Course Title: Teaching of Integrated Sciences

Course Code: 121 Credits - 4

Time Allotted: 64 Hours

MM: 100 (External 75, Internal 25)

Course Objectives:
The Student teacher will be able to-
1. Develop an understanding of the nature of integrated science and its interface with society.
2. Acquire a conceptual understanding of the objectives of teaching integrated science.
3. Appreciate the significance of integrated science at various levels of school curriculum.
4. Acquire the understanding of techniques/approaches and skills of teaching integrated science.
5. Develop and use the techniques for evaluation of student's performance.

Course Content:

Unit-I: Science in School Curriculum (15 hours)
- Nature and scope of integrated science.
- Development of science in India: Landmarks.
- Correlation of Integrated Science with other Subject.
- Aims & Objective of Teaching of Science with special reference to integrated Science.
- Science Curriculum at Secondary Level.
- Integrated Science Books: Qualities of good science books, its effective use; Criteria for evaluation of integrated science textbook.

Unit-II: Planning, Designing and Translation of Instruction. (25 hours)
- Development of unit plan, Lesson Plan, using variety of approaches.
- Teaching Learning process with a focus on:
- Inquiry Approach
- Problem Solving Approach
- Project Method
- Constructivist Approach
- Science Laboratory: Organization & Management.
- Instructional Aids: Preparation, Improvisation and Effective use.
- Planning and execution on Extended Experiences:-
- Science Exhibition
- Science Fair
- Science Quizzes
- Science Club

Unit-III: Evaluation in Integrated Science (14 hours)

- Evaluation: Concept & importance.
- Techniques of evaluation for theory & practical.
- Comprehensive and continuous evaluation, need and importance of class tests.
- Diagnostics test and remedial measures & Monitoring learner's progress.
- Achievement test-its construction & administration.

Unit-IV: Professional Development of integrated Science Teacher (10 hours)

- Need for professional development at individual level, organizational level and Government level.
- Technology Integration: Planning with the iNtegrating Technology for inquiry (NTeQ) model for Integrated Sciences at secondary school level.

COURSE TITLE : TEACHING OF INTEGRATED SCIENCE COURSE CODE 121

UNIT 1: SCIENCE IN SCHOOL CURRICULUM

TOPIC 1: NATURE AND SCOPE OF INTERGRATED SCIENCE

MEANING:

Integrated Science is our accumulated understanding of the natural world. For example,anatomy, biology, chemistry, earth/solar system, ecology, genetics, and physics. These topics are integrated, showing how all things work together to sustain life. it is usually a class taken in high school. It is science that is a combination of all types of science such as earth, physical, and basic science.

NATURE::

Integrated Science is a dynamic, expanding body of knowledge covering ever new domains of experience.

How is this knowledge generated? What is the so-called scientific method? As with many complex things in life, the scientific method is perhaps more easily discerned than defined. But broadly speaking, it involves several interconnected steps: observation, looking for regularities and patterns, making hypotheses, devising qualitative or mathematical models, deducing their consequences; verification or falsification of theories through observations and controlled experiments, and thus arriving at the principles, theories and laws governing the physical world. There is no strict order in these various steps.

Sometimes, a theory may suggest a new experiment; at other times an experiment may suggest a new theoretical model. Speculation and conjecture also have a place in science, but ultimately, a scientific theory, to be acceptable, must be verified by relevant observations and/or experiments. The laws of science are never viewed as fixed eternal 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 analysis. The methodology of science and its demarcation from other fields continue to be a matter of philosophical debate. Its professed value neutrality and objectivity have been subject to critical sociological analyses. Moreover, while science is at its best in understanding simple linear systems of nature, its predictive or explanatory power is limited when it comes to dealing with non-linear complex systems of nature. Yet, with all its limitations and failings, science is unquestionably the most reliable and powerful knowledge system about the physical world known to humans. But science is ultimately a social Endeavour.

Science is knowledge and knowledge is power. With power can come wisdom and liberation? Or, as sometimes happens unfortunately, power can breed arrogance and tyranny. Science has the potential to be beneficial or harmful, emancipative or oppressive. History, particularly of the twentieth century, is full of examples of this dual role of science.

