Course III Sec 2

Understanding Disciplines and School Subjects

Objectives

- To understand the basic concepts associated with academic disciplines
- To comprehend the meaning of interdisciplinary and multidisciplinary learning
- To understand different approaches in interdisciplinary learning
- To appreciate the different academic disciplines and their place in the school curriculum
- To appreciate the role of academic disciplines in facing global challenges
- To apply the understanding of academic disciplines in curriculum transaction

✓ Module One
   Academic Disciplines and Interdisciplinary Approach

   - Unit One: Basics of Academic disciplines
   - Unit Two: Teaching across disciplines

Unit One

a) Basics of Academic disciplines

b) Meaning and characteristics of academic disciplines

c) Emergence of academic disciplines

d) Relationship between academic disciplines and subjects

- Meaning of academic discipline
   Discipline is defined by the Oxford English Dictionary as "a branch of learning or scholarly instruction." An academic discipline refers to a form of specific, rigorous scientific training that an individual is exposed to.

Give relevant examples of different disciplines

- Arthur Dirks points out ‘discipline in an academic sense, pertains to the practice of study of a certain category of experience, its methodologies, how it goes about its pursuit of truth. There is fundamental theory and fact (one might call it doctrine) that informs the practice of that pursuit, but it is the pursuit that counts.’

- According to Moti Nissani (1997), a discipline can be conveniently defined as the study of “any comparatively self-contained isolated domain of human experience which possesses its own community of experts”
• **Characteristics of academic disciplines**

1. Body of specialised knowledge
2. Has theories and concepts
3. Specific terminology
4. Specific object of research
5. Definite methodology of research
6. Institutional manifestation in form of subjects taught, professional organizations

Discuss these characteristics with suitable examples from some disciplines

• **Subjects are generally classified under these discipline heads**

  Humanities (also called Arts and Humanities)

  Social Sciences

  Natural Sciences

  Mathematics

  Business

Discuss all the five broad disciplines with

Examples of subjects

The main focus of the study of the discipline

Methods used to expand disciplinary knowledge (eg Science uses scientific inquiry, experimentation etc while Social sciences use Social critique, interpretative methods)

Impact of these disciplines on our lives

Professions and the disciplines

Emergence of academic disciplines

Emergence and evolution of

Language as a discipline

History and Geography

Science
Mathematics

Relationship between academic disciplines and subjects

Subjects within a disciplines have common features
understanding of the disciplines helps to understand a subject better

The subtle differences between disciplines and subjects
Disciplines and subjects are like ground and figure

Why do teachers need knowledge about disciplines and subjects?

Definite focus while teaching a subject

Appreciate other subjects within one’s discipline

More meaningful learning experiences can be arranged

Clarity of concepts

Teachers may need to give vocational and academic advice to students

Why do teachers need knowledge about disciplines and subjects?

Creates interdisciplinary bent of mind

Help in research work

Community of practice benefit, better contribution to academic bodies and journals

Helps to face real world challenges

Unit Two
Teaching across disciplines

Classification of academic disciplines

Becher-Biglan typology (pure-hard, pure-soft, applied-hard, applied-soft types) with emphasis on nature of knowledge in each type.

Interdisciplinary and multidisciplinary teaching and learning: meaning, significance and role of the institution

Strategies/approaches for interdisciplinary learning (team teaching, experiential learning)
• **Pure disciplines**

Concentrate on fundamental research

systematic observation of phenomena solely for the purpose of discovering unknown facts which may develop into theories

Result in new knowledge

Eg Pure Mathematics, pure chemistry

**Applied Disciplines**

relate existing knowledge to real world situations

Application of theory to real life

Aim at problem solving

Eg Education, applied psychology, Engineering (application of Science and Mathematics)

**Hard disciplines**

that tend to use quantitative data, tend to be predictive and use experimental methods

concern for career development and cognitive goals (such as the learning of facts and concepts).

Eg Science, Mathematics, engineering

**Soft Disciplines**

Rely on qualitative data

Generally do not use experimental methods and hence do not make predictions

concern for general education development, character development, critical thinking and ‘scholarly’ activities (such as the reading of research articles).

Eg: History, Sociology, Law, Language

Biglan- Becher typology
Hard-Pure disciplines

- Quantitative data
- Concerned with universal phenomena
- Nature of knowledge is cumulative
- Knowledge growth can be compared to crystal growth (building on what already exists)
- As new knowledge is found, old knowledge gets enhanced
- Relationship between knowledge and knowledge seeker is unbiased and objective
- Knowledge is verified by fixed criteria
- High degree of consensus between two knowledge seekers
- Academic communities in hard-pure disciplines are well organized, their work is quite competitive and publication rates are high

Hard- Applied disciplines

- Purposive work involving application of theory
- Emphasis is on creating techniques and products
- Practical in nature, try to solve problems
- Use heuristic approach
- Criteria to judge the products of these disciplines are functional
- The ethos in such disciplines is entrepreneurial and dominated by professional values. Patents are submitted for publication.

