The Secondary School Biological Science Curriculum of Odisha
A Critical Study

GITANJALI MOHANTY*

Abstract

The study spreading over 31 secondary schools, and involving 31 biological science teachers, 143 students (60 boys and 83 girls) and 10 experts and educationists, is an attempt to discover and reflect facts about the biological science curriculum at the secondary level in the State of Odisha and improve the effectiveness. The study revealed many shortfalls like absence of laboratory in almost all the schools, textbooks with many deficiencies, want of appropriate and adequate teaching aids, non-performance of co-scholastic activities, absence of access to community resources, lack of initiative to visit places of biological and scientific importance in order to connect knowledge to life outside the school and to make learning more practical rather than textbook-centric. The educationists interviewed voiced concern regarding the existing process of evaluation needs improvement as felt by eminent educationists. The curriculum transactions in the schools did not indicate the input of the intended curriculum to be operationalised in real sense of the term. The operational aspect of curriculum needs be emphasized in its right perspective so as to provide benefit to learners.

Rationale

Effective science education is the need of the day. Human thirst to acquire more knowledge for better life has been encouraging research in various branches of science and the results, discoveries and inventions in the twentieth century have been eye-openers for the humanity. Science, particularly biological science, assumes the high importance.

In India, there have been persistent efforts in this direction from the later part of the twentieth century. Beginning

* *Assistant Professor* in Education, Regional Institute of Education, Bhubaneswar-751022

from the Kothari Commission 1964-66, every effort has been taken to develop and upgrade science curricula. In the National Policy on Education (NPE) 1986, the *National Curriculum Framework (NCF)* for school Education-2000 and the *NCF-2005* all have emphasised the need to promote science education.

Biological science at the secondary school level occupies a significant place along with physical science. It requires a differential treatment so as to create genuine curiosity in learners towards the living world. Research findings show that the secondary schools in Odisha do not possess adequate provisions for effective transaction of biological science curriculum.

Effective transaction of biological science curriculum bears a great relevance at the present juncture. The curricular issues require a fresh look to help the students to cope up with the challenges arising out of biological science so as to make them fit for higher studies in the field. The present study intends to explore the provisions in an insight biological science curriculum for the high schools affiliated to the Board of Secondary Education, Odisha.

Objectives of the Study

The objectives of study were to

1. study the objectives of biological science curriculum at secondary level;
2. analyse the intended biological science curriculum on the basis of the syllabus prescribed for H.S.C. Examination by of Board of Secondary Education (Odisha);
3. find out the deficiencies of incorporated biological science concepts in the textbooks prescribed by Board of Secondary Education, Orissa; and
4. examine the operational biological science curriculum of Board of Secondary Education, Odisha, with reference to
   - teacher and their qualifications
   - laboratory and other facilities
   - biological science-related concepts
   - methods adopted for teaching biological science
   - co-scholastic activities related to biological science
   - performance of students.

Delimitations of the Study

- The study was conducted only in Odia medium schools affiliated to Board of Secondary Education, Odisha.
- The study was limited to biological science courses' study of Classes IX and X prescribed by Board of Secondary Education, Orissa for High School Certificate Examination.
- The study was limited to the district of Khordha only which is considered as one of the most educationally advanced district in the state of Odisha.

Plan and Procedure of the Study

Sample

The data were collected on the basis of the technique of stratified random sampling. The sample for the study was drawn from secondary schools of Odisha, based on the level of achievement

in the annual High School Certificate Examination, conducted by the Board of Secondary Education, Odisha. Eleven high level schools (securing more than 80 per cent result), ten average level schools (having 40-60 per cent result) and ten low level schools (with result below 30 per cent) were selected. The sample consisted of both Government and Private Schools, was drawn from both urban and rural areas and included boys, girls and co-educational schools.

Tool

An inquiry form for heads of the sample schools, and a questionnaire were used as a tool for collecting both qualitative and quantitative information from biological science teachers. In addition, an opinionnaire for the experts, interview schedule for the students and an observation schedule for classroom transaction were developed for eliciting data.

Administration of Tools

The biological science teachers were contacted personally to obtain first-hand information through questionnaire. Observation of bio-science-related activities were done in the sample schools by using the observation schedule. The students were interviewed and their responses noted. The experts were requested to note their considered views in the questionnaire.

Organisation of Workshop

A workshop was conducted by including ten curricular experts and biological science teachers. The participants discussed the issues after being divided into four groups and assigned to make group discussion on the topics as follows:

Group 1: Compared the objectives of biological science curriculum for secondary schools prescribed by the Board of Secondary Education, Odisha with that prescribed by the Central Board of Secondary Education, New Delhi

Group 2: Analysed the content of the syllabus and the textbooks prescribed by Board of Secondary Education, Odisha.

Group 3: Difficulties of biological science concepts provided in the textbook prescribed by Board of Secondary Education, Odisha.

Group 4: Comparative analysis of question papers developed by Board of Secondary Education, Odisha and Central Board of Secondary Education, New Delhi.

After the analysis was done, the focus group discussion was held and inferences were drawn.

