organize their class room instructions accordingly because to overcome misconceptions first of all teachers have to identify misconceptions.

INTRODUCTION

Misconceptions refer to intuitive ideas that students have constructed for themselves as a result of experiences with their physical environment, popularly known as students' conceptions, children's science alternative conceptions or alternative frame works (Gilbert and Watts, 1983), and as private concepts, naive theories and half truths (Mestre, 1987) and as naive conceptions or naïve knowledge (Reiner, Slotta, Chi and Resnick, 2000) and as commonsense beliefs (Hestenes, Wells and Swackmer, 1992). Piaget's (1971) concept of assimilation helps us understand why misconceptions persist. New information is more easily learned when it can be related to something that is already known. Assimilation describes the type of learning that occurs when information can be taken on board without revising our existing cognitive frameworks. This stands in contrast to accommodation, which describes learning where we must revise what we already know (or thought we knew) to accommodate a new idea. We have a natural tendency to overemphasize information that supports our current theories and discount information that would throw us into disequilibrium (Longfield, 2009). Misconceptions are a problem for two reasons. First, they interfere with learning when students use them to interpret new experiences. Second, students are emotionally and intellectually attached to their misconceptions, because they have actively constructed them

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(Oberoi, 2017). Studies related to the students' misconceptions are being conducted seriously all over the world. In India studies related to students' misconceptions in physics, chemistry and mathematics are being done but not in biology. Therefore, a study of students' misconceptions in biology conducted at secondary school level has great significance.

Objective of the Study

To study the misconceptions among secondary school students with respect to biological concepts in the unit of environment of 9th class text book.

MATERIALS AND METHODS

Descriptive method of research was used in the conduct of the present study: The study was completed in two phases:-

Phase I: Construction and Standardization of Concept Achievement Test (CAT) in Science in the content area of environment was constructed and standardized by the researcher to include the concepts of: "adaptations, habitat, biosphere, ecosystem, food chain and food web, functions of ecosystem, biomass and biodiversity" from PSEB prescribed science text book. The students responded on the three tier test in which the students had to answer the multiple choice question, then write reason for the answer chosen and to show the confidence in the third tier.

Phase II: Field Work

Sampling

A sample of 912 students of 9th class studying in high and senior secondary government schools was selected by randomly selecting 33 schools from seven districts of Punjab namely, Patiala, Ropar, Ludhiana, Bathinda, Mansa, Fatehgarh Sahib and Sangrur for identifying the errors and misconceptions in science.

Findings

On the basis of the reasons (analyzed separately) written by the students in the second tier of the Concept achievement Test (CAT) in Science the Common misconceptions in environment (Content Wise) are presented below:

(i)Adaptations

Habitats are called adaptations; when plants and animals change their habitat it is called adaptaion; adaptation is adjustment; adaptation is a place which is best suited for plants and animals to live. Xerophytes do not require water; xerophytes grow on places which are not water deficient; xerophytes grow on marshy places. Mesophytic plants have reduced leaves which help in the growth and development of the plants; the stems of mesophytic plats are solid and freely branched because they get more amount of water and minerals as compared to other plants; the mesophytic plants are strong because they have more number of stomata. Sometimes lotus grows on land but mostly grows in water; Cactus and rose are hydrophytic plants; bipedility is not the feature of terrestrial adaptaion; fins and feathers are equivalent; dolphins respire through its lungs in water; lizard has modification to live in water; dolphins live in sea only; birds make their own food; birds have fins which help them to fly.

(ii)Habitat

Environment consists of air only because air purifies the environment; animals and their environment are biotic components; ecology consists only of micro-organisms; habitat of plants and animals can only be land because they can live only on land; habitat of plants and animals can only be water and land.

(iii)Biosphere

Biosphere has two components: the ones who can breath and the others who cannot breath; biosphere has three components: biotic, abiotic and animals; biosphere has four components i.e. sun, plants, herbivores and carnivores; biosphere has two components i.e. water and land; carbon dioxide, light and minerals are biotic components; a plant gets food from symbiotic relationship; a plant depends upon biotic components only for its survival; Temperature, sunlight and moisture are the biotic factors; green Plants are called producers because animals get leaves from them; green plants are called herbivores because herbs are also green in colour; herbivores are green coloured plants; green plants are called producers because we get fruits, vegetables, medicines and wood from them; plants grow by their own so they are called producers. Green plants are living, therefore they are called producers; green plants produce more plants so are called producers; green plants are called producers because herbivores eat them; plants get chlorophyll from sun and grow by their own.

(iv)Ecosystem

Rivers and forests are the terrestrial ecosystem; only forests have terrestrial ecosystem; rivers and desserts are the terrestrial ecosystems; park is artificial ecosystem because man feels happy and peaceful in park; forest is the artificial ecosystem because all the animals live in forests; ecosystem is applicable in forests only; mountains have artificial ecosystem because there the temperature is high and oxygen is in less quantity.