- Engineering is a hard-applied discipline which draws from Mathematics, Physics and Chemistry. Clinical Medicine is a hard-applied discipline dependent upon Biology and Chemistry.

Soft-Pure disciplines

- Stress on understanding and interpretation of phenomena
- Knowledge is reiterative (there can be repetition of results)
- Concerned with particular happenings rather than general occurrences
- Qualitative data. Hence high subjectivity while interpreting
- Personal relationship between knowledge & knowledge seeker
• No definite views on verification of data
• As compared to hard pure disciplines, Less structured academic communities
• Publications rate is lower
• Eg History, Anthropology, Sociology

**Soft Applied disciplines**

Emphasize processes and protocols
Functional and utilitarian in nature
Help to enhance professional practice
Dominated by ‘intellectual fashions’
Use both qualitative and quantitative data
Case studies are important means to build knowledge
Eg Law, Education

**Unit 2 b**

**Interdisciplinary and multidisciplinary teaching and learning:** Meaning, significance and role of the institution

Interdisciplinary Learning is a process of answering a question, solving a problem, or addressing a topic that is too broad or complex to be dealt with adequately by a single discipline, and draws on the disciplines with the goal of integrating their insights to construct a more comprehensive understanding.

According to Garner (1995), the term ‘multidisciplinary’ refers to a combination of various disciplines as independent and separate components of learning, which allows students to work within discipline specific parameters and attain discipline specific goals.

Characteristics .... interdisciplinary learning

• draws from more than one discipline e.g. War
• Focus is beyond the realm of one disciplinese.g. Health (sci, geog, eco)
• Pragmatic approach (problem solving attitude)

Dialectical process (team work between people more than one discipline, logical discussion of ideas and opinions) Reasoning in which question-answer approach (dialectic) is used to examine the correctness, legitimacy, or validity of an assumption, idea, opinion, etc.
Integrative in nature (disciplinary perspectives deliberately and productively. Knowledge, understanding and skills)

4 cognitive abilities

Perspective taking Techniques

Development of structural Knowledge

Integrating of conflicting insights

Interdisciplinary understanding increases and hence holistic thinking occurs.

HOTS such as creativity, critical and systems thinking, synthesis, evaluation and analysis

IB – MYP

Concepts, methods or forms of communication from two or more discipline or established areas of expertise so that they can explain a phenomenon, solve a problem, create a product

Migration

History-different eras and diff nations

Geog-patterns of migration, reasons for migration and types of migration (migration within a nation and out of the nation)

Economics: has affected livelihoods, population

Science: migration of animals, reflect on similarities, difference in animal and human migration.

Literature: Migration influenced lang, e.g.parsi

Political science: Students res leave the country, reasons, new nation

Multidisciplinary learning will also show similar characteristics but it is not integrative in nature. Each discipline retains its uniqueness

Difference between interdisciplinary and multidisciplinary learning

Significance of Interdisciplinary and multidisciplinary learning

Promote a broadened outlook as learner is aware of different perspectives put forth by different disciplines

Narrow allegiance to one discipline is prevented
Comprehensive way of looking at life’s challenges

Objectivity in learning is promoted

Appreciation of other disciplines

Reflection of how the real world works

Sensitivity to ethical issues eg question of euthanasia is examined from different disciplines ..medicine, ethics, law, religion

Promotes the ability to synthesize information

unconventional and original thinking

develop a new awareness of the meaningful connections that exist among the disciplines

Useful in research

**Role of the institution**

- Role of Principals and Heads of Institutions
- Offer variety of subjects
- Strengthen individual departments (eg subscribe to journals)
- Selection of faculty with knowledge of different disciplines
- Training sessions for faculty
- Flexible timetables for interdisciplinary and multidisciplinary learning
- Information technology can be used to plan collaboratively, online forums for discussion
- Document good practices
- Involve industry personnel to give view of application
- Healthy campus atmosphere that encourages sharing between disciplines

**Role of teacher**

- Design and implement learning experiences that include id and md learning
- Choose appropriate topics and plan for id and md learning
- Include varied learning experiences that reflect both a discipline-based and an interdisciplinary orientation
• Attend seminars of other disciplines
• Undertake id and md based research
• Invite experts from other disciplines or from fields other than academics
• Simply planning for interdisciplinary and multidisciplinary learning is not enough. Teachers must engage students in epistemological questions such as “What is knowledge?” “What do we know?” and “How can we link knowledge with real world application?” Constructivist approach (where students explore and take responsibility for their own learning) will be effective in interdisciplinary learning.

