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AMALGAMATION OF SOCIO-SCIENTIFIC ISSUES WITH CONCEPTS OF CHEMISTRY: AN ANALYSIS OF CHEMISTRY CURRICULUM IN SCIENCE TEXTBOOKS AT SECONDARY LEVEL

Education

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ABSTRACT

The literature on education beginning from late 1970's has indicated a emerging awareness that, for science learning to be constructive and worthwhile, it must consider the impacts, it is putting on society, be it a cultural, health or environmental impact, which provides its setting and whose needs it is expected to serve. Moreover, the disinterest in science among students, puts a thrust on educators to realise the essential, cultural beliefs about the realm that pupils and teachers bring to their classroom discussion because, the science learning is fruitful only if it can find a niche in the thought process and socio-cultural construct of students, that is science should be connected with everyday life. This paper attempts to analyse the secondary level science curriculum especially the concepts of Chemistry and its emphasis on incorporation of Socio-scientific issues associated with those concepts. Using a framework emerging from NCF 2005, and other education policy documents of India, it studies whether and to what extent the inclusion of socio-scientific issues has been translated into practice in the existing NCERT science textbooks for Secondary level.

KEYWORDS

Socio-scientific issues, Science textbooks, Chemistry, NCF 2005, Education policy documents of India, Secondary level

INTRODUCTION

Educators have long viewed science as culture in its own right and many see science as one of the aspects of culture and starting from late 1970s, the literature on education has revealed an emerging cognizance to the fact that, for science learning to be fruitful and effective, it must interconnect the socio-cultural context, which gives its setting and whose requirements it is likely to serve. While going through the several education policy documents and especially focusing on NCF 2005 , there has been constant emphasis on enriching the curriculum to provide for overall development of children as "Good science education is true to the child, true to life and true to science"(NCF 2005). Also, it brings to notice that the "Environmental validity"(NCF 2005), wants the science as a discipline to be positioned in the broader context of the learner's environment, both local and worldwide scale, enabling him/her to understand the issues at the boundary of science, technology and society, and preparing the learner with the requisite knowledge and skills to move into the working world. Moreover it could be seen in the document on Education policy of 1979 wished for an educational system that will not only facilitate people to broaden their knowledge but also help in building "awareness of morals and ethics among students"(Draft National Policy on Education – 1979), so that they can have holistic development of personality and become well-intentioned citizens .Similar quotes can be observed in NPE 1986, where it highlighted the necessity to build awareness of issues and concerns related to environment by incorporating them with educational processes at all stages of education involving all the stake holders of the society. "Living in harmony within oneself and with one's natural and social environment is a basic human need" (NPE 1986).

Textbooks play a key and powerful role in the transaction of the curriculum but those who are planning and developing the curriculum, however, have the mind set of compartmentalizing science education to be just assimilation of concepts of science with merely any connect with the society and from learner's context, as can be seen in the subject of chemistry as part of science curriculum of secondary school. Textbook is not only seen as a pedagogical aid in the classroom but also provides a framework for planning of classroom teaching and the teacher is likely to be aware and well versed with the contents presented in the textbooks. While textbooks cannot be the only resort for teaching-learning, they, nonetheless, are an important resource for teaching in Indian context where universalization of content has been one of the basic pursuit of our forefathers who drafted Secondary education commission report 1952 ,especially where there is a resource crunch like in remote and rural areas. While the teaching –learning methodology using textbooks by teachers as well as the classroom interactions play a significant role- but the content involving the concepts, activities, learning tasks, illustrations, represented in the textbooks can be an vital indicator of the possibilities of amalgamation of socio-scientific issues with core concepts of chemistry depicted in science books of secondary level. In such a scenario, a textbook may be an important tool to gauge the opportunities for teaching-learning in the classroom. Present NCERT books were designed on the guidelines on NCF 2005. This paper attempts to present an analysis of the NCERT science textbooks of secondary classes IX and X to assess how the vision of curricular document, NCF 2005 and other education policy documents related to science education has been translated into practice in the science textbooks. In particular, it focuses on understanding whether socio-scientific issues associated with the concept of chemistry has been addressed in the science textbooks for secondary school.