(v)Food Chain and Food Web

Consumers consume the producers directly; consumers consume the producers indirectly; consumers consume producers neither directly nor indirectly; those organisms which feed both on plants and animals are called carnivores e.g. grass→ deer→ Lion; carnivores get food from plants and meat from animals; insectivores get food both from plants and animals; plants and animals get food from omnivores; consumers which feed directly on plants for their food are called carnivores. The consumers which feed directly on plants are called decomposers; autotrophs depend upon producers for food; deer is the example of decomposer because it feed both on herbivores and carnivores; bacteria and fungi are the adaptations for decomposers; decomposers are plants; decomposers are dangerous; in a food chain animals/organisms depend directly on each other; food chain is eaten by living beings. Grass is a herbivore; deer is a decomposer; food chain is always in forests; in a food chain first come herbivore then decomposer and then carnivore; confusion between food chain and food web; a food web has 5 or 6 number of food chains only; food web is a kind of web in which living beings are trapped.

(vi)Functions of Ecosystem

Soil, moisture, light and air are the organic compounds that help in the formation of organisms; formation of organic compounds is not possible without soil, moisture, light and air; carbohydrates, temperature and sunlight are the organic compounds; biological magnification creates new scientific changes in the environment; biological oxidation is the process of digestion of poisonous substances. When the organisms at higher trophic level get food its oxidation is done; in biological diversification, organisms get poisonous substances; in a food chain plant→ Deer -> Lion, lion has more energy than deer and plants because deer eats plants and lion eats deer, so all the energy goes to lion; all have equal energy because they all get energy from sun; plants have more energy because they suck photosynthesis. Plants have more energy because all the animals eat plants; lion is at the last trophic level of food chain so has maximum energy; plants provide so many facilities to animals, that is why they have more energy; all the nutrients and materials are present in plants so have more energy; all the organismswill die without plants so they have more energy; proteins, nitrogen, Sulphur are inorganic substance because they are not made up of carbon; the percentage of nitrogen in the atmosphere is 78% because of increasing population and decreasing trees in the world; nitrogen fixation, nitrification and ammonification are the factors which are obtained by nitrogen cycle.

(vii)Biomass and Biodiversity

In ecosystem herbivores have maximum energy; herbivores e.g. elephants have maximum energy so they have maximum biomass; carnivores consume meat so their biomass is maximum; biomass of lion is more as compared to other animals; herbivores are at first tropic level; biomass of decomposers is maximum because they decompose the organisms slowly; carnivores have maximum biomass because they are physically very strong and they possess the biomass of producers and consumers; the decomposers cannot die so easily so they have maximum biomass. Plants occupy so much of space on this earth so have maximum biomass; for conservation of species animal banks are made; gene banks are the best banks; blood banks are made for the conservation of species because blood is essential for our body; DNA banks are made for the conservation of species. Similar misconceptions have been found by Adeniyi (1985) about food chain, energy flow and carbon cycle; Gallegos et al (1994) in the concepts of food web and relationship with ecosystem; Leach et al (1995) in the concepts of functions of ecosystem; Ozkam (2001) about ecological concepts of environment, ecosystem, decomposers, food chain and food web; Cetin (2004) about energy flow, food chain, food web and recycling of matter.

Conclusions and Implications

1. Use of innovative techniques: Traditional methods of teaching are not sufficient in overcoming student misconceptions. New innovative techniques and models of science instruction must be practiced by teachers such as cooperative learning strategies, Inquiry training model, web-quest etc. Educators, therefore, must help students to overcome their misconceptions by diagnosing the misconceptions, creating dissatisfaction with the misconceptions, and providing opportunities to practice the goal conceptions.

2. Curriculum Modification- Misconception may arise when teaching fails to induce a conceptual change among the students. It is necessary to prevent them from occurring. Certain prerequisite concepts are necessary for a learner to develop genuine understanding of a certain concept. This consideration suggests that, it is crucial to consider the logical structure of the subject matter. The curriculum planners and the text book writers need to be extra cautious in this regard. The teacher should take into account the students' prior knowledge; identify the misconceptions before curriculum transaction. Some misconceptions seem to arise from the students' inability to use concepts in novel situations. Students tend to restrict their understanding to the particular context, in which the concept is learned. To overcome this problem, teachers should provide opportunities for students to apply a learned concept in different contexts. Science teachers, students and authors must be made aware of such misconceptions presented in biology textbooks which teachers and students use without questioning.

3. Development of Enrichment Material- To promote effective and meaningful learning, we need to identify the causes of such misconceptions and find ways to rectify them. To achieve this goal, research based material is very crucial. It will help teachers, and students to overcome misconceptions and other barriers of understanding. The use of such a material will certainly bring significant changes in conceptions and improved understanding in all the topics, teachers dealt with (Amir and Tamir, 1990).

4. Class room instructions- may be organized in a manner that takes into account students' conceptions similar to the ones that have been identified in this study. When directly confronted with conceptions that students realize are not scientifically acceptable and through discussion with the teacher and with peers in small groups, students may lead to arrive at more fruitful understanding of concepts of environment. For example, discussions about adaptations in plants and animals will help to remove various misconceptions generated due to confusion and language imprecision. Earlier, Engel Clough and Wood Robinson (1985) have also suggested providing more structured opportunities for students to talk through ideas at length, both in small groups and whole class discussions.

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