Role of students

Healthy attitude to all disciplines

Reading and reflecting

Extended learning spaces eg museums, field visits, libraries

If possible involve students in planning for id and md learning

Unit 2c Strategies/ approaches for interdisciplinary learning (team teaching, experiential learning)

Team teaching

Meaning

Characteristics

How to plan and organise Team Teaching

Benefits of team teaching

Challenges

Experiential Learning

Kolb’s cycle of experiential learning

Discuss Kolb’s cycle with examples involving different disciplines

Advantages of using Experiential Learning for interdisciplinary learning
Unit III
Unit Three: Humanities and Social Sciences in the Curriculum

Place of Humanities and Social Sciences in present school curriculum

Issues and challenges in teaching Humanities and Social sciences

Role of Humanities and Social Sciences and humanities with respect to the following global issues: promoting peace and respecting diversity

Scope of the units

Status – through commissions

Issues & challenges of the discipline

For social science, Humanities & Art

Role of each to develop peace and diversity

Definition of Peace education & appreciation of diversity.

Methods and techniques of integration- give examples.

Place of Social science in the curriculum

**Definition of social science –**

The study of human society and of individual relationships in and to society.

A scholarly or scientific discipline that deals with such study, generally regarded as including sociology, psychology, anthropology, Economics, political science, and history.

Social science encompasses diverse concerns of society and include a wide range of content drawn from various disciplines.

**Place of social sciences in the curriculum**

- World over Social sciences hold a significant place in the curriculum because the knowledge and understanding developed through the study of social sciences and humanities can help inform discussion on critical social, cultural, economic, technological, environmental, and wellness issues, and can provide a strong foundation for vibrant, healthy, and engaged citizenship.

- Social science explores individual and collective human behavior and needs as well as patterns and trends in society.

Its place in the Indian context of Education
After 1947, social studies gained an honorable place in the curriculum. Before independence British history was taught to the Indians which had no relevance with the Indian contexts.

The N.C.E.R.T., has given it a due place in the curriculum. K.P. Chaudhary by supporting social sciences in the curriculum says, “Like the natural sciences, Social science efforts are to develop general laws and predict the future.”

Post colonial India – social science significance was perceived needs of nation building, modernization.

Lead to the utilitarian view of fitting students for life, for society.

UNESCO Round table conference 1954 was on teaching of social sciences in Asia. The conference emphasized the Plea of social science for citizenship.

NEC National Education commission 1975 gave the nation building emphasis. That is for citizenship. So it has always been a fairly progressive vision for social science. NCERT suggested a history/geog in middle school, secondary history/civics and eco/geog and finally suggested we need an integrated approach without causing damage to the individuality of the discipline.

NCFSE 2000 emphasized shaping or reconstruction of society through social science – so the discipline gained critical significance.

NCF 2005 said social science as a scientific endeavor that must challenge patriarchal frames and strive to generate in students a critical, moral and mental energy making them alert to the social forces that threaten these values and create inquisitive and transformative citizens.

- Finally the NCERT squarely addressed the importance of social science as a non utility subject. The NCERT paper states through the National Focus Group on ‘Teaching of Social Sciences’

- “The Social Sciences carry a normative responsibility to create and widen the popular base of human values, namely freedom, trust, mutual respect, and respect for diversity. Given this, social science teaching should aim at investing in children a critical moral and mental energy to make them alert to the social forces that threaten these values. Through the discussion of concerns such as threats to the environment, caste/class inequality, state repression, through an interdisciplinary approach.”

**Issues and challenges with social sciences**

- Issues are several:

- Status of the subject: The experiments in social science in the country have not given a feeling of success in handling the subject as a unified discipline. So although in principle we are in favor of a unified discipline the textbooks, treatment has always been fragmented.

- Prevailing perceptions of social science is another issue. The popular perception is it’s a non-utility subject as a result low self esteem governs the classroom transaction.
Natural Sciences are considered superior to the social sciences. Widespread belief that social science only transmits information and is too centered on text and memory.

- Perception that not many desirable job options are open to students specializing in the social sciences. And that it does not provide life skills to function in the real world.

- Content load - the NCF says that the social science taught in Indian schools stress on retention rather than application. NCFSE 2000 suggest that social science should focus on concepts and ability to analyze socio-political realities.

- Plurality and local content: India is a land of plurality. It is important that all regions and social groups get represented in the textbooks. However, because of centralized nature textbook production we miss out on this element. So sometimes local content gets lost.

- Scientific rigour. - Notion that scientific rigor is lacking in social sciences.

- Interrelationship among disciplines: the subjects have distinct methodologies so preservation of boundaries sometimes make it difficult to interrelate. And a realization that not all themes can be taught in an interdisciplinary manner

- Normative concerns: the social sciences carry a normative responsibility to create and widen a popular base of human values namely freedom, trust, mutual respect and respect for diversity.

