Semester II

Unit I

Topic - Curriculum Reforms in Science Education

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Recent Trend in Science Curriculum

Today science is taught as 'integrated science' in secondary classes while at senior secondary level learners study science as disciplines such as physics, chemistry and biology. The syllabus at secondary level focus on themes like Food materials, The world of living , Moving Things, People and Ideas and Natural resources, etc. But disciplinary approach is followed at senior secondary classes. As we know, a variety of changes has been brought in school curriculum from time to time as result of various education policies and curricular frame works such as National Education Policy (1975), National Curriculum Framework (1975), National Policy on Education (1986), National Curriculum Framework (1988), and National Curriculum Framework (2000 and 2005). The NCF of 1975 recommended 10+2 pattern of school education with general education of 10 years; science as a core subject as activity based integrated subject till class X. The National Curriculum for Elementary and Secondary Education (NCESE) of 1988 also suggested general science as a core subject up to class X. The curriculum should be 'learner centred' aiming to develop abilities in cognitive, affective and psychomotor domain of the learners. The learning of science at secondary stage should help learners to develop the skills of problem solving and decision making along with comprehension of key concepts across various disciplines. The National Curriculum Framework for school Education (NCFSE), 2000 recommended teaching of science and technology in classes VI to X as single disciplines and disciplinary approach in

senior secondary level. NCFSE also suggested to include 'technology; in science courses as technology has influence on life in varied ways. The committee constituted to outline National Curriculum Framework-2005 remarks on science education "looking at the complex scenario of education in India, three issues stand out unmistakably. First, science education is still far from achieving the goal of equity enshrined in our constitution. Second, science education in India, even at its best, develops competence but does not encourage inventiveness and creativity. Third, the overpowering examination system is basic to most, if not all, the fundamental problems of science education in India". The committee recommended various suggestions on science curriculum, pedagogy, content, examination, teacher training processes, etc. NCF-2005 reinstates the recommendations of NPE 1986; curriculum should have a common core and other components that are flexible.

The following are the recommendations related to science education outlined in the NCF-2005.

Understanding Science Constructivist Approach of Learning: The NCF-2005 places learners at the centre of teaching – learning process. NCF remarks, the knowledge construction is an evolving process and learners constantly develop knowledge by actively participating and utilizing his/her previous experiences. The active participation of the learners in the teaching-learning process is a prerequisite for the construction of knowledge. Thus the 'constructivist approach' of learning is emphasised by NCF-2005.

Learner Centred Syllabus:

The information load in syllabus is reduced by considering the report 'Learning without Burden' and thus age appropriate concepts are included in the syllabus. 'Learner Centred' syllabus has been recommended that would enable learners to develop problem solving skills, curiosity, inquisitiveness, etc. Food and Nutrition, Health, Population, Agriculture, Environmental Protection forms the essential components of syllabus. The Learner is expected to develop skills in process of science rather than acquaintance with content of science.

Pedagogical Shift:

Pedagogy deals with strategies and practices concerning organisation of teaching learning activities in a classroom. The NCF-2005 has recommended extensive changes in various pedagogical aspects. Acquisition of knowledge by the learners is replaced with the approach of construction of knowledge by the learners themselves. While planning teaching-learning activities, the teacher has to consider the existing ideas of the leaner and must facilitate, guide and support learners to construct new knowledge. In such classrooms, learners are the key players and such pedagogy is called 'learner centred pedagogy'. Learner centred pedagogy is recommended by NCF-2005. Thus the teaching centred classrooms have been shifted to learner centred classrooms.

Assessment Mechanisms:

The assessment of learners should include multiple assessment strategies like assessing learning activities, experiments, portfolios, presentations, project work, assignments, self-evaluation etc. The understanding and application level of learners must be assessed in place of testing the rote memorisation capabilities. The examination stress is reduced by implementing continuous and comprehensive examination (CCE). Continuous refer to assessment of learners throughout the academic year and comprehensive means assessment of overall aspects of learners including curricular, co-curricular and personality attributes.

Critical Pedagogy:

NCF -2005 recommends sense of democracy in science learning through the critical pedagogy approach. Critical pedagogy is a learner centred pedagogy that considers the experience and perception of learners in the teaching-learning process thereby making learning fear free and independent for the learner. As we know, learners were considered empty slates to which the teacher was pouring factual information. But today, the knowledge given by the teacher is critically analysed and learners construct their own knowledge. Teacher has to motivate and facilitate learners to construct knowledge in a democratic way.

Scientific Method and Scientific Inquiry:

The learners must be engaged in challenging situations so as to develop the skill of inquiry and to arrive at reasonable answers employing scientific method. As learners explore

answers to problems, skills like observation, hypothesising, data collection, etc. are developed Science in School Curriculum among them. Also the experience with problem solving situations helps learners to explore the world around them. Thus NCF-2005 advocates experiential learning in science classrooms.

Diversity, Inclusion and Planning Teaching Learning Activities:

The classroom normally consists of learners having multiple skills, intelligence levels and learning styles. Also there are learners from different castes, religion, backward classes; learners with learning disabilities and learners who need special assistance. Since the classroom being diverse in nature, the teacher must plan teaching learning activities that suits the individual needs of the learners and promote meaningful learning of science.