SCOPE:

Man has always been curious to find answer to the mysteries posed by the reality he lives in one of the deepest and most profound is the one that in itself searches for the answer to how he come to be, to how his world originated, to how and when he and all living beings emerged from the nature they live in. all these question are answered by science.
Science literacy is of increasing importance in the workplace. More and more jobs demand advanced skills, requiring that people be able to learn, reason, think creatively, make decisions, and solve problem. An understanding of science and the processes of science contributes to these skills. Other countries are investing heavily to create scenically and technically literate workforce. To keep pace in global market, our country also needs to have an equally capable citizenry
It has been truly said that as integrated science progress it encourages the study of other subjects. Most of the effort in science teaching is directed , these days to improve condition of life and in tackling the new problem that arise. Therefore the importance of integrated science in schools is increasing.

TOPIC 2 : DEVELOPMENT OF SCIENCE IN INDIA

The **history of science** is the study of the historical development of science and scientific knowledge, including both the natural sciences and social sciences. (The history of the arts and humanities are termed the history of scholarship.) From the 18th century through late 20th century, the history of science, especially of the physical and biological sciences, was often seen as a narrative of true theories replacing false ones. More recent historical interpretations, such as those of Thomas Kuhn, portray the history of science in more nuanced terms, such as that of competing paradigms or conceptual systems in a wider matrix that includes intellectual, cultural, economic and political themes outside of science.[1]

Science is a body of empirical, theoretical, and practical knowledge about the natural world, produced by scientists who emphasize the observation, explanation, and prediction of real world phenomena. Historiography of science, in contrast, often draws on the historical methods of both intellectual history and social history. However, the English word *scientist* is relatively recent—first coined by William Whewell in the 19th century. Previously, people investigating nature called themselves natural philosophers.

While empirical investigations of the natural world have been described since classical antiquity (for example, by Thales, Aristotle, and others), and scientific methods have been employed since the Middle Ages (for example, by Ibn al-Haytham, and Roger Bacon), the dawn of modern science is often traced back to the early modern period, during what is known as the Scientific Revolution that took place in 16th and 17th century Europe. Scientific methods are considered to be so fundamental to modern science that some consider earlier inquiries into nature to be *pre-scientific*.[2] Traditionally, historians of science have defined science sufficiently broadly to include those inquiries

Mathematics: The earliest traces of mathematical knowledge in the Indian subcontinent appear with the Indus Valley Civilization (c. 4th millennium BC ~ c. 3rd millennium BC). The people of this civilization made bricks whose dimensions were in the proportion 4:2:1, considered favorable for the stability of a brick structure.[29] They also tried to standardize measurement of length to a high degree of accuracy. They designed a ruler—the *Mohenjo-daro ruler*—whose unit of length (approximately 1.32 inches or 3.4 centimetres) was divided into ten equal parts. Bricks manufactured in ancient Mohenjo-daro often had dimensions that were integral multiples of this unit of length.[30]

Indian astronomer and mathematician Aryabhata (476-550), in his *Aryabhatiya* (499) introduced a number of trigonometric functions (including sine, versine, cosine and inverse sine), trigonometric tables, and techniques and algorithms of algebra. In 628 AD, Brahmagupta suggested that gravity was a force of attraction.[31][32] He also lucidly explained the use of zero as both a placeholder and a decimal digit, along with the Hindu-Arabic numeral system now used universally throughout the world. Arabic translations of the two astronomers' texts were soon available in the Islamic world, introducing what would become Arabic numerals to the Islamic World by the 9th century.[33][34] During the 14th–16th centuries, the Kerala school of astronomy and mathematics made significant advances in astronomy and especially mathematics, including fields such as trigonometry and analysis. In particular, Madhava of Sangamagrama is considered the "founder of mathematical analysis".[35]

