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REVIEW OF RELEVANT LITERATURE ON CAUSATIVE AGENTS OF MISCONCEPTIONS ABOUT BIOLOGICAL CONCEPTS

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Abstract

Learning science is an important activity for the development and improvement of new civilization and because of this reason more focus is given to the science curriculum. Before entering in the school boundary, students already experience so many things and for this reason they are not considered as blank slates. But it is not necessary that their experiences are correct and accurate to the scientifically accepted concepts it may be inaccurate and non scientific, this kind of understanding are considered as Misconceptions. Parents as well as teachers should know about sources of misconceptions so that they can be alert for the development of these misconceptions and can work on the development of appropriate scientific concepts. In this paper, the researchers reviewed the previous studies for finding out the causative agents of misconceptions and the end the researchers concluded about the implementations on the findings of the previous researches.

Keywords: *Biological Concept, Causative agent, Misconception*

INTRODUCTION:

Learning **Science** is an important activity for human being for enriching the quality of life in any civilization and its application proceeds towards a new developed era. It is an active process, whereby learners take information from the environment and construct their personal interpretations and meaning based on their prior knowledge and experiences. There are two views of Science in the scientific world it is-static and dynamic. The static view is what a layman thinks of science, i.e. science is a body of facts and also a way of explaining the observed phenomena. The emphasis, then, is on the present state of knowledge and adding to it. The dynamic view regards science as an activity i.e. 'what scientists do'.

Science education in modern era acts as an essential part. It is a cumulative processes and each new piece of information is added to what students already know (**Galvin & Grady, n.d.**). From the first step of schooling science is introduced in the curriculum. In beginning, the science subject is taught in combination of three subjects and later it is divided into three

different subjects i.e. Physics, Chemistry and Biology. Biology is a subject of natural science concerned with the study of life and living organisms including the structure, function, growth, origin, distribution and evolution of organisms and helps us to know the world where we live in. Biology is a course which needs the ability to observe the micro and macro relations among concepts.

Students enter into science classroom with various experiences which they acquired from their everyday life **(Tekkaya, 2002),** so they can't be considered as blank slates **(Deshmukh & Deshmukh, n.d.).** Science is the pursuit and application of knowledge and understanding of knowledge of the nature and social world following a systematic methodology based on evidences. When students combined a newly concept with their previous concept make a conceptual conflict in the students mind **(Tekkaya, 2002)**.

Biology is a course in which students experience difficulty with **(Keles & Kefeli, 2010).** Text books plays an important role in biology education **(Cobanoglu, Sahin & Karakaya, 2009)**, it acts as a good source of information for teaching **(Deshmukh & Deshmukh, n.d.)**. As the subject is based on abstract concepts that may cause students difficulty in constructing knowledge. Previous findings indicate that The studies concerning students understanding in biology courses which has a rich potential in terms of concepts , reveal that students have misconception on : diffusion- osmosis, photosynthesis, respiration circulatory system, genetics and in general biology topic **(Selvi & Yakkisan, 2004, in Keles & Kefeli, 2010)**.

MISCONCEPTION:

In broad terms, misconceptions correspond to the concept that have particular interpretations and meaning in students' articulations that are not scientifically accurate **(Bahar, 2003)**. Previous researches indicate that students have considerable degree of misconceptions related to biological concepts **(Tekkaya, 2002)**. Any conceptual idea that differs from commonly accepted scientific consensus is known as misconception **(Galvin & Grady, n.d.).** School students come to the classroom with numerous misconceptions **(Deshmukh & Deshmukh, n.d.)**. Misconceptions can be defined as knowledge contrary to the scientific facts, which students have learnt before or during educational process **(Ozcan, Yildirim & Ozgur, 2012).** It is an important factor which affect learning **(Bahar, 2003)** as a barrier **(Singh & Kaur, 2010)** and affects students achievement **(Pukkila, 2008; Mills Shaw, 2008)**. Misconceptions of the students significantly affect making correct link with a new concept and hence disrupt meaningful learning **(Ozcan, Yildirim & Ozgur, 2012)**. Misconceptions are the abstract

concepts which are difficult to comprehend for adults let alone for lower secondary school students **(Svandova, 2014)**.