Use of Textbooks and Learning Materials:

Textbooks function as an important resource for knowledge construction. Textbooks should not be loaded with factual information's rather should provide learners challenging situations to actively engage in learning processes and construction of knowledge. So textbooks and other learning materials should be used.

Different Approaches and Strategies of Learning:

The NCF-2005 recommends different approaches and strategies for transaction of the curricular content to learners. The approach and strategies includes constructivist

approach, learning model, collaborative learning approach, problem solving approach, concept mapping, experiential learning, inquiry approach, cognitive conflict, analogy strategy, etc.

Use of Information and Communication Technology:

Extensive use of various ICT resources and e-learning applications are advocated as a supplement of teaching-learning processes.

A brief discussion of curriculum at various stages

Primary Stage (Classes I to V):

The curriculum of science at primary stage should focus on the following aspects:

- To develop cognitive and psychomotor skills by engaging and exploring nature, natural phenomena, hands-own activities, etc. This promotes the curiosity among learners as they slot in observation, classification, drawing inference, judging situation, estimation and measurements
- To help learners to internalise human values, cleanliness, honesty, cooperation, truth, hygiene, social interaction, concern for life and environment, etc. Group activities, situations to engage in activities

outside classroom, opportunity to interact with nature, plays, etc. is to be promoted.

- Primary stage emphasises language skills (3RC's- Reading, Writing, Speaking) through science learning, as one of the ways. Care should be taken to transact teaching content in local language/mother tongue. The teaching learning process must be unstructured giving freedom to teacher to organise learning activities and accomplishment of overall objectives at primary stage.
- The practice of teaching science as "Environmental Studies" is to be continued but health education should find a prominent space. The criteria for selection of content should be meaningful, relevant and according to the interest of the learners.
- Even though teaching learning is unstructured, from class III onwards, a structured way is advocated and assessment should be continuous. Up to class II, formal assessment practice is not to be practiced. Formal periodic tests, judging based on grades are to be avoided and no pass or fail system is to be followed at the primary stage .

Upper Primary Stage (Classes V to VIII):

The curriculum of science at upper primary stage should focus on the following aspects:

- Learners have opportunity to explore various elements of science and starts making sense of science in daily experiences and thus science education transit from

environmental studies to elements of science and technology at the upper primary stage. Learners recognize science concepts through hands-own activities and experiments, even then not necessary to strictly follow the inductive approach of inquiry.

- The integrated approach of teaching is followed emphasising teaching science as a single subject. Emphasise teaching biographies of scientists and inventors to inspire learners and implement experiences to acquire Science in School Curriculum different process skills. Apart from textbook knowledge, create opportunities to explore, discuss, and debate environmental issues, problems of health, drug related matters, etc.
- The problems that learners sense meaningful and significant (arrived through discussions in the classrooms in the presence of teacher, communication with elders, from newspapers, etc.) must be tested and experimented apart from simple experiments and hands-own activities.
- The practice of pass and fail and no detention policy to be avoided but steps may be implemented to organise periodic assessment of learners through unit tests, term tests, etc. The weightage on annual examination should be reduced and external examination must be discarded.
- The in-service teachers should prepare question papers that assess learners' problem solving skills, data analysing skills, application of learned knowledge in

various situations, solving numerical problems, etc. The tests should have both written and experimental components and open book examination may be promoted to think beyond mere recalling conceptual knowledge.

Secondary Stage (Classes IX and X):

The curriculum of science at secondary stage should focus on the following aspects:

- Disciplinary approach(such as physics, chemistry and biology) is to be followed at secondary stage. In addition to learning definitions of science, teaching is bestowed with focus on comprehension and attainment of higher skills.
- Together with recognising theoretical knowledge, occasions are to be organised to experiment the same and project methods also may be emphasised. The curriculum should not be overloaded with teaching contents.
- The participation of learners in co-curricular activities is promoted by involving them in projects concerning local issues, environmental concerns, etc.
- The board examination should include questions that test the experimental knowledge and skills of learners.

Higher Secondary Stage (Classes XI to XII):

The curriculum of science at higher secondary stage should focus on the following aspects:

- The option of either academic or vocational streams recommended by the NPE, 1986 may be reviewed to give chance to learners to select subjects of their interest and choice.
- The disciplinary approach of teaching may be followed with syllabus having gradual and steady flow of contents from that of secondary stage emphasising experiments, investigatory projects and technology. Nevertheless the syllabus should not be overloaded.
- The contents should be selected keeping in view the competence of learners, depth of the content, delimitations, etc. But core areas must be included. The contents must be systematically organised. 78 Understanding Science
- The theoretical aspects of syllabus should emphasize conceptual understanding, problem solving skills, and critical enquiry. Opportunities must be provided to test the theories with scope to interpret, hypothesise and develop results.
- To develop awareness and impact of environmental concerns, microchemistry as a means for experimentation may be thought of as a branch of chemistry and biology. Similarly use of micro chemical techniques may be promoted.
- Learners may be encouraged to participate in co-curricular activities such as debates, discussions, mathematics and science Olympiads, informal project works, etc. But it should not be considered for formal assessment.

- Periodic assessment in curricular activities must be practiced to reduce the stress of annual examinations. The tests should contain questions to check experimental/technology skills of the learners. ICT must be widely used in whatever possible means to arouse enthusiasm and interest of learners