A Study of Misconceptions in Science among Students of Standard VIII of Ranchi District

A

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1.0 Introduction

The term “misconception in science” can be simply paraphrased as an idea or an explanation that differs from an accepted scientific concept. If the view or the opinion or the concept of an individual is different with what is generally accepted by scientific community the individual may tend to develop misconception. Wrong information, misunderstanding or partial understanding of scientific concepts may lead to misconceptions among students.

2.0 Implications of Review of Related Literature for the Present Study

For the present study, hundred and twenty studies were reviewed on misconceptions in science in India and Abroad. Out of hundred and twenty, hundred and eleven studies were conducted abroad and only nine studies were conducted in India. On the basis of the review of the related literature the researcher has come to the conclusion that misconceptions in science is prevalent among students in many countries but less studies have been conducted in India. It was also observed that most of the studies conducted on misconceptions were experimental studies and less survey has been done. Therefore, the researcher through present study wanted to know the status of misconceptions in science among Indian students. Moreover, the researcher has not come across any study on misconceptions in science in India except five in the past decade so the urge for the present study was felt.

3.0 Rationale

Students’ misconception is a major threat in general teaching-learning process at school level. Misconceptions cover a large range of science concepts, so science educators in many countries are paying attention upon students' misconceptions about scientific concepts (Osbome and Wittrock, 1983). During learning, the students try to connect new knowledge into his/her cognitive structure. If they hold misconceptions, these misconceptions interfere with subsequent learning. Therefore, new knowledge cannot be connected to their existing structure and misunderstanding of the concepts arises (Nakhleh, 1992). Therefore, it is of utmost importance that the misconceptions among students must be identified then only proper teaching learning strategies can be developed to minimize it.

4.0 Research Methodology of the Study

4.1 Research Questions

1. How misconceptions in science can be measured?
2. What leads to the development of misconceptions in science among students?

4.2 Statement of the Problem

"A study of misconceptions in science among students of standard VIII of Ranchi district"

4.3 Objectives of the Study

1. To identify misconceptions in science among students of standard VIII.
2. To study the reasons and sources of misconceptions in science among students of standard VIII.
3. To study misconceptions in science with respect to:
    a. Gender.
    b. Availability of teaching learning materials.
    c. Availability of science laboratory.
    d. Educational qualifications of teachers.
    e. Professional qualification of teachers.
    f. Experience of teachers.
    g. Educational qualification of parents.

4.4 Hypothesis

The hypotheses for the present study are as follows:

1. There will be no significance difference in the mean score of misconceptions in science between boys and girls of standard VIII.
2. There will be no significance difference between availability and non-availability of teaching learning material on misconceptions in science among students of standard VIII.
3. There will be no significance difference between availability and non-availability of science laboratory on misconceptions in science among students of standard VIII.

4. There will be no significance difference between higher educational qualification and lower educational qualification of teachers on misconceptions in science among students of standard VIII.
5. There will be no significance difference between higher professional qualification and lower professional qualification of teachers on misconceptions in science among students of standard VIII.
6. There will be no significance difference between higher experience level and lower experience level of teachers on misconceptions in science among students of standard VIII.
7. There will be no significance difference between higher educational qualification and lower educational qualification of parents on misconceptions in science among students of standard VIII.

4.5 Explanation of the term

Misconception: Misconception refers to any conceptual idea whose meaning deviates from the one commonly accepted by scientific consensus (Haslam & Treagust, 1987).

4.6 Operationalization of the term

1. Misconceptions in Science: For the present study the term misconception refers to the incorrect answer given by the students in Three-Tiered Multiple Choice Science Misconception Test (TTMCSMT). Misconceptions among students can be in the form of misunderstandings, mistakes, errors, improper/partial understanding of the facts and the concepts.

2. Score on Misconceptions in Science: For the present study scores on misconceptions refers to the total achievable scores minus scores obtained by students on Three-Tiered Multiple Choices Science Misconceptions Test.