**Integrated vs disciplinary emphasis.** Many people feel the integrated approach is a threat to the disciplines structure and uniqueness.

Social science textbooks writers especially in India need a broader perspective. Kothari commission has said the textbooks use a developmental approach where the poor have failed the nation due to poverty, caste, narrow minded thoughts due to illiteracy. Lack of integrated textbooks. Textbooks, teachers all have to generate the values through an inter disciplinary approach

What are the challenges?

- Restore self esteem to the social science by addressing socio-political issues in an engaging thought provoking manner.

- Create Awareness - change peoples perceptions – creating job opportunities for social sciences, raising the status.

- Educate people about the importance of social science

- Better textbooks- should open up avenues for further inquiry. More gender equity. Move from a patriarchal frame work to more egalitarian framework. And more of an integrated approach.
Better questions and evaluation - not memory based.

Teacher training for a more emancipated teaching of social science

**Humanities**

- The humanities - are part of the liberal arts. They are defined by Webster's Dictionary as "the branches of learning having primarily a cultural character."

  The emphasis is on languages, literature, art, music, philosophy, and religion. An Arts & Humanities degree in humanities major can include art history, classical studies, liberal arts, English, history, modern languages, philosophy, religious studies and writing. They are all classified as humanities degrees, despite the fact that many colleges and universities have separate faculties for these studies.

**Scope**

- In the humanities, we study all aspects of society - from past events and achievements to human behavior and relationships among groups. You learn how to learn, developing your skills in researching, reading, writing, and thinking your way through abstract problems.

  *The calling of humanities is to make us truly human in the best sense of the word.*

  J.Irving Mille

**Status of Humanities**

- Post independence we took up the three language formula again reiterating the significant status of language in the school curriculum. The National Policy on Education (NPE) – 1986 reiterated the need for the implementation of the three language formula in its true spirit while recording the unsatisfactory implementation of the formula in some parts of the country. The National Curriculum Framework–2005 developed after a nation-wide debate and discussion approved by Central Advisory Board of Education (CABE) makes the following guidelines on language education:

**The status**

- The National Commission on Education known as the Kothari commission examined and recommended a graduated formula which was recommended by the National Policy of Education 1968.

- This is the relevant extract of what it says: Development of Languages (a) Regional Languages: The energetic development of Indian languages and literature is a sine qua non for educational and cultural development.
Unless this is done, the creative energies of the people will not be released, standards of education will not improve, knowledge will not spread to the people, and the gulf between the intelligentsia and the masses will remain, if not widen further. The regional languages are already in use as media of education at the primary and secondary stages. Urgent steps should now be taken to adopt them as media of education at the university stage.

**Three language formula**

*Three-Language Formula:* At the secondary stage, the State Governments should adopt, and vigorously implement, the three-language formula which includes the study of a modern Indian language, preferably one of the southern languages, apart from Hindi and English in the Hindi-speaking States, and of Hindi along with the regional language and English in the non-Hindi speaking States. Suitable courses in Hindi and/or English should also be available in universities and colleges with a view to improving the proficiency of students in these languages up to the prescribed university standards.

**National language**

*Hindi:* Every effort should be made to promote the development of Hindi. In developing Hindi as the link language, due care should be taken to ensure that it will serve, as provided for in Article 351 of the Constitution, as a medium of expression for all the elements of the composite culture of India. The establishment, in non-Hindi. States, of colleges and other institutions of higher education which use Hindi as the medium of education should be encouraged.

**Additional language**

*Sanskrit:* Considering the special importance of Sanskrit to the growth and development of Indian languages and its unique contribution to the cultural unity of the country, facilities for its teaching at the school and university stages should be offered on a more liberal scale. Development of new methods of teaching the language should be encouraged, and the possibility explored of including the study of Sanskrit in those courses (such as modern Indian languages, ancient Indian history, Indology and Indian philosophy) at the first and second degree stages, where such knowledge is useful.

*International Languages:* Special emphasis needs to be laid on the study of English and other international languages. World knowledge is growing at a tremendous pace, especially in science and technology. India must not only keep up this growth but should also make her own significant contribution to it. For this purpose, study of English deserves to be specially strengthened.

NPE 1986

The National Policy on Education (NPE) – 1986 reiterated the need for the implementation of the three language formula in its true spirit while recording the unsatisfactory implementation of the formula in some parts of the country.
The National Curriculum Framework–2005 developed after a nation-wide debate and discussion approved by Central Advisory Board of Education (CABE) makes the following guidelines on language education:

Language teaching needs to be multilingual not only in terms of the number of languages offered to children but also in terms of evolving strategies that would use the multilingual classroom as a resource.

