BIOLGICAL LITERACY AND THE SENIOR SECONDARY BIOLOGY CURRICULUM: THE ROLE OF THE TEACHER

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Abstract

Scientific literacy is a phrase commonly used by educators to express a major objective of contemporary science education-science education for all. Biology in a senior secondary science subject, studied by almost all students - science and non-science irrespective of gender and social class, can translate this aim into a reality namely biological literacy. Thus biology programs have to present biological knowledge skills and values necessary for students to become effective citizens in the society. In this paper, an investigation into the meaning and indicators of biological literacy, their implication for the design of an appropriate biology curriculum, and the senior secondary biology curriculum in relation to biological literacy is made. The implications of these in relation to the role of the biology teacher in enhancing biological literacy is also discussed.

Introduction

A contemporary goal of science education is the development of scientific literacy in people. Scientific literacy requires an understanding of the nature of science, the nature and value of scientific knowledge and its limitations as well as the methods and process of scientific inquiry. Students who have done science formally at school, should be scientifically literate. They should be able to understand how scientists do science. They should be able to develop and use both the knowledge skills and products of science. Mathematics and Technology and integrate such functional knowledge and skills into their thinking, their lives and their work (BSCS, 1993). Such functional knowledge and skills should include those needed by learners to fulfill civic responsibilities improve the learners health and life style, as well as help him cope with a changing and increasingly technological world. Science education should enable the learner to become citizen that can make informed choices in personal and community issues (such as health, family life etc), based on evidence and national decisions. The scientifically literate rational citizen should also take into consideration both the long and short term effects risks and benefits of their decisions.

Banu (1992), has given more indicators of a scientifically literate person. According to him such an individual should be able to, among other things:

- recognize that scientific concepts are invented or created by acts of human intelligence and imagination and not accidentally discovered;
- realize that science is dynamic and its concepts mutable and provisional;

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understand and appreciate how scientific knowledge is acquired (i.e., the scientific process); recognize the values and limitations of science.

But from these, the scientifically literate person should be able to enjoy and use appropriately contemporary technologies.

The statement of scientific literacy is very crucial to science education. Scientific literacy implies that science progress in schools be structured in such a way as to develop functional knowledge, skills and attitudes in the students. It also implies science for all - science and non-science majors, privileged and unprivileged students. This aim of science education can be translated into reality through science programs - physics, chemistry, biology, etc. Biology is a popular core science subject taken at school secondary schools by majority of students - both science and non-science. Its attribute of having a unique aspect population places it in a central position of providing students the opportunity to acquire scientific literacy. Therefore Biology program is for all students should contribute to the achievement of Biological Literacy which is an important aspect of scientific literacy.

Biology Literacy: Meaning, Indicators

Biology literacy means understanding the nature of biology as a science subject, the nature and characteristics of biological knowledge, the way biologists as scientists do their work, the values and limitations of biology as a science as well as the inter-relationship between biology and other subjects.

The pursuit of biological literacy is a life long process and involves different knowledge domains. The American Biological Sciences Curriculum Study (ABSCS, 1993) identified a four level continuum of biological literacy with their characteristics. These levels include:

1. Nominal functional;
2. Structured functional; and
3. Multidimensional literacy levels.

Nominal Biological Literacy: Here students are able to understand terms and concepts as biological in nature.

They may have naive explanations of biological concepts as well as certain misconceptions. For example students may enter the senior secondary school with a vague idea of pollution and photosynthesis. They may know that pollution means discharge of harmful substances into the environment without knowing that:
(a) energy can be included as a pollution;
(b) these substances must be discharged in a quantity that is enough to cause harm to it to pollute the environment;
(c) pollutants reduce the quality of environment.

Nominal Literacy level may be the entry level of students registered for biology programs.

Functional Biological Literacy: At this level, students can use biological vocabulary, define terms correctly, memorize appropriate definition of the biological concepts, and yet have limited
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understanding of or personal experience with them. For example the student can now define pollution correctly and fully. This can be a result of better understanding of the term pollution (through teaching, reading) or by role memory.

3. Structural Biological Literacy: At this level, students not only understand the conceptual schemes, procedural knowledge and skills of biology, but can also explain these biological concepts in their own words. Students can do these when they are exposed to and engaged in hands-on investigative experiences.

These can generate interest, enthusiasm and excitement in students. Students can acquire not only knowledge but skills at this level. Through hands-on investigative activities, the students understand the biological concepts more fully and deeply as well as identify the relationship among biological concepts. For example students can be engaged in hands-on activities on the effects of pollutants. They can try the effects of air pollutants like sulfur dioxide, carbon dioxide, dust particles on living things. Students can find out how these pollutants affect the organisms e.g. Is it through these activities, students can understand pollution better both in breadth and depth, explain its meaning in their own words as well as see the relationship between it and disturbance in the various biological systems.