Score on Misconception = 76 - Score obtained by a student on TTMCSMT

As there were 76 items of one mark each in the test, therefore, maximum achievable score was 76.

Second tier was used to know the probable reasons of misconceptions and third tier was used to know the probable sources of misconceptions.

4.7 Delimitation of the Study

The present study was delimited to schools affiliated to Jharkhand Board of Secondary Education of Ranchi district. The present study was further delimited to standard VIII students enrolled in the academic year 2019-2020. It was also delimited to scientific concepts only.

4.8 Methodology

A descriptive survey method was used for the present study.

4.9 Population

The population for the present study consists of all the schools affiliated to Jharkhand Board of Secondary Education of Ranchi district of Jharkhand state.

4.10 Sample and Sampling Technique

There were a total of 18 blocks in Ranchi district. One school from each block was selected using lottery method.

4.11 Tools used for Data Collection

To collect the data on Misconceptions in Science following tools were used.

1. Content analysis of Science and technology textbook of standard VIII of Jharkhand State Board.
2. Semi-Structured Interview for school teachers.
3. Three-tiered Multiple Choices Science Misconception Test.
4. Information Schedule for school teachers.
5. Observation Schedule for availability of teaching learning material.
6. Observation Schedule for availability of science laboratory.

4.12 Data Collection

First the researcher has taken a permission letter from her guide for data collection. Then a forwarding letter was taken from the Dean and Head of The Faculty of Education and Psychology, Department of Education (CASE) The Maharaja Sayajirao University of Baroda. This forwarding letter was presented to the District Superintendent of Education (DSE) of the Ranchi District. There after permission letter was sought from the DSE of Ranchi district which allowed the researcher to collect data

in the selected schools. The data was collected during the period of February 2020 to March 2020.

5.0 Data Analysis

Data analysis of scores of students in Three-Tiered Multiple Choice Science Misconception Test was done by frequency and percentage. Hypotheses were tested through independent t-test and one way ANOVA and decisions regarding rejection of the hypotheses were taken accordingly.

5.1 Major Findings

1. It was found that majority (64.80 %) of students had given incorrect answers of the true and false questions of Three-Tiered Multiple Choice Science Misconception Test.
2. It was found that majority (83.40 %) of students had given incorrect reasons for their true and false answers of Three-Tiered Multiple Choice Science Misconception Test.
3. It was found that (64.16 %) of the students who had complete misunderstanding or misconceptions considered books as their primary source of knowledge.
4. It was found that there was no significant difference in the mean score of misconceptions in science between boys and girls.
5. It was found that availability and non availability of teaching learning material has significant difference on misconceptions in science among students. It was found that higher the number of teaching learning materials lower is the level of misconceptions among students.
6. It was found that there was no significant difference between higher and lower level of educational qualification of teachers on misconceptions in science among students.
7. It was found that there was a significant difference between higher and lower level of professional qualification of teachers on misconceptions in science among students. It was found that higher the professional qualification of teachers lower is the level of misconceptions among their students.
8. It was found that there was a significant difference between higher and lower experience level of teachers on misconceptions in science among students. It was

found that higher the experience level of teachers lower is the level of misconceptions among their students.

9. It was found that there was a significant difference between higher and lower level of educational qualification of parents on misconceptions in science among students. It was found that higher the educational qualification of parents lower is the level of misconceptions among their children.

5.2 Conclusion

On the basis of the findings of the study it can be concluded that misconceptions in science is prevalent at a higher extend among students. Misconceptions in science among students can stem from variety of factors such as textbooks, improper instructional practices, and lack of hands-on experiments, over or under simplification of scientific concepts, misinterpretation of scientific concepts leading to incomplete or incorrect understandings. With all the considerations and observations we can arrive at a point that it is crucial to address these misconceptions in order to foster a better understanding and appreciation of the scientific method and its contributions to our understanding of the natural world.