Astronomy: The first textual mention of astronomical concepts comes from the Vedas, religious literature of India.[36] According to Sarma (2008): "One finds in the Rigveda intelligent speculations about the genesis of the universe from nonexistence, the configuration of the universe, the spherical self-supporting earth, and the year of 360 days divided into 12 equal parts of 30 days each with a periodical intercalary month.".[36] The first 12 chapters of the *Siddhanta Shiromani*, written by Bhāskara in the 12th century, cover topics such as: mean longitudes of the planets; true longitudes of the planets; the three problems of diurnal rotation; syzygies; lunar eclipses; solar eclipses; latitudes of the planets; risings and settings; the moon's crescent; conjunctions of the planets with each other; conjunctions of the planets with the fixed stars; and the patas of the sun and moon. The 13 chapters of the second part cover the nature of the sphere, as well as significant astronomical and trigonometric calculations based on it.

Nilakantha Somayaji's astronomical treatise the Tantrasangraha similar in nature to the Tychonic system proposed by Tycho Brahe had been the most accurate astronomical model until the time of Johannes Kepler in the 17th century.[37]

Linguistics: Some of the earliest linguistic activities can be found in Iron Age India (1st millennium BC) with the analysis of Sanskrit for the purpose of the correct recitation and interpretation of Vedic texts. The most notable grammarian of Sanskrit was Pāṇini (c. 520–460 BC), whose grammar formulates close to 4,000 rules which together form a compact generative grammar of Sanskrit. Inherent in his analytic approach are the concepts of the phoneme, the morpheme and the root.

Medicine: Findings from Neolithic graveyards in what is now Pakistan show evidence of proto-dentistry among an early farming culture.[38] Ayurveda is a system of traditional medicine that originated in ancient India before 2500 BC,[39] and is now practiced as a form of alternative medicine in other parts of the world. Its most famous text is the Suśrutasamhitā of Suśruta, which is notable for describing procedures on various forms of surgery, including rhinoplasty, the repair of torn ear lobes, perineal lithotomy, cataract surgery, and several other excisions and other surgical procedures.

Metallurgy: The wootz, crucible and stainless steels were discovered in India, and were widely exported in Classic Mediterranean world. It was known from Pliny the Elder as *ferrum indicum*. Indian Wootz steel was held in high regard in Roman Empire, was often considered to be the best. After in Middle Age it was imported in Syria to produce with special techniques the "Damascus steel" by the year 1000.[40]

The Hindus excel in the manufacture of iron, and in the preparations of those ingredients along with which it is fused to obtain that kind of soft iron which is usually styled Indian steel They also have workshops wherein are forged the most famous sabres in the world.

TOPIC 3: CORRELATION OF INTEGRATED SCIENCE WITH OTHER SUBJECTS.

To bring about the unification of knowledge that exists in the various branches of learning, conscious cooperation between the teachers of various subjects is very essential. All the learner should make deliberates efforts to strive some degree of correlation between science and other subjects . integrated science is such a subject which can be easily correlated with any other subject. This will arouse interest in the pupils who associate the knowledge he is gaining with the knowledge he has already gained in the period of other subject. For the sake of elucidation of such correlation, a few brief general suggestions are given below

SCIENCE AND LANGUAGE

Science students are usually week in their expression. So it is very essential that the science student should be able to express their thought in clear, concise, correct and attractive language. This is only possible if the science teacher and the language teacher take a joint responsibility of using language in understanding and expressing the taught subject.

SCIENCE AND SOCIAL SCIENCE

Science and sst are related to each other to a greater extent. Every student is quite familiar with the impact of science on our way of thinking and the standard of living. Science is a dominant factor in determining the belief of educated people. It has direct intellectual effect in dispelling many traditional superstation and beliefs and the introduction the introduction of scientific methods, thereby changing the outlook of people altogether. The history of scientific inventions and discoveries provides useful background for the teaching of history this correlation between science and history is best sought in topics like story of earth, story of man, story of moon etc.