Major Findings

Objectives of the Curriculum

The nine objectives of the curriculum laid down by Board of Secondary Education, Odisha were appropriate.

Syllabus

- There is provision for practical/ project work in Class IX in Science, but there is no specification of activities/ experiments.
- There is provision of internal evaluation in Class IX, but no specific direction has been provided due to which evaluation is done in an unsystematic way.

- There is no provision for practical/ project work in Class X in Science.

Teacher

- The study revealed untrained biological science teachers in the sample schools.
- Majority of teachers had not got an opportunity to participate in in-service training. Only 48.38 per cent sample teachers attended seminars, 29 per cent refresher course, 32.25 per cent attended a workshop, 6.45 per cent conferences, 12.9 per cent lecture programmes and 3.22 per cent summer institutes.

Textbooks

- Eighty per cent of the sample teachers used textbooks on different occasions like reference, classroom preparation, discussion of exercises and asking questions in class, preparation of text items, etc.
- Seventy-seven per cent of the sample teachers felt the textbook is adequate in translating the objectives of teaching biological science. They felt that the topics and sub topics are arranged logically.
- Eighty-seven per cent of the teachers perceived that language of the textbook is appropriate in regard its correctness (Spelling, grammar, sentence structure).
- There was proper and sequential internal arrangement of sub-topics within a topic.
- The significant information was given in the boxes so as to draw the attention of the students.
- All sample teachers viewed that there was no gender bias in illustrating the examples and all the examples in the text were relevant to the text.
- There were varieties in the items given in the exercises.
- Ninety per cent of the sample teachers felt that the exercises catered to the need of most of the learners in the class.
- The life sketches of biologists like Mendel, Darwin, Linneous, Pranakrusna Parija, Comillo Golgi, Heekel and others need to find place in the textbooks.
- Thirty-eight per cent students felt difficulty in understanding the language of the textbooks.
- The topics in the textbooks need to be presented in a simpler way with the help of activities.
- Majority (80 per cent) students felt difficulty in understanding the chapter *Diversity in the Living World* in Class IX and 68 per cent of the students felt difficulty in understanding the chapter "*Heredity"* in Class X.
- The illustrations were not accurate and led to create confusion among the students to understand the relevant concepts.
- The pictures in the textbooks were not coloured and clear for better conceptual clarity.
- The textbooks were deficient in glossary of technical terms, list of practical activities and indices.

Infrastructural Facilities

- Majority (81 per cent) of the sample schools were running without a science laboratory even with out science store.

- Teaching aids though available were not adequate.
- Sixty-five per cent sample schools had botanical garden in name sake.
- None of the sample schools had biological science museum.

Curriculum Transaction

- Majority of teachers used coloured chalk, chart, map and model while teaching biological science.
- The sophisticated teaching aids like TV, slides, films and projector etc. were not available during curriculum transaction.
- The teachers encouraged the students to collect specimens for teaching.
- The teachers used to assign project work to the students.
- Improvisation of apparatus was very good (72.72 per cent) in high level schools but was poor in average and low level schools.
- Among community resources garden, river, ponds were utilised the most but factory, water supply centre, hills etc were used in negligible percentage and teachers had not shown any interest for utilisation of community resources even if it was available to make the learning more meaningful.
- Observation, discussion, demonstration, activity, project, Inductive-deductive, inquiry and problem-solving methods need to be used for better conceptual clarity in learners.
- Sixty-five per cent sample teachers expressed that they used discussion method most of the times and other methods were used at times. Sixty-three per cent sample teachers used lecture method and 36.84 per cent discussion method as observed in bioscience classes.
- Though there was pupils' participation during teaching learning process in 68.42 per cent sample schools, it was adequate only in 36.84 per cent schools.
- The skill of questioning was found to be used in 73.68 per cent schools, but it was adequate only in 36.84 per cent schools.
- The skill of explaining was done by 57.89 per cent sample teachers relevantly but it was adequate only in 42.11 per cent cases.

Co-scholastic Activities

- Fifty-eight per cent sample teachers used to arrange field visit.
- Almost 58 per cent of schools had organised science exhibition, 66 percent sample students participated in the science exhibition organised by other schools.
- Only 19.35 per cent schools had science club for the name sake. The clubs were mostly disorganised.
- Publication of biological science magazine was done in only 10.33 per cent schools and extension lecture programmes were organised with low frequency in 22.58 per cent sample schools.
- Few teachers (42 per cent) expressed their inability to arrange field visit.

Evaluation

- The teachers used to diagnose learning defects and take remedial measure by arranging coaching

classes, special classes and making the lesson interesting.
- Home assignment was given and checked regularly in most of the schools.
- There is no scope for evaluating psychomotor skill.

Recommendations

After a detailed study of The Secondary School Biological Science Curriculum of Orissa the following measures are recommended for its improvement.