5.3 Implications of the Present Study

Following implications can be drawn from this study and this may require considerable changes from school teachers to the policy makers.

1. The teachers should plan their lesson keeping in mind the nature of the scientific concepts which they are going to teach. Abstract concepts should be concretized through the judicious use of teaching learning materials as well as making proper connections to the real life experiences of the students.
2. It has been observed that the printing quality of the textbook is not up to the mark. Diagrams need to be more clear and proper labelling should be done.
3. The teachers should be given proper orientation regarding identification of misconceptions in science among students and the ways to refute it.
4. Frequent in-service training of the science teachers should be conducted where teaching strategies that help students learn science meaningfully should be discussed.

5. Content developers and textbook writers should also be aware about the possible sources and causes of misconceptions among students.

5.4 Suggestions for Further Research

Every research work gives insight to other researchers for further investigation. This study suggests certain areas which can be further investigated. These areas are as follows:

1. A set of diagnostic studies can be conducted to identify misconceptions in science among students.
2. Qualitative studies on small groups can be conducted for in depth understanding of misconceptions in science among students.
3. Similar studies can be conducted exclusively for the concepts of Physics, Chemistry and Biology.
4. Similar studies can be conducted using different tools such as four-tier test, five-tier test, conceptual understanding scale, concept inventory test, concept maps, concept cartoons etc.
5. Similar studies can be conducted on students other than standard VIII.

5.5 Recommendations

The researcher has suggested following recommendations in order to reduce the occurrence of misconceptions in science among students**:**

1. Teachers need to emphasize more on transacting scientifically correct concepts to students rather than focusing more on rote learning and memorization.
2. Misconceptions in science cannot be refuted through chalk and talk method, therefore teachers need to engage the students in different learning environments and learning experiences such as experiments, activities, field trip, multimedia, theatre, role play, demonstration, group discussion and investigations etc. inside and outside the classroom for developing correct and concrete understanding of concepts, and promote interest and attitude towards science.

BIBLIOGRAPHY

Abdelhaleem, I. H. (2002). Examining the impact of the guided constructivist teaching method on students' misconceptions about concepts of Newtonian Physics. (Doctoral Dissertation, University of Central Florida, 2002). *Dissertation Abstract International*, (62)10, 3338A.

Barke, H. D. (2012), Two Ideas of the Redox Reaction : Misconceptions and Their Challenge in Chemistry Education. *African Journal of Chemical Education,* 2, 32-50.

Eaton, J. F., Anderson, C. W. & Smith, E. L. (1984). Student's Misconceptions Interfere with Science Learning: Case Studies of Fifth Grade Students. *The Elementary School Journal*, 84(4), 365-379.

Haslam, F., & Treagust, D. F. (1987). Diagnosing secondary students' misconceptions of photosynthesis & respiration in plants using a two-tier multiple choice instrument. *Journal of Biological Education,* 21(3), 203-11.

Nakhleh. (1992). Why some students' don't learn chemistry. *Journal of Chemical Education,* 69, 191-196.

Palmer, D. H. (1998). Measuring contextual error in the diagnosis of alternative conceptions in science. *Issues in Educational Research*, 8(1), 65-76.

Ramadas, V. (1993). *A Study on Misconceptions in Science. (Unpublished Ph.D Thesis).* Oregon State University: Thailand.

Tam, P. H. (2015). The identification of students misconceptions on a two tier item. *Science Education Research and Practices,* 15(2), 147-162. doi: 10.1007/978-981-287-472-6_7

Wandersee, J. H. (1985). Can the history of science help science educator anticipate students' misconception? Journal of Research in Science Teaching, 23, 581-587.

Zajkov. O., Zajkov. G. S., & Mitrevski, B. (2017). Textbook caused misconceptions, inconsistencies and experimental safety risks of grade 8 physics textbook. *International Journal of Science and Math Education*, 15, 837-852. doi: 10.1007/s10763-016-9715-0