4. Multidimensional Biological Literacy: At this level, students can understand the place of biology among other disciplines, how the history and nature of biology, and understand the interactions between biology and the society. For example students can at this level carry out further investigations on pollution; find out the quantity that is harmful. They can also relate pollution to social and ethical concern. They can discuss pollution, its historical development and its effects on soil, atmosphere, water and their biodiversity etc. with their peers as well as their teacher. Students can even take projects of furthuring investigations on pollution in their various communities. They can find out their source and effects; discuss with these concerned; and write reports on what they did. They can also be interested in it as to cut out pertinent newspaper, pieces of information on pollution, and bring these to class to be discussed intelligently.

The Biological Literacy Model showing the four levels is illustrated in Figure I.

Figure I:

Students often

and often leave

FUNCTIONAL

students can do:

STRUCTURAL

students (a) develop concept and (b)

students have constant interest in a biological concept

students have common learning more about this concept

MULTIDIMENSIONAL STUDENTS (a) react; (b) obtain additional to related subject

Figure I:

The Biological Course

of these four levels

A biologically literate p

I. Understand:

- biological print.
BIOLOGICAL LITERACY MODEL (ISSCS, 1993) P. 74

Students often come to class with nominal biological literacy

and leave the class with

functional biological literacy
students can describe a concept but have a limited understanding of it.

structural biological literacy
students (a) develop personal relevance and are interested in the study of a biological concept and (b) construct appropriate meaning of the concept from experiences.

students have continued
interest in a biological concept OR
are confronted with an unresolved problem or question related to a biological concept.

students have commitment to
study more about biological concept OR
develop a plan of action to resolve the problem or to answer the question.

multidimensional biological literacy
students (a) recognize personal deficiencies in knowledge (b) obtain additional knowledge or skills, and (c) apply knowledge of a concept in related subjects and to solve a problem or answer a question.

Figure 1:

An biological course in secondary schools should aim at helping students acquire biological literacy at one four levels mentioned so as to be truly biological literate.

Biologically literate person according to ISSCS (1993:15) should:

understand:

- biological principles and major concepts of ecology.

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- the impact of humans on biosphere.
- the process of scientific inquiry.
- historical development of biological concepts.

2. Develop appropriate personal values regarding:
- scientific investigations.
- biodiversity and cultural diversity.
- the impact of biological and biotechnology on society.
- the importance of biology to the individual.

3. Be able to:
- think creatively and formulate questions about nature.
- reason logically and critically and evaluate information.
- use technologies appropriately.
- make personal and ethical decisions related to biological issues and
- apply knowledge to solve real-world problems.

These characteristics of a biologically literate individual should be achieved by biology programs. This has implications for the nature of a biology program (its objectives, content, strategies, methodologies and assessment), that can effectively achieve biology literacy in students.

Implications of the Nature and Indicators of Biological Literacy for a Biology Program

The nature of biological literacy and its indicators to be achieved have been discussed in the previous section. The design of a contemporary biology program is based on understanding the nature of the students and their interests, the differences in understanding the value of biological literacy and its limitations. Such a program must have as one of its main objectives enabling students to acquire biological literacy. The program should aim at preparing students to be active, good citizens who can interact successfully with their physical and biological world.

The context of a biology program for biological literacy should include concepts that are meaningful and relevant to students' needs and interests. Concepts related to living and nonliving, nutrition, energy, sources and transformation, ecologic, and conservation, population, environmental studies, evolution, and adaptation microbiology and health, personal and community, as well as genetics, heredity, and reproduction, are all of appropriate. To achieve an indepth study of these concepts, the unifying principles of biology which provide a framework for organizing biological content should be understood and used where possible e.g., evolution, energy. Such concepts must not only help the student understand himself, but also other living things, nonliving things, and the interrelationship. Also these concepts should be taught in contexts that have personal, social, and ethical meaning.

The biology course for biological literacy must be taught in processes that engage all student and cater for their individual differences, motivate them to investigate and acquire scientific knowledge, attitude, and critical way of thinking. This implies the use of student centered activities as opposed to teacher centered activities. These include inquiry methods, construction, and discussion strategies method.

These inquiry methods. These include formulating manageable tasks, pupils' roles, communication, reflection of the biological learning environment, and strategies that develop critical thinking and decision making on personal and social issues.

Implications of Biological Literacy

This implies the need for the traditional and non-traditional newspaper cutting and

Relevance of the New

1. Objectives

The senior secondary
Preapring the pupil
- adequate learning
- meaningfulness
- ability to apply knowledge
- reasonableness

These objectives are functional biological life problems and social acquisition of community

1. Content and Strands

The senior secondary
Achieved by Biology, contents, strategies.