SCIENCE AND MATHEMATICS

Science is probably incomplete without mathematics. It is mathematics that has given a sound footing to the scientific laws, for the real understanding of science the knowledge of science

TOPIC 4: AIMS AND OBJECTIVES OF TEACHING OF SCIENCE WITH SPECIAL REFFERENCE TO INTEGRATED SCIENCE

The Major Aims and Objectives

Harmonious development of child's personality and social efficiency etc. are the general aims of education. If science teaching is to be made effective, then its aims should be in consonance with the general aims of education. We deal with the following main objectives of science teaching.

A. Knowledge. This aim has received the top priority as compared to other aims. Pupils studying general science should acquire the knowledge of:

(i) Fundamental principles and concepts useful in daily life.

(ii) Facts for science study.

(iii) Inter-dependence and relationship of different branches of science.
(iv) Knowledge of plants and animals.

(v) Natural phenomena going on.

(vi) Knowledge of general rules of health and human body etc.

B. Skills.

Science students should acquire skills in experimentation,, construction, observation, drawing etc. Experimentation and construction skills include handling, arranging, preserving, and repairing scientific instruments.

C. Abilities.

The general science teaching should develop certain abilities such as ability to

(i) Sense a problem (ii) organize and interpret

(iii) Analyse
(iv) Generalise

(v) Predict

(vi) Organise exhibitions, excursions and fairs

(vii) Discuss, argue and express scientific terminology

(viii) Improvise and manipulate instruments using his acquire knowledge.

D. Attitudes.

Science teaching directly inculcates the scientific attitudes among the students. So the students should be taught directly and systematically and every individual should be paid heed to ascertain that he develops the desired attitudes and practices them. A man with the scientific attitude is

(a) Critical in observation and thought

(b) Open-minded

(c) Respectful of others' view point and is ready to discuss his problems with others and accepts what appears correct.

(d) In search of the answers to 'What's' and 'Whys' and 'How's' of the things he observes and accepts the natural things as such.

(e) Objective in his approach to problems.

(f) Not a believer of superstitions and misbelieves.

(g) Follower of cause and effect relationship.

(h) Truthful in his experimentation and conclusions.

(i) Impartial and unbiased in his judgments.

(j) Adopts planned procedure in solving a problem.

E. Reflective Thinking.

With the above attitudes developed, a science student will handle a problem scientifically. He will sense a problem, define it, collect evidence, organize and interpret the data, formulate the hypothesis, test its validity and finally draw conclusions impartially. The training in the scientific method should be one of the important aims of teaching science.

F. Habits.

Certain socially desirable habits like honesty, truth, tolerance, self-confidence, self-reliance etc. should be inculcated through the science teaching.

G. Interests.

The teaching of science should also aim at developing some interests in reading scioentific literature, in scientific hobbies, in activities of clubs, excursions, in natural phenomena; in drawing, in leadership, etc. The motivational techniques like rewards and punishments, praise and blame, rivalry and emulation etc. should be implied by the teacher.

H. Appreciation.

The appreciation of natural beauty, scientific inventions, scientists, endeavour is the outcome of science teaching. For the purpose the teacher should arrange outings, should relate the life histories of scientists and should keep the students in touch with the new inventions in science.

I. Providing Work for Leisure.

As the empty mind is devil's workshop, a science student should not while away his leisure. He can prepare inks, soaps, boot polishes and other daily useful things or he can keep hobbies of stamp collecting, coin collecting, photography, drawing, gardening, study of plants and animals or of minerals etc. He can learn to improvise certain instruments, learn to play for musical instruments along with its construction knowledge.

J. Training for Better Living.

A science student should know the ways and means of prevention and eradication of diseases to maintain good health, and should be able to adjust himself with his own domestic, social environment and economic and cultural conditions.

K. Forming Basis for Career.

The attitudes and interests of the students should well be adjudged by the science teachers and they should impart them the knowledge accordingly so that they may prosecute the desired professions. An artist can never be a doctor. So nothing should be forced into the minds of the students. Acceleration should be provided in his own direction to get a suitable vocation and fit himself well in society and prove an asset to it.

The aims and objectives differ a bit at different stages. Preliminary knowledge of objectives is required at early stages while complete and complex objectives are needed at higher stages. So capabilities