Objectives of Curriculum

- The Secondary School Biological Science curriculum of Orissa is examination oriented and mainly based on gaining knowledge and facts rather than developing scientific thinking, appreciation, Interest, problem-solving skill and experimentation. It needs to be redesigned with due weightage to all aspects including importance to practical experiences.
- The curriculum should discourage rote method and be more learning centered.
- The curriculum should be framed according to the real life experiences of the students, with alternative topics for urban and rural areas. It should deal with local population and culture, local flora and fauna, local crops, pests, local source of water, local soil and local environment at large.

Textbooks

- Review of the existing textbooks for Class IX and Class X is essential by experienced working teachers and eminent experts of biological science.
- The objectives should preface each unit in Science and Technology text-book along with a word to teacher regarding method of teaching, co-scholastic activities and practical suggestions for improvising the relevant bio-science apparatus.
- The chapters "*Diversity in Living World"* and "*Organisation of Living World",* of Class IX and "*Heredity"* and "*Reproduction*" of Class X should be made attractive and well explained by rewriting, keeping the mental level of the students in view.
- Bigger, simpler, well labeled and self explanatory multi coloured clear diagrams should be provided in the textbook.
- The textual material should possess clarity and should be organised in a systematic manner.
- A summary of the subject matter should be given at the end of each unit. Glossary of important scientific terms should be appended at the end of the book.
- The supplementary activities for the topics must be suggested at the end of the unit.
- Life sketches of Biologists like Linnaeus, Camillo, Golgi, Robert Hook, Lamark, Hill, Mendel, Darwin, Edward Jenner and their contribution should be briefly placed in the textbook to set role model in front of the learners.
- The text of the book needs to be reviewed for use of simpler and colloquial words as far as possible.
- The textbooks should be attractive with hard cover binding.

Teacher Qualification

- Keeping the present Biological Science Curriculum in view, the minimum qualification of the secondary school biological science teacher should be post graduation in Botany /Zoology / Life Science with a degree in Education.
- The existing trained graduate biological science teachers should be reoriented with a comprehensive refresher course followed by a test.
- The existing untrained Science graduate teachers should be provided in-service teacher training at the earliest. Further recruitment of untrained teacher in any sector to be banned.

Facilities

- A biological science laboratory cum bioscience room is the basic requirement of the high school. In bioscience room charts, diagrams, graphs are to be displayed. Laboratory equipments and chemicals are to be stored as per requirement. There should be an aquarium and terrarium in each school.
- Till laboratories are established in the schools, alternative arrangements like high school students doing experiments in the nearest college laboratory and interacting with college students and teachers may be explored.
- All the schools should be furnished with charts, models, microscope, projector, tape recorder, computer, films and television, etc.
- Every school must have a garden with plants, involving the bioscience syllabus. The students should be encouraged to take interest in maintenance of garden to acquire practical knowledge of plants and gardening.
- Every school should endeavour to maintain a bioscience museum displaying at least objects, specimens available in the surroundings and students should be encouraged to collect materials/ specimens of scientific interest. The community members should be associated in maintenance and growth of the museum.
- Every school must have a library with books supplementary to the textbooks with arrangement of sitting and reading by the students. Periodical magazines on biological science should be available in the library.

Techniques of Teaching

- There should be improvement in techniques of teaching over and above the conventional method of classroom lecture. The process of teaching should be developed to suit the modern curriculum. Experimentation, demonstration, project work, field visits and improvisation of apparatus should be given due weightage and adequate time schedule in the school time-table.
- The teachers should inspire and encourage the pupils to read, to listen and to speak often to attain higher levels of cognitive and affective domain objectives.

Co-scholastic Activities

- The existing arrangement of holding annual state level and circle level science exhibition/fair should be

extended to school level. There should be a science club in every school.

- Every school should organise seminar or lecture programme on Biological science by inviting eminent persons in bioscience, community doctor, agriculturalist, nurse, veterinary doctor, pharmacist, ICDS personnel, etc., at least once in three months.
- Students should be encouraged to draw diagram, write article, story and poem on biological science to be displayed on the wall magazine to develop creativity and competitive spirit.

Professional Growth

- In-service teacher training should be made mandatory and compulsory for all bioscience teachers.
- There should be a vigorous follow-up programme with a view to helping the teacher to continuously apply the new knowledge in the class room.
- In order to keep the teachers aware about new developments, concepts and problems in their areas they should be provided opportunity to attend/participate in seminar, workshop, conference, refresher course, summer institute, etc.

Evaluation

- The items for evaluation should be framed by giving equal weightage to understanding, knowledge, application and skill objectives.
- Ten per cent of total marks should be earmarked for practical aspects to be internally evaluated.
- Internal assessment to be conducted with right spirit.

Contribution to Field of Education

The findings of this study may be useful to;

- Education Department and Director, Secondary Education, Government of Odisha in the matters of provision of infrastructural facilities and augmenting in-service training of teachers.
- The Board of Secondary Education, Odisha to take care to improve the textbook and syllabus.
- TE and SCERT in matters of preparation of quality textbooks, teacher's guidebooks and augmentation of in-service teacher training.
- Supervising authorities in transaction of scholastic and co-scholastic activities.
- Headmasters/Headmistresses and teachers in all-round improvement in curriculum transaction.

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