

D.Ed Curriculum Review -2012
Department of State Education Research and Training
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Position Paper on Teaching & Learning Science

TITLE: “ELEMENTARY SCIENCE TEACHER EDUCATION”

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EXECUTIVE SUMMARY

Finding and exploring the truth is the aim of science. It is natural that every human being learns through enquiry, exploration and confirmation. School works as a catalyst in bringing this learning. But schools or classroom process are simulated situations for learning. There lies the point of making learning as much as natural. Child learns science through exploring in a natural environment at very young age. But in the higher primary level, the child needs to be exposed for construction and reconstruction of knowledge. Naturally the teacher trainee must have content, pedagogy and skill aspects for facilitating the learner for one's own construction and reconstruction of knowledge.

Science education at the D.Ed level should focus on:

Preparation in science (Pedagogical content knowledge)

Science is for all students

Preparation to teach (reflective practices)

Specific Recommendations for teaching science in the D.Ed course

1. Joyful learning should be given importance.
2. Exploration of the immediate environment through the use of sensory organs must be given importance.
3. Skills such as observation, classification, raising inquiry question, discrimination, measurements, and such skills as related to concrete operational development are to be given prominence.
4. A constructivist approach to the teaching- learning of science is needed.
5. The activities in classroom and in the environment under Nature can take the dominant place in the development of learning experiences.

6. Pedagogical content knowledge approaches take the front seat. Guided inquiry activities enter the field of learning.
7. Importance is to be given for involving community knowledge and resources.
8. Inter dependence in environment is to be given importance as a learning outcome.
9. Student teachers are to be trained in using technology in the science classroom

To conclude:

Perceive children not as passive receivers of knowledge, augment their natural propensity to construct meaning, discourage rote learning, make critically examine curriculum and textbooks, contextualize curriculum to suit local needs.

Organize learner-centered, activity-based, participatory learning experiences through, play, projects, discussions, dialogues, observations, visits and learning to reflect on their own practices.

Integrate academic learning with social and personal realities of learners, responding to diversities in the classroom.

Promote values of peace, democratic way of life, equality, justice, liberty, fraternity, secularism and zeal for social reconstruction.

This can only be achieved if teacher education curriculum provides appropriate and critical opportunities for student teachers to observe and engage with children, communicate with and relate to children.

Understand the self and others, one's beliefs, assumptions, emotions and aspirations; develop the capacity for self-analysis, self-evaluation, adaptability, flexibility, creativity and innovation.

Develop habits and the capacity for self-directed learning, have time to think, reflect, assimilate and articulate new ideas; be self-critical and to work collaboratively in groups.

Engage with subject content, examine disciplinary knowledge and social realities, relate subject matter with the social milieu of learners and develop critical thinking.

Develop professional skills in pedagogy, observation, documentation, analysis and interpretation, drama, craft, story-telling and reflective inquiry.

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Introduction:

It is often claimed that “experience is the best teacher.” While this is arguably true in many contexts, what we learn from our experience varies considerably in terms of its generality and usefulness. With respect to science, everyday experiences often reinforce the very conceptions of phenomena that scientists have shown to be limited or false, and everyday modes of reasoning are often contrary to scientific reasoning. Students bring conceptions of everyday phenomena to the classroom that is quite sensible, but scientifically limited or incorrect.

The laws of science are never viewed as fixed truths. Even the most established and universal laws of science are always regarded as provisional, subject to modification in the light of new observations, experiments and analyses.

People today are faced with an increasingly fast-changing world where the most important skills are flexibility, innovation and creativity. These different imperatives have to be kept in mind shaping science education

Good science education is true to the child, true to life and true to science.

(Position Paper science education 1.1 NCERT)

Finding and exploring the truth is the aim of science. It is natural that every human being learns through enquiry, exploration and confirmation. School works as a catalyst in bringing this learning. But schools or classroom process are simulated situations for learning. There lies the point of making learning as much as natural. Child learns science through exploring in a natural environment at very young age. But in the higher primary level, the child needs to be exposed for construction and reconstruction of knowledge. Naturally the teacher trainee must have content, pedagogy and skill aspects for facilitating the learner for one’s own construction and reconstruction of knowledge.

Science curriculum varies as the child enters from one stage of development to another stage. At the primary stage the child is involved in joyful exploration of environment around. This is because at that stage the child has the curiosity about the environment, materials, and pupil around. Therefore the curricular activities involve exploration and hands on activities. This enables the child to acquire cognitive skills.

At the upper primary stage the child is engaged in the development of concepts and principles of science. Students at this stage will have entered the socialization stage and are interested in learning with the peers. Thus the transaction of curriculum is through group activities and discussions even though each child develops his/her own strategy to acquire knowledge.