Theoretical Framework

NCF 2005 lays down a framework for developing a curriculum that aims at enriching it, to provide for overall development of children and realising educational goals through meaningful teaching-learning experiences. Keeping in view the existing challenges in the education system, it provides guiding principles within which learning tasks could be intended that will encourage in making children sensitive to the environment and will bring thought about the necessity for its protection as the advancement of new technological choices and living styles happened in the last century, has led to emergence of environmental issues of grave concerns as well and created socio-economic gap between haves and have-nots. It is the education and the way it is put forth, that can offer the much needed perspective on how human life can come up with solutions and alternate pathways to solve the crisis related to the environment by recognizing the SSIs, active participation in discussion during teaching –learning process and engaging learner's in becoming informed citizen,. Moreover, the education policy document have highlighted the necessity for enhancing awareness about environmental issues and concerns by "integrating it in the educational process at all stages of education" (NPE 1986). Following criteria have been considered for analysing the Chapters related to Chemistry in NCERT science textbooks at secondary level.

Socio-scientific issues (SSIs)

Socio-scientific issues are placed into science education as an aid to encourage scientific literacy, which enhances the ability to apply scientific and moral thought processes and reasoning to the real world situations. A few instances of SSIs in science includes climate change, waste disposal, genetic engineering, petroleum extraction etc. There are research studies which have shown that bringing SSI in teaching helps in better understanding of science in various context and making child informed with what decision to make. Many educators feel that SSI can nurture citizens having scientific literacy that will allow them to relate scientific content knowledge to real-world socio--scientific settings and inculcate mutual social conscience by which learners will be able to reflect on the conception and consequences of their own reasoning. When it comes to SSI in the school science, the content in textbook should include SSI on concepts of science and questions related to SSIs. Moreover, the teachers must encourage discussion of SSIs to nurture the understanding of content of science with the implications involved in everyday life issues.

Analysis of Textbooks

Beginning with the class Ninth, NCERT science textbook, the chapters which, where looked into as chemistry content are: Chapter 1-Matter

in our surroundings; Chapter 2- Is matter around us pure; Chapter 3- Atoms and molecules and Chapter 4 -structure of the atom.

The content of Chapter1 i.e. on Matter in our surrounding discusses about different states of matter, their scientific understanding and the processes involving conversion of states of matter and some of practical application into daily life situation is given in form of e.g. or asked in form of question.

The content of Chapter 2 i.e. on "Is matter around us pure?" discusses about the classification of matter into pure substance and mixture. It has further given classification of mixture in different types that is homogenous and heterogeneous mixtures. The heterogeneous mixture is further classified as colloids and suspension. Also, a classification scheme on colloids given as aerosols, gel, emulsion, etc. and in later part of the chapter separation techniques of mixtures are given based on scientific understanding of the type of mixture. In this chapter some of the practical application of colloids were discussed along with properties of other type mixtures and some daily life application involving separation technique of mixtures were given

The content of Chapter 3 i.e. on Atoms and Molecules discuss scientific understanding of concept of atom and molecules different laws related to chemical composition of substance. This chapter also introduces concept of ions and valence required for formation of compound followed by mole concept, which are all scientific understanding of concepts. It is important to note that in NCERT textbook for Science the concept atom is introduced in class ninth but the chapter on chemical effects is dealt in class VIII, which needs the concept of ions to be discussed at that class.

The content of Chapter 4 i.e. on Structure of atom talks gives an account of the history of development of different models of atoms by different scientists over a period and talks about discovery of some subatomic particles.

After going through the content of class ninth science textbook, a table showing chapter wise analysis was prepared taking into consideration the socio-scientific issues that has been discussed or could have been incorporated in a chapter for a particular topic. Hence, in the table, a column has been introduced for socio-scientific issue. The Table I showing chemistry content analysis of class IX science textbook is given below

Table I: Chapter wise chemistry content analysis of class IX science textbook

Chapter. No	Chapter Name	Concepts Discussed with Scientific Understanding	Socio-scientific issues discussed/not discussed
1.	Matter in our surroundings	Physical nature of Matter, Different, Characteristics of Particles of Matter, States of Matter, change of state of matter and factors affecting change in state	Not Overtly mentioned The issues related to global warming and waste dumping like electronic waste could have been incorporated.
2.	Is matter around us pure	Pure substance, Mixtures, Types of Mixtures: Homogenous (True Solution) and heterogeneous mixtures (Suspension and Colloids). Concentration of Solution, Colloids are classified according to the state (solid, liquid or gas) of the dispersing medium and the dispersed phase (Aerosol, gel, foam, sol, emulsion etc.) & techniques for separation of mixtures given.	Not Overtly mentioned. Issues like smog, ozone depletion, food adulteration could have been taken up
3.	Atoms and Mol-ecules	Laws of Chemical Combination, atom and molecules ,ions, chemical formula, atomic mass & mole concept	Not overtly mentioned The concept of atom& molecules is introduced for the first time in class IX, hence, only scientific understanding is given. The issues with heavy elements and concentration terms related to the pollution level issues could have been incorporated.
4	Structure of atom	Structure of atom, models of atom by different scientists, subatomic particles , atomic no, Mass no., electronic configuration	Not overtly mentioned The issues related to nuclear energy could have been incorporated.