Program aims section imply the facts and their whole scheme, as well as (at least) will have an end in mind aim at preparing all biological and biological students to understand, and all students in the context of secondary biology curriculum, it becomes necessary to find the extent to which curriculum can help achieve biological literacy.

Objective: Biology secondary biology curriculum has its cardinal objectives the following:

- Students understand students understand and students understand concepts should be

- Student and teacher conduct and strategies, and 3 to teacher oriented.

The objectives are positively related to biological literacy. Acquisition of meaningful, relevant and functional biological skills and attitudes will enable the individual to tackle and solve everyday problems and make rational decisions on biocultural, biological, and socioeconomic issues. However, the implementation of biological literacy should be spell out and included as one of the cardinal objectives.

Content and Strategy

The secondary school biology curriculum contains contents and strategies relevant to the
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1. Plant and Animal Nutrition which discusses photosynthesis, classes of food, modes of feeding, digestion, digestive systems and enzymes.

2. Concept of living which discusses the cell, and its environment as well as Form and Function.

3. Conservation of Natural Resources including energy sources transformation and nutrient cycling.


5. Variations, variability and heredity with their applications to crime detection, agriculture and medicine.

6. Evolution and Adaptation: This looks into the theory of organic evolution, succession, competition and their effects. Biodiversity and speciation are also topics to be discussed.

8. Micro-organisms around us, Personal and Community Health: This concept looks at the growth and control of micro-organisms, their effects, as well as personal, and community health issues. In this Biological curriculum, it is stipulated that in studying these concepts, emphasis should be on the use of student-related activities. Practical work, inquiry discussions, visits to places of importance should be appropriately and extensively used.

The Biology curriculum has relevant concepts and strategies that can be properly implemented in the biological literacy. The appropriate strategies such as the inquiry/scientific method, practical method and discussions are used in the learning of these concepts that are of relevance to the students, meaningful functional knowledge, skills, and attitude are acquired to demand by the requirements for biological literacy.

However, some concepts/topics on biotechnology, biotechnology and history of biological knowledge need to be included in the curriculum to enhance acquisition of biological literacy.

The teacher's role in enhancing biological literacy

The senior secondary biology curriculum is relevant for biological literacy. The quantity and quality of this literacy acquired by students is dependent on the teacher who is the user and implementer of the curriculum in the class. The teacher acts as a catalyst for learning and as a facilitator and supporter of biological literacy among the students.

For the teacher to facilitate and accomoplish biological literacy, he has to fully understand and appreciate the aim of biology education in terms of biological literacy so as to translate this into reality. The teacher has to be aware of and should fully acknowledge that biology education for biological literacy should:

help students to
- improve students
- help them; desire
- understand how

Biology literacy individuals and as a whole.

Biology literacy biological concept imperative that the teacher and organism approach the subject.

Achievement of this knowledge and understanding on the part of the teacher signifies that the teacher is conversant and informed in the field that will help prepare future students.

CONCLUSION

Education as a process of survival in a scientific age. Biology is to be used as a tool for students of biological literacy. Teachers are requested to intervene in the teaching of biology as a tool for enhancing students' understanding of the world around them. This will help improve the quality of biological literacy in the students. Teachers are therefore requested to intervene in the teaching of biology as a tool for enhancing students' understanding of the world around them. This will help improve the quality of biological literacy in the students.

References

modes of teaching.

Function.

Educational Practices in

childhood, youth, and adult life.

The teacher's role in learning.

Ecology, Ecology

Agriculture and

Science, competition and

evolution, cooperation and

individuality, biological literacy.

Biological literacy implies "biology for all". It is the duty of the teacher to understand his students - as individuals and as a group, their unique needs and differences. The teacher has to use varied teaching and assessment strategies to reach all students.

Biological literacy demands that students are helped to construct their knowledge of the world and biological concept. Since students normally come to class at the nominal literacy level, it becomes necessary that the teacher identifies students' prior knowledge and misconceptions so as to be able to design appropriate strategies to help them improve upon students' construction and understanding of biology concepts and principles.

Achievement of biological literacy among pupils especially at the structural and multidimensional levels means the teacher exposes the students to appropriate learning strategies and environment. This in turn helps the teacher fully understands, appreciates and the extensively the inquiry, practical unsupervised and discussion methods or strategies in their lessons. The teacher also should be well informed in the biological related social, ethical and technological issues as to direct meaningful discussions that will help prepare students to make informed and responsible decisions about these issues.

CONCLUSION