All the knowledge about the subject is not necessary in order to teach the subject. Teachers do not have to know a lot about science because science is not comprehensive. A teacher needs to know the topic to be able to teach it. For a teacher a basic knowledge of his teaching and willingness to learn along with the kids is important. Teacher should know enough to create an enquiring mindset among children.

School Science education should have the following criteria of validity in its curriculum i.e., science curriculum should possess cognitive validity, content validity, process validity, historical validity, environment validity and ethical validity. That means validity should be given utmost importance in drawing science curriculum under science education.

Thus at the D.Ed level, science curriculum should focus on:

- **Preparation in science (Pedagogical Content Knowledge) (PCK):** The science content knowledge of prospective elementary school teachers needs to be strengthened. Although knowing science content is a necessary condition for

effective instruction, it is not sufficient. Teachers must also know how to facilitate science learning in their students. In other words, they must also have science pedagogical content knowledge.

- **Science is for all students:** This principle is one of equity and excellence. Science in our schools must be for all students: all students, regardless of age, sex, cultural or ethnic background, disabilities, aspirations, or interest and motivation in science, should have the opportunity to attain high levels of scientific literacy.
- **Preparation to facilitate learning (reflective):** Teachers need to be more reflective about their work. Prospective teachers must learn to engage with the theories of learning, content and processes of science with their own experiences of learning and engaging with children. Time and space must be given to student teachers to reflect constantly on learning to create appropriate learning experiences based on requirement.
- **Aims of science :** The aim of this course is to challenge students' misconceptions related to concepts in science and help them advance towards a better understanding. Students should be encouraged to grapple with the nature of science and relate it with inquiry in this area. They will need a non-threatening space to freely express their ideas about various aspects of the nature of science and reflect on classroom practices based on this understanding. Students should be able to critically reflect on issues of gender and inclusive space in science education.

Enumeration of specific concerns/Objectives:

Knowledge is power. Science develops true knowledge. Over the years, Science has developed an approach of pursuing knowledge. Thus, learning the science implies an understanding of this approach. For almost a century now, science has been considered the most reliable and powerful knowledge system. Development of this system of knowledge is to be given importance in science educational process. The role of teachers and hence teacher educators who are responsible for grooming prospective teachers should be to provide experience in the enterprise of science.

This implies developing the knowledge of science concepts, science process skills, an awareness of the impact of science and technology in society and an understanding of the nature of science.

The basis for the development of conceptual knowledge and the process involved should consider the intellectual level of the child. The student teacher should be empowered to select the knowledge of science appropriate to the intellectual level of the child. Learning science is the right of every child.

The broad objectives of teaching science at the D.Ed level would therefore be to develop among student teachers:

1. a pedagogical content knowledge of science
2. an understanding of children and how children learn science
3. a perspective of science as an inclusive and democratic enterprise

Concerns of NCF 2005, NCFTE-2009, and RTE Act

According to NCF 2005 science education in India has three critical issues.

- Science education is still far from achieving the goal of equity enshrined in our constitution
- Science education in India even at its best develops competence but does not encourage inventiveness and creativity
- The over powering examination system is basic to most, if not all, of the fundamental problems of science education in India

The National Curriculum Framework for Teacher Education 2009 (NCFTE) aims at “improving the quality of teacher education by addressing the prevalent concerns as they exist today, bring in key changes, so as to reorient teaching that emphasizes activities, discovery and exploration of environment and surroundings”.

The implication of RTE Act on science education is that schooling is a legal right of every child and science being a compulsory subject in school, access to quality science education is every child’s right.

Significance of science in classroom process

Aims of Science Education as enumerated by the National Focus group on Teaching of science (NCERT, 2006), should be to enable the learner to:

- know the facts and principles of science and its applications, consistent with the stage of cognitive development
- acquire the skills and understand the methods and processes that lead to generation and validation of scientific knowledge
- develop a historical and developmental perspective of science and to enable to view science as a social enterprise

- relate the environment (natural environment, artifacts and people), local as well as global, and appreciate the issues at the interface of science, technology and society
- acquire the requisite theoretical knowledge and practical technological skills to enter the world of work
- nurture the natural curiosity, aesthetic sense and creativity in science and technology
- imbibe the values of honesty, integrity, cooperation, concern for life and preservation of environment
- cultivate ‘scientific temper’, objectivity, critical thinking and freedom from fear and prejudice

Lower Primary Stage

Joyful learning and exploration of environment would be the focus of science learning at this stage. The curiosity of the child about the world (like natural environment, pupil and objects around) is aroused. Therefore the curricular activities should contain exploratory engagement of the child and hands on activities involving the following:

- a) Observation
- b) Classification- differentiation
- c) Hypothesising
- d) Inferring
- e) Illustrating
- f) Estimation and measurement

This stage should also emphasize development of appropriate language for simple communication. The subject matter of science selected should be relevant and meaningful to the stage of development of the child.