In the class Tenth, NCERT science textbook, the chapters which, where looked into as chemistry content are: Chapter 1- Chemical Reactions and Equations; Chapter 2- Acids, Bases and Salts; Chapter 3-Metals and Non-metals; Chapter 4-Carbon and its Compounds; Chapter 5- Periodic Classification of Element.

As done for class ninth , similarly going through the content of class Tenth science textbook, a table showing chapter wise analysis was prepared taking into consideration the socio-scientific issues that has been discussed or could have been incorporated in a chapter for a particular topic. Hence, in the table, a column has been introduced for socio-scientific issue. The table II showing chemistry content analysis of class X science textbook is given below:

Table II: Chapter wise chemistry content analysis of class X science textbook

Chapter. No	Chapter Name	Concepts Discussed with Scientific Understanding	Socio-scientific issues discussed/not discussed
1	Chemical Reactions and Equations	Chemical Reactions and Equations , balancing of equation and writing the standard form of chemical equation for a chemical reaction, types of reaction: exothermic, endothermic Combination, decomposition, displacement, double displacement &oxidation reactions and some effects of oxidation reaction	Issues related to corrosion discussed. Other issues relating exothermic reactions like combination reaction of carbon with oxygen could have been related with issues of global warming. Distinction between naturally occurring reaction and synthetic reactions could have been introduced.
2	Acids, Bases and Salts	Properties of acids and bases, Reactions of acids and bases, Neutralization reaction of acids and Bases, Formation of different types of salts, pH scale and its importance in our day-to-day life, Uses of some important salts like common salt, bleaching powder, washing soda, baking soda,& gypsum.	Daily life application related to pH is discussed Issues related to soil pollution regarding increase in acidity or basicity level of soil by use of fertilizers could been incorporated. The social issues relate to over use of bleaching powder and other bleaching agent could have been introduced
3	Metals and Non-metals	Physical properties of Metals and non-metals, Chemical properties of metals i.e. reaction of metals with water, oxygen, acids, non-metals, Formation of ionic compounds and protection of metals from corrosion by painting, galvanising,	Not overtly mentioned Issues related to heavy metals and its pollution. Issues related to electrolysis and electroplating waste could have been included. Also, mining issues could

		chrome plating, anodising or making alloy. Metallurgical processes like oxidation, reduction, electrolytic reduction and electrolytic refining.	have been discussed.
4	Carbon and its Compounds	Nature of carbon , bonding in carbon that is the covalent bonds present, properties of covalent bond , allotropes of carbon, saturated and unsaturated carbon compounds, hydrocarbons and their types, homologous serious, nomenclature , chemical properties of carbon compounds, Properties of some important carbon compounds that is ethanol and ethanoic acids, soaps and detergents.	In addition reactions few issues related to saturated fatty acid said to be harmful for health discussed. And health issues related to consumption of alcohol is also discussed. Aromatic and carcinogenic character of benzene and global warming issues related to combustion reaction with emphasis on carbon credits could have been discussed
5	Periodic Classification of Elements	Classification of elements by different scientists, Mendeleev's work in development of a Periodic Table and its advantages and disadvantages ,Modern periodic table and trends in Modern periodic table.	Not overtly mentioned Issues related to some metals and non-metals and scientific wars related to discovery of an element could have been discussed

CONCLUSION AND DISCUSSION

As evident from in the content analysis of class ninth chemistry chapters in science textbook, the following socio-scientific issues could have in incorporated:

In chapter 1, Matter in our surroundings, the issues related to global warming could have been taken with gaseous state and waste dumping could have been related with characteristic of solid state as it takes more of space like electronic waste.

In chapter 2, 'Is matter around us pure?' Issues like smog could have been related with colloids like aerosols and further with ozone depletion. Further food adulteration could have been taken up with concept of mixtures and separation techniques.

In chapter 3, Atoms and Molecules, The concept of atom& molecules is introduced for the first time in class IX, hence, only scientific understanding is given. Although in later part of chapter the concept of atomic mass could have been linked with some of the heavy elements which are not good for human health. With mole concept and concentration term, the pollution level issues could have been incorporated.