- Home language(s) of children, should be the medium of learning in schools.
- If a school does not have provisions for teaching in the child's home language(s) at the higher levels, primary school education must still be covered through the home language(s). It is imperative that we honour the child's home language(s). According to Article 350A of our Constitution.
- Education in the mother–tongues will facilitate richer classroom transaction, greater participation of learners, and yield better learning outcomes.

Perception

- Literature in its turn is seen as a luxury – it works on the top of Maslow’s hierarchy of needs; it is not significant for most of the people in the world. Where poverty and disease and war afflict the world and power and money rule individual aspiration, aesthetic pleasure is subsidiary.
- Nothing concrete, tangible or ‘useful’ can be achieved from the study of Humanities – that is what popular opinion dictates. And this reflects in the absolute lack of opportunity and progress for Humanities graduates in their own field. Humanities is the most neglected subject at school level in India. A mere mention of the word "Humanities" can bring frowns on your parents’ forehead.”
- Opting Humanities is considered to mean that you are a weak student and not as brilliant as the one who is picking the science subjects.

Issues of teaching Humanities

The state of or actually, let’s just stick to the more accurate term ‘Humanities’ – is pathetic, for the lack of a better description. The infrastructure is flawed; the curriculum is outdated, irrelevant and paltry at best.

Language is seen as a medium of communication rather than the multi-dimensional aspect of language.

Lip service to developing the aesthetics in literature

Three language formula

Three language formula has failed to take off in the true spirit in different parts of the country. North it’s a two language formula nearly. South again they have adopted Tamil and English. Tripura too has ignored Hindi.
India has several languages rich in literature but policies are not in place to promote them.

Teacher training for language teaching a huge area of deficit.

Mother tongue issue -Mother tongue stressed - but all states the regional language may not be the mother tongue for the student. And all minority languages schools may not have facilities to offer.

Treatment of literature : The number of methods that linguistic and learning are several. Many theories have produced over a period of time

most of these methods have been developed in the context of second-language acquisition. We are concerned with the teaching of not just first but also second and third languages as well as classical and foreign languages in a variety of different contexts

Textbooks need to be more innovative

Different methods audio-lingual, communicative approach, structural approach.

quality of materials

Assessment and Evaluation: criterion referenced norm referenced test required

Teachers lack quality. They have to be researchers .

Challenges for Humanities

Challenge to change mindsets

Improve job opportunities through humanities

Teach the languages in correct perspective within the local context.

Write better textbooks

Evolve better teacher training

Art Education

Since Independence - various policy documents have stressed the need for art education in the overall development of the child.

Education commission 1952-53 various art, crafts to be provided an honorable place in the curriculum. It also suggested that children take up any craft and gain reasonable proficiency in the same.

- Status :
  
  - Kothari commission 1964-66 lamented that creative expression is lacking in children in schools. Adequate facilities for training music and visual arts must be provided.
They constituted a committee to look into art education. The report said the neglect of the arts impoverished education and leads to a decline of aesthetic values.

NPE 1986 again emphasized the importance of appreciation of culture and art for personality development. All the NCF’s 1975, 88 and 2005 emphasize the promotion of music art drama. Paradigm shift from art as dignity of labor to creative expression.

**Issues**

- Same perception that Humanities is not about developing critical thinking. It is not lucrative as a career.
- As it does not carry marks weightage is seen as less. Both teachers and students
- Lack of trained teachers
- Art education is activity based so creative teachers who can make the teaching interesting.
- Lack of teacher training. art degrees in teaching

**Challenges**

How to make it process oriented assessment ?

To make art education enjoyable & experiential.

Change perceptions of parents and schools and encourage them to provide space for art

Creating awareness about art education among stakeholders

Teacher training to change and lay emphasis on art education

Promoting peace and appreciation for diversity

Role of Humanities and Social Sciences with respect to the following global issues : promoting peace and respecting diversity

Peace education curricula generally include instruction in conflict resolution; cooperation and interdependence; global awareness; and social and ecological responsibility.

Two main ways of bringing appreciation for peace & diversity

Topic based integration

Issue based integration

Topic based involves teaching values of diversity and peace as and when opportunity presents itself within the lesson.
Issue based teaching involves picking up issues and connecting history and political science to it.

Valuing peace and diversity through history and pol science

- Respect for others regardless of race, gender, age, nationality, class, sexuality, appearance, political or religious belief, physical or mental ability
- Empathy – a willingness to understand the views of others from their standpoint.
- A belief that individuals and groups of people can make for positive change.
- Appreciation of and respect for diversity.
- Self esteem – accepting the intrinsic value of oneself
- Commitment to social justice, equity and nonviolence
- Concern for the environment and understanding of our place in the eco-system & Commitment to equality

positive emotional expression
- recognizing and expressing feelings in ways that are not aggressive or destructive
- conflict resolution strategies
- empathy
- nonviolent action in relation to problems both personal and societal
- ability to act on ideas - self reflection
- independent research

Peace and language teaching

- Educating about Peace and language teaching share a number of common techniques. Dialogue, debate, and conversation, for example, are important ways to practice language and are also a means of connecting the personal or individual to the cultural or multicultural.
- Written and verbal exchanges of ideas give meaning to language and, at the same time, promote the understanding of differences.
- Active listening is part of the language of non-violence and is also a vital skill in the acquisition of language.

Some ways for humanities

- Expression through language and art contribute to peace.
- Illustrations on peace or diversity help eg. Of a somali refugee
- Drama on peace issues, diversity
Music that creates harmony and songs for world peace and talks of oneness of the world

Poetry. Prose, story writing on themes related to peace and diversity.

Critical analysis of texts, reading of texts to understand peace and importance of diversity.

In Art – as in Design Technology – investigating and making can be practised collaboratively in the classroom. Knowledge and understanding of the arts and crafts of a diversity of societies can heighten sensitivity to different ways of seeing the world and so contribute to future perceptions of peace.

In Music, performing and composing can be collaborative skills, while listening and appraising can encourage appreciation of other cultural values.

Adapting drama to peace education and diversity - if I were in your shoes kind of perspective.

Puppet shows

Illustrations

- [Unit IV]
  Natural Sciences and Mathematics in the Curriculum

- Place of the disciplines Science in present school curriculum
  - Compulsory subject from Class 1 in school education.
  - Basic to most professions hence important.

- Science Education at Primary School

- Science & Social Science to be integrated as Environmental Studies.

- Science Education at Upper Primary School

- According to National Curriculum framework for School Education (2000), Science education at different stages is as follows:

  Primary School ------- Environmental Studies as an integrated course

  Upper Primary & Secondary ------- Science & Technology as an integrated approach

  Higher Secondary --------- Physics, Chemistry & Biology as separate disciplines.

  Science Education at Primary School

- Science & Social Science to be integrated as Environmental Studies.

  At this stage Science education should help to:
- nurture the curiosity of the child about the world (natural environment, artifacts and people),
- have the child engage in exploratory and hands-on activities for acquiring the basic cognitive and psychomotor skills through observation, classification, inference, etc.;
- emphasise design and fabrication, estimation and measurement
- develop basic language skills: speaking, reading and writing not only for science but also through science.

- **Science Education at Upper Primary School**
  
  • At this stage,
  - the child should be engaged in learning the principles of science through familiar experiences, working with hands to design simple technological units and models (e.g. designing and making a working model of a windmill to lift weights)
  - continue to learn more about the environment and health, including reproductive and sexual health, through activities and surveys.
  - Scientific concepts are to be arrived at mainly from activities and experiments.
  - Group activities, discussions with peers and teachers, surveys, organisation of data and their display through exhibitions, etc. in schools and the neighbourhood should be important components of pedagogy.

  - **Science Education at Secondary School**
    
    • At the secondary stage,
    - students should be engaged in learning science as a composite discipline,
    - in working with hands and tools to design more advanced technological modules than at the upper primary stage, and
    - in activities and analyses on issues concerning the environment and health, including reproductive and sexual health.
    - Systematic experimentation as a tool to discover/verify theoretical principles,
    - working on locally significant projects involving science and technology, are to be important parts of the curriculum at this stage.

  - **Science Education at Higher Secondary School**
    
    • At the higher secondary stage,
-science should be introduced as separate disciplines,

-with emphasis on experiments/technology and problem solving.

- **Place of the discipline of Mathematics in present school curriculum**

  - Compulsory subject from class I to Secondary level.
  
  - Has significance due to its relation to several vocations, its correlation to other subjects and life.
  
  - As per NCF-2005, the main goal of math education is the development of children’s ability of mathematisation.

  i.e. Children should learn to think about any situation using the language of mathematics so that the tools and techniques of mathematics can be used. This typically involves drawing pictures (representations), choosing variables, framing equations and arriving at a conclusion logically.

  - The narrow aim of school mathematics is to develop ‘useful’ capabilities, particularly those numeracy-related skills such as the ability to deal with arithmetic operations, ability to compute percentage, area, volume, to factor polynomials etc.,

- Skills needed to transact ones daily life business along with social obligations smoothly.

  - The higher aim is to develop the child

- to think and reason mathematically,

- to pursue assumptions to their logical conclusion

- to handle abstraction.

It includes a way of doing things, and the ability and the attitude to formulate and solve problems.

  - These are important to deal with in the modern complex technological world.

  - NCF-2005 talks about teaching ambitious, coherent and important mathematics.

  - An ambitious mathematics seeks to achieve the higher aim rather than only the narrower aim.

  - Coherent means linkages of mathematics with other subjects.

  - Teaching important mathematics means that it is not merely textbook material but something both children and teachers consider worth spending their time and energy on, and mathematicians consider significant for mathematics.

  - An important consequence of such requirements is that school mathematics must be activity oriented.
• **Discipline of Math in present school curriculum**

• The sequential curriculum is followed in math across the school years.

• *Sequence* is the presentation of the material in a logical order. The sequence could be determined...

- By increasing **complexity**, 
- By **logic** (local environment to world),
- Psychologically (begins with immediate interests and proceeds to more remote ones)

• Any curriculum for mathematics must incorporate the progression from the concrete to the abstract and subsequently a need to appreciate the importance of abstraction in mathematics.

• **Math Education at Primary & Upper Primary School**

• In the lowest classes,

  - activities with concrete objects form the first step in the classroom to enable the child to understand the connections between the logical functioning of their everyday lives to that of mathematical thinking.

  - Operations on natural numbers usually form a major part of primary mathematics syllabi.

  - However, the standard algorithms of addition, subtraction, multiplication and division of whole numbers in the curriculum have tended to occupy a dominant role in these. This tends to happen at the expense of development of number sense and skills of estimation and approximation.

• Hence operations should be introduced contextually. This should be followed by the development of language and symbolic notation, with the standard algorithms coming at the end rather than the beginning of the treatment.

• Making simple comparisons and classifications along one dimension at a time, and identifying shapes and symmetries, are appropriate skills to acquire at this stage. Encouraging children to use language to freely express one's thoughts and emotions, rather than in predetermined ways, is extremely important at this and at later stages.
• Mathematical games, puzzles and stories involving number are useful to enable children to make these connections and to build upon their everyday understandings.

• **Math Education at Upper Primary School**

  • At the upper primary stage, students start the application of powerful abstract concepts.

  • Students are introduced to algebraic notation and its use in solving problems and in generalisation, to the systematic study of space and shapes, and for consolidating their knowledge of measurement.

  • Data handling, representation and interpretation form a significant part of the ability of dealing with information in general, which is an essential 'life skill'.

  • The learning at this stage also offers an opportunity to enrich students' spatial reasoning and visualisation skills.

  • (Involves Set theory, Ratio & proportion, Simple planar Geometry concepts, basic algebraic Concepts, linear equations etc.

• **Math Education at Secondary School**

  • At the secondary stage, students begin to perceive the structure of Mathematics as a discipline.

  • They become familiar with the characteristics of mathematical communication: carefully defined terms and concepts, the use of symbols to represent them, precisely stated propositions, and proofs justifying propositions.

Topics covered – Concept of IR and R numbers and their operations Exponential numbers, Quadratic equations, Simultaneous equations, Theorems on elements of a circle / quadrilaterals, Mensuration, Logarithms, Trigonometry etc.

• At this stage, students integrate the many concepts and skills that they have learnt into a problem-solving ability.

• Mathematical modelling,( A mathematical model is a description of a system using mathematical concepts and language. The process of developing a mathematical model is termed mathematical modeling.) Mathematical models are used in the natural sciences (such as physics, biology, earth science, meteorology) and engineering disciplines (such as computer science, artificial intelligence), as well as in the social sciences (such as economics, psychology, sociology, political science). Physicists, engineers, statisticians, operations research analysts, and economists use mathematical models most extensively. A model may help to explain a system and to study the effects of different components, and to make predictions about behaviour.
• data analysis and interpretation taught at this stage can consolidate a high level of mathematical literacy.

• Individual and group exploration of connections and patterns, visualisation and generalisation, and making and proving conjectures. In mathematics, a conjecture is a mathematical statement which appears to be true, but has not been formally proven. A conjecture can be thought of as the mathematicians way of saying “I believe that this is true, but I have no proof yet”. A conjecture is a good guess or an idea about a pattern.

• are important at this stage, and can be encouraged through the use of appropriate tools that include concrete models as in Mathematics laboratories and computers.

• Math Education at Higher Secondary School

• The aim of the Mathematics curriculum at the higher secondary stage is to provide students with an appreciation of the wide variety of the application of Mathematics, and equip them with the basic tools that enable such application.

• A careful choice between the often conflicting demands of depth versus breadth needs to be made at this stage.

• Topics – Sequences/ Series, Arithmetic /Geometric Progression, Calculus, Higher algebra, Coordinate geometry, Conics (2d Geometry), Trignometry etc.

• Issues and challenges in teaching the disciplines Science and Mathematics

**Position Paper of National Focus Group on Science** identifies some issues w.r.t teaching of Science:

- Lack of infrastructure: resource rooms, activity rooms, laboratories, material for models, toys, tools, appropriate books – reference, encyclopedias, dictionaries, multimedia and internet facility.

- Overloaded syllabus. The most important consideration while developing a science curriculum is to ensure a reduced emphasis on mere information and provide greater exposure to what it means to practice science.

- Inadequacy of textbooks based on constructivist methods.

- Need to use science curriculum as an instrument of social change to reduce the divide related to economic class, gender, caste, religion and region.

- Present day science education develops competence but does not encourage inventiveness and creativity.

• **Issues and challenges in teaching the discipline of Mathematics**
• Position Paper of National Focus Group on Mathematics identifies some issues wrt teaching of Mathematics:

(a) A sense of fear and failure regarding mathematics among a majority of children,

b) A curriculum that disappoints both a talented minority as well as the non-participating majority at the same time,

(c) Crude methods of assessment that encourage perception of mathematics as mechanical computation,

• Issues and challenges in teaching the discipline of Mathematics

(d) Lack of teacher preparation and support in the teaching of mathematics.

(e) Compartmentalisation: there is very little systematic communication between primary school and high school teachers of mathematics, and none at all between high school and college teachers of mathematics

(f) Systemic problems further aggravate the situation, in the sense that structures of social discrimination get reflected in mathematics education as well. Especially worth mentioning in this regard is the gender dimension, leading to a stereotype that boys are better at mathematics than girls.

• Role of Science and Mathematics w.r.t sustainable development and Health

• Contributing To Informed Decisions That Impact the World:

- By emphasizing and explaining the dependency of living things on each other and on the physical environment, science fosters the kind of intelligent respect for nature that can inform decisions on the uses of technology to improve the world for humans and all living things.

• The more science-literate individuals are, the stronger their society can be. Specifically, the lessons and skills science gives us can have effects that help make for more responsible citizens, a balanced economy, a healthier environment, and a brighter sustainable future for everyone.

• Role of Science and Mathematics w.r.t sustainable development and Health

• Science makes us aware of environmental problems

• Helps to improve our understanding in areas such as climatic change, growth in rates of resource consumption, demographic trends, and environmental degradation

• Use of technology for remote sensing and GIS helps in tracking environmental degradation

• Helps in meaningful resource utilization
• Science helps suggest alternative practices to reduce pollution

• Statistics helps to see the impact of our actions on the quality of life we lead. It help to estimate and visualize the position of resources in future (prediction) and thus we can take required steps

• Scientific knowledge should be applied to articulate and support the goals of sustainable development, through scientific assessments of current conditions and future prospects for the Earth system.

• Such assessments, based on existing and emerging innovations within the sciences, can be used in the decision-making process and in the interactive processes between the sciences and policy-making.

• To develop innovative, green solutions to address the climate, food and energy crises facing the world today, science, technology, research and development capacities for sustainable development must be strengthened

• Mathematical models are used to predict environmental changes

• Advances in Science & Technology have led to longer, healthier, better lives.

• A generation that understands and honors or celebrates past achievements will welcome and pave the way for future discoveries and inventions that will improve physical and mental health.

• Science helps create an awareness of diseases (Physical and mental health), Importance of having a balanced diet, measures to prevent diseases

• Risk factors for diseases are estimated through the use of mathematics

• Modeling is important in a range of areas such as:
  - preparing for flu outbreak
  - modelling the impact of an epidemic
  - Predicting health needs of the future
  - certain Computational models use gene expression data to diagnose and treat diseases.

UNIT THREE: References


- [http://www.ppu.org.uk/learn/peaceed/pe_ednetcurriculum.html](http://www.ppu.org.uk/learn/peaceed/pe_ednetcurriculum.html)

Social science learning in schools: perspectives and challenges sage publications 2010.

By Poonam Batra

http://www.ncert.nic.in/new_ncert/ncert/rightside/links/pdf/focus_group/Indian_Languages.pdf


http://www.youthkiawaaz.com/2014/08/study-humanities-in-india/

http://www.minglebox.com/arts/courses/arts


Kali-Kalisu – An Arts Education Teacher Initiative

http://www.indiaifa.org/programmes/kali-kalisu.html

http://www.ncert.nic.in/departments/nie/deaa/publication/Print/pdf/1.pdf

All position papers on social science, language and art of NCERT.


NCERT, (1988), Guidelines and Syllabi for Secondary Stage (Class IX, X), New Delhi: NCERT.

UNIT IV References:

- http://www.ncert.nic.in/rightside/links/focus_group.html


• NCERT, (1988), Guidelines and Syllabi for Secondary Stage (Class IX, X), New Delhi: NCERT.

• Narendra Vaidya : Science teaching in school for the 21st century. Deep and deep publications Pvt Ltd.,