Higher Primary Stage

At this stage science education should provide a gradual transition from environmental studies to the study of basic science, its method and application of technology.

This implies:

- i) Science concepts have to be developed through activities. Experimental nature of science can help in this direction.
- ii) Science education need not be rigid but can be based on inquiry and investigation to satisfy the inquiry nature of the child.
- iii) Designing and fabrication of simple models and practical knowledge about very simple mechanical devices can be the technology component of the science curriculum.
- iv) Involving children in investigatory projects to get a deep understanding about the interdependence of the ecological components, (NCERT, 2006) is necessary.

Critiquing the existing system

- 1) Presently, science is taught through lecture and formal demonstration method in schools and D.Ed colleges
- 2) Elementary teacher education science curriculum does not draw illustrations from environment

- 3) Present science education gives more importance to learning from books than knowledge generation.
- 4) Science content is learnt in a ritualistic way. Focus is not on continuous and comprehensive evaluation.
- 5) Inclusive model is not practiced.
- 6) Student-teachers are not given freedom to develop his /her own knowledge by experience.
- 7) Present science education does not give importance to the use of ICT (technology) in the science classroom

How should science education be at the elementary teacher education level?

For teaching science at the lower primary stage:

1. Joyful learning should be given importance. Learning of science must be experiential wherein the child will find joy by connecting with its life.
2. Exploration of the immediate environment through the use of sensory organs must be given importance.
3. Skills such as observation, raising inquiry questions, discrimination, classification, measurements, and such skills as related to concrete operational development are to be given prominence.
4. The activities in the classroom and in the environment can take the dominant place in the development of learning experiences.
5. Formative evaluation process will be very effective at this stage.

Science Education at higher primary stage:

1. Pedagogical content knowledge approach takes the front seat. Guided inquiry activities enter the field of learning.
2. Importance is to be given for involving community and its resources for gaining the knowledge of science.
3. Inter dependence in environment is to be given importance as a learning outcome
4. A constructivist approach to the teaching learning of science is used.
5. Student teachers are to be trained in using technology in the science classroom
6. The curriculum should include different types of assessments that assess children's conceptual understanding and acquisition of process skills. This can be in the form of continuous and comprehensive evaluation.

The objectives of teaching science at the D.Ed level would be to develop among student teachers:

1. A knowledge of Pedagogy
2. Knowledge of Science developed through method of science
3. An understanding of children and how children learn science.
4. A perspective of science as an inclusive and democratic enterprise.

These objectives should enable student-teachers to:

1. become mentally engaged in the concept, process, or skill to be learned
2. actively explore their environment or manipulate materials
3. provide opportunities to introduce formal terms, definitions, and explanations for concepts, processes, skills, or behaviors
4. develop conceptual understanding and allow them to practice skills and behaviours

5. encourage learners to assess their understanding and abilities and evaluate students' understanding of key concepts and skill development
6. engage children with various aspects of science as a process and product
7. help children understanding of scientific concepts, by consciously linking to their everyday knowledge
8. gain the ability of developing new concepts by linking with previously learned concepts
9. structure learning to make children learn science process skills
10. gain the ability to create opportunities for children to develop the requisite values, associated with scientific enterprise
11. connect school knowledge with community knowledge and life outside the school
12. reflect on the need and importance of ICT in providing learning experience in science teaching

Broad Content/methodologies proposed

The subject matter of science that helps in the development of abilities and competencies at the primary stage may be selected as content of science. Physics, Chemistry, Biology can integrate itself as environmental science at the lower primary and the subject of general science can become the content for higher primary.

The student teachers are to be empowered in selecting the appropriate subject of science for developing the conceptual understanding of science, process skills, values related to science among children.

Student teachers should learn the strategies of presenting the learning experience by using both individual constructivism and social constructivism.

Student teachers are to be given an understanding of pedagogical knowledge of science.

The required and relevant theories of psychology of learning and principles of sociology and anthropology of education are to be taught at this level.

Principles of andragogy and guided inquiry methods would be most suitable for the teaching of science at the D.Ed level.

Precautions/dos and don'ts

1. Unnecessary subject matter should be removed
2. Only relevant concepts along with the pedagogic principles in terms of specific theories related to the practice are to be prescribed in the curriculum.
3. Long drawn memory based tests and examinations should be replaced by continuous, comprehensive evaluation

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