In chapter4, Structure of atom, the issues related to nuclear energy could have been incorporated in concept dealing with sub-atomic particles.

As evident from table II in the content analysis of chemistry chapters of class X science textbook, the following socio-scientific issues could have in incorporated:

In chapter 1, Chemical Reactions and Equations, issues related to corrosion and rancidity due to oxidation reaction discussed. The phenomenon of corrosion leads to damage of various structures that are made of metals, especially those of iron like car bodies, bridges, iron railings, ships and other such objects. Corrosion of iron is one of the major serious problems as an enormous amount of money is spent each year to maintain the structures like bridges etc by replacing the damaged iron from them and other issues relating exothermic reactions like combination reaction of carbon with oxygen could have been related with issues of global warming. Also, a distinction between naturally occurring reaction and synthetic reactions could have been introduced.

In Chapter 2, Acids, Bases and Salts, some of daily life application related to pH is discussed but issues related to soil pollution regarding increase in acidity or basicity level of soil by use of could been incorporated in the topic of pH. Moreover, while discussing bleaching powder the social issues relate to over use of bleaching powder and other bleaching agent could have been introduced.

In Chapter 3, Metals and Non-metals, issues related to heavy metals and its pollution could have been incorporated .Moreover the issues related to electrolysis and electroplating waste could have been included. Also, mining issues could have been discussed

In Chapter 4, Carbon and its Compounds, regarding addition reactions few issues discussed e.g. animal fats generally made up of saturated fatty acids which are said to be unsafe for health. Hence, oils having unsaturated fatty acids should be a choice for cooking purposes. And health issues related to consumption of alcohol is also discussed but aromatic and carcinogenic character of benzene could have been discussed and global warming issues related to combustion reaction could been discussed with emphasis on carbon credits.

In Chapter 5, Periodic classification of elements, regarding trends in periodic table issues related to some metals and non-metals and scientific wars related to discovery of an element could have been discussed.

Further, from the review of the NCERT science textbooks, it is quite evident that the vision of NCF 2005 related to linking science concepts with wider context of the learner's environment, enabling him/her to appreciate the issues at the interface of science, technology and society, has not been addressed adequately in the textbooks. Despite of the guidelines related to environment validity and ethical validity in NCF 2005, certain kinds of fixes continue to be rooted in the textbooks. Hence, it requires a critical analysis of the parameters that guides the selection and build-up of the content for transaction of knowledge and the role of school curriculum in striving towards amalgamation of socio-scientific issues with concepts of Chemistry as a part of Science curriculum. Moreover, the advances in scientific thinking and reasoning requires freedom and ability to analyse the components of the socio-economic-environmental and the cultural domains, which are an integral part of social sphere. For realizing this, science textbooks will have to fill in the gaps by carefully assessing and administering the ideas in view of the existent situation.

REFERENCES

1. NCERT. (2005). National Curriculum Framework (NCF). NCERT: New Delhi
2. Klees, S.J. 1986. Planning and Policy Analysis in Education: what can Economists tell us? Comparative Education Review, pp. 574-607.
3. Yechuri, Sitaram. 1986. Educational Development in India. Social Scientist. No. 153154,Vol.14, No.2 & 3.
4. Singh, Y.K. 2005. History of Indian Education System. PHI.
5. Ranganathan, S. 2007. Educational Reform and Planning Challenge. Kanishka Publishers.New Delhi.
6. Singh, V.N. 2005. Education in India: From Earlier Times to Today. Vista International Publishing House. New Delhi.
7. William W. Cobern ,(1998),"Science and a Social Constructivist View of Science Education", Socio-Cultural Perspectives on Science Education,Science & Technology Education Library ,Volume 4, , pp 7-23
8. Taber, K. S. (2012). "Chemistry in the secondary curriculum." In K. S. Taber (Ed.), Teaching Secondary Chemistry (2nd ed., pp. 369-378). London: Hodder Education.
9. Sadler, T. D. (2009). "Situated learning in science education: Socio-scientific issues as contexts for practice". Studies in Science Education, 45, 1-42.
10. Margareta Ekborg, Malin Ideland, Claes Malmberg , (2009) "Science for life – a conceptual framework for construction and analysis of socio-scientific cases" ,Nordina, Nordic study in science education, Vol 5, No 1
11. Dana L. Zeidler, Troy D. Sadler Michael L. Simmons, Elaine v. Howes (2005) "Beyond STS: A Research-Based Framework for Socioscientific Issues Education",Wiley InterScience
12. Science textbook for Class IX, NCERT,2006
13. Science textbook for Class X, NCERT,2006