Misconceptions are stable and resistant barriers to acquiring scientific perspectives **(Bulunuz, 2008)**. **Maskiewicz and Lineback (2013**; quoted in **Leonard, Kalinowski & Andews, 2014)** argued that misconceptions are associated with out- of- date theories of learning, and therefore, biology education researchers and instructors who use this term are likely to use ineffective instruction. Misconceptions are often based on personal experiences and are difficult to bypass route to meaningful learning **(Gelman and Gallistel, 1986; Wellman, 1990 (**quoted in **Mills Shaw, 2008).**

To overcome misconceptions, students must become aware of the scientist concept, the evidence that take on the validity of their misconceptions and the scientific concepts, and they must be able to generate the logical relationship between evidence and alternative conceptions **(Lowson & Thompson, 1988; quoted in Svandova, 2014).**

WHY TO FINDOUT MISCONCEPTIONS AMONG STUDENTS?

Misconceptions acts as a barrier to acquire actual scientific knowledge. These misconceptions could be a big block for the students in learning scientific concepts **(Liu & Li, n.d.).** If misconceptions are formed once, then it is quite impossible to remove immediately. If those ideas are not changed during the school learning, they will be kept in students mind for a long time **(Liu & Li, n.d.)**. So the teachers' duty is to identify those misconceptions which are already included within the children. Understanding of misconceptions can help teachers in their preparation for teaching. One of the methods which teachers can use to organize valid concepts or eliminate misconceptions is to introduce a conceptual change text. **Svandova (2014).** These **misconceptions** can be swayed by attitudes towards science among the students.

For a biology teacher there is a need to know about all the causative agents of misconceptions in Biology. So that they can develop their

The paper is reviewing the causative agents of misconceptions in biological concepts.

CAUSATIVE AGENTS OF MISCONCEPTIONS IN BIOLOGICAL CONCEPTS:

The causative agents of misconceptions identified by various researchers in various times are discussed below:

Svandova (2014) investigated the common misconceptions of lower secondary school students regarding the concept of Photosynthesis and Plant respiration. Sample size consisted of 108 lower secondary school students (age 11-16 yrs) in the Czech Republic. The

researcher have written that these misconceptions are most often arise by misinterpretation or bad understanding of curriculum when students do not create a symbiosis with curriculum. In the study they found that the students were unaware that breathing takes place continuously and that it is an indispensable condition of life. This misconception may be caused by how the chemical reactions of both processes (respiration and photosynthesis) taught.

Ozcan, Yildrim & Ozgur (2012) conducted a study to determine the misconceptions and inadequate information which the university freshmen students' held about mitosis and meiosis by the use of 10 open ended questions. And some students were interviewed for determining the alternative (misconceptions) better and then the answers were evaluated. The result of the study revealed that the students have some misunderstanding, deficient information and alternative opinions about mitotic and meiotic cell division. Oral answers acquired from the students showed that the deficiencies arise from their high school education and mainly as a result of education method depending on memorizing. The other reason is considered that it (biology) is a difficult subject to understand as it is at microscopic level. In the end of the study, the reason for students not to be able to understand the DNA, genes, chromosome, mitotic and meiotic cell division subjects are concluded to be the contents of the syllabus which are higher of the students' level that there were no sufficient practices held.

Cokadar (2012) conducted a study to find out whether perspective teachers had described the studying materials and reactions in a scientifically correct manner. The written responses of the study showed that some of the perspective teachers had misconceptions. So it can say that teachers are one of the causative agents of misconceptions.

Cimer (2012) conducted a study to determine what makes biology learning difficult and effective: students' view. For this study the researcher selected 207 students from secondary school students in Rize province. A self developed questionnaire was used and the data were analysed by both qualitative and quantitative method. The findings showed that why students have difficulties to learn the concepts in biology. According to the analysed data there are mainly five reasons that makes biology learning difficult to them. These are: nature of the topic, teachers' style of teaching biology, students' learning and studying habits, students negative feelings and attitude towards topic, and a lack of resources. The abstract concept of biology and the foreign/ Latin words used in biology also make difficult to the biology learning.

Gooding & Metz (2011) point out that parents, folklore, teachers, media and even learners themselves are responsible for cultivating and fostering misconceptions. They also mentioned that science curricula and text books are also responsible for perpetuating misconceptions.

Keles & Kefeli, (2010) conducted a study to detect 6th and 7th grade students' misconceptions on "Photosynthesis and respiration" unit and to determine the effect of the developed computer assisted instruction (CAI) material on removal of these misconceptions. The misconceptions were determined by clinical interview conducted with the help of the prepared question cards. In the study they found similar misconceptions with the previous study. They concluded the reason for students from different background, living in different countries and different ages have similar misconceptions may be similar experiences they have in their daily life. Here it can conclude that daily life experiences are one of the causative agent of misconceptions in biological concept.

Joseph (2010) has written that the misconceptions can come from all the sources of data gathering and the way of thinking. He has also mentioned that misconceptions may arise as the result of: 1. The neurological "hardware" or genetic programming (as in the case of automatic language – processing structures, which may be invoked when "reading" on equation). 2. The second is certain experiences that are commonly shared by many individuals (as with moving objects).

Cobanoglu, Sahin & Karakaya (2009) examined the biology text books for 10th grades in high school education and the idea of pre service teachers. They found that during preparation of the biology text book, international standards of science education were disregarded. The books are written in an encyclopaedically fashion and the examples are not related to daily biology studies and natural sciences. Some logical mistakes are found like the definitions are not written properly they were incomplete. So they concluded that the text books are week and inadequate. The books are not able to meet the needs of teachers and students. The visual materials are found to be inadequate for reaching at the goal of science education. So the text books acts as a causative agent of creating misconceptions.

Prokop, Kubiatko & Fancovicova, (2007) conducted a study to identify children's ideas of various age classes (7/8- 14/15) about birds. A questionnaire with 31 multiple choice and open ended questions and eight photographs were administered to 495 children from 10 elementary schools in Slovakia. They found that children of all grades showed misconceptions in understanding and ideas about all investigated aspects (like bird

classification, food senses, communication, migration and breeding including parental care). This is because children's concepts about birds have been largely overlooked.

Perrone (2007) conducted a study to determine what will happen to student understanding of science concepts about reproduction and heredity when their misconceptions are addressed through inquiry based methods. In the study the teacher researcher examined common misconceptions about heredity and formulated open-ended questions directed towards selected students' own ideas. Using four students, each was pre-assumed on genetics using an open-ended assessment. Then inquiry activities were implemented into daily lessons. Finally the students were reassessed using an interview model to assess result of the study. The study showed that inquiry method is a good tool for deconstruct misconceptions. The study also indicates that one student is confused by the process, which more than likely stems from poor teaching or a blending fact.

Kwen (2005) highlighted the teachers' or question setters' misconceptions concerning some key biology science concepts in the areas of plant and animal morphology, function and genetics. It was baesd on scrutiny of numerous sets of primary science examinations in Singapore. The study concluded that whilst some of the misconceptions may be due to poor item crafting. Here it is also mentioned that teachers can be the source of many misconceptions held by the students.

Dikmenli & Cardak (2004, quoted in Galvin & Grady, n.d.) adult a play an imperative role in creating misconceptions in students. Studies also highlights that textbooks are another prevalent source that contributes to the formation of misconceptions by students.

Ozay and Oztas , 2003 (quoted in Svandova, 2014) suggested that misconceptions are influenced by the school curriculum.

Tekkaya (2002) reviewed to compile lists of common misconceptions detected in order to alert teachers to the prevalence of misconceptions on basic biological concepts and to suggest ways to remediate them. The researcher mentioned that misconceptions may originate from certain experiences that are commonly shared by many students. Some of them rooted in everyday experiences. Lack of integration among topics and inappropriate presentation of topics in textbooks influence students' further misunderstanding. Some of the biological concepts like genetics, evolution, and metabolic process ecosystem are closely related to physics and chemistry. The misconceptions in physical sciences may cause a reason of arising misconception in biological concepts.

Wandersee, Mintzes & Novak, 1994 (quoted in Bahar, 2003) gave eight knowledge claims regarding misconceptions. Two of them said about the sources of misconceptions. 1. Misconceptions have their origins in a diverse set of personal experiences including direct observation and perception, peer culture and language, as well as in teachers explanations and instructional materials. 2. Teachers often subscribe to the same misconceptions as their students.

Wescott & Cunningham (n.d.) examined some of the misconceptions that students enrolled in Introduction to Biological Anthropology at the University of Missouri-Columbia have about the nature of science and evolutionary process, and compare them to published data. They found that the terminologies used in biology may create misconceptions among the students. The survey indicates that 40% of UMC students in IBA do not differentiate between the vernacular and scientific use of terms.

Deshmukh & Deshmukh, (n.d.) investigated the prevalence and persistence of misconceptions among students, related to life processes and to determine whether text books play a role in inducing or reinforcing students' misconceptions. In the process of identifying the causes of misconceptions, the author found that NCERT & SCERT science text books are one of the sources of misconceptions. In their survey, they asked the students that why heart is known as an important organ. In the interview the students replied that their parents had told that heart is very vital organ, because our feelings, emotions and life are stored in it. Language textbooks and movies also exhibit romantic ideas about this organ. The symbol of heart as love and an origin of feeling in literature, the students got confused. In some diagrams, many arrows show the blood flow in heart. These generate confusion among students. The researchers also summarized the sources of misconceptions. These are like textbooks, reference books, teachers, language, cultural beliefs and practices are some of the principle sources of high school students' misconceptions of many science concepts including those in biology.

Sanders, 1993 (quoted in Tekkaya, 2002) suggested that assessment strategies used by biology teachers could be a factor influencing the development of misconceptions in their students.

Griffith & Preston (1992, quoted in Galvin & Grady, n.d.) have mentioned many sources of misconceptions, these are like that throughout our lives we immersed with information. The process of understanding this information can lead the formation of our misconceptions. This can result due to the number of contacts students make with the physical and social

world around them, they may occur due to something the students experienced in their personal life, from communication with different teachers and friends or through sources of media

Liu & Li (n.d.) presented a report on findings of an empirical research study that examined common misconceptions on photosynthesis and respiration held by junior secondary school biology teacher and their students. The study showed that i) some biology teachers of middle schools do have more or less incorrect or incomplete understanding on the key concepts in biology; ii) the misconceptions of teachers and that of their students do have some similarity in between; iii) such similarity is featured as statistically positive correlation, and the teachers' misconceptions are very much likely to be the source of those of the students.

IMPLICATION:

Misconceptions act as a barrier in learning process. For an effective learning there is a need to remove these misconceptions and form correct scientific concepts among the students.

IMPLICATIONS FOR TEACHERS:

Teachers play a vital role in identifying misconceptions among the students. Teachers can use various tools for identifying the misconceptions about various concepts. They can provide a forum of group discussion to express their concepts. They can take a test of their previous knowledge for knowing their clearance of the concept, and then make their teaching strategy. The teachers can bestow a platform to the students to ask any doubt about any questions for any content. Teachers should try to know what will be the possible causative agents of misconceptions.

IMPLICATIONS FOR TEXT BOOK WRITER:

The text book writers should revise their books time to time. They should write the correct scientific explanation accordance with the age of the students. They should not use any layman term which can confuse the students.

IMPLICATIONS FOR CURRICULUM DEVELOPER:

Curriculum developer should know about the possible sources of misconceptions. Before developing their curriculum they should survey to know the preconceptions and alternative conceptions of the students of all ages. So they should develop their curriculum on the basis of their age level.

IMPLICATIONS FOR TEACHER EDUCATERS:

The teacher educators should know various sources of misconceptions. They can teach the would be teachers how to identify the misconceptions among the students. Additionally with

this they should instruct the removable process of misconceptions. They can develop various teaching materials to provide correct scientific knowledge and with this introduce various teaching methods to provide accurate scientific concepts.

CONCLUSION:

Each student is an individual learner, with individual misunderstanding (Gooding & Metz, 2011). By listening the students' responses carefully, analyzing them clarifying the doubts by giving explanation and discussion we can determine their understanding of the content.

Misconceptions can be corrected, but since they are individualized paradigms, they must be corrected by their owners. These misconceptions are formed once it is quite impossible to remove them from root. So the teachers, parents, curriculum developers, text book writers are somehow responsible to develop these misconceptions, so they should care on the formation of misconceptions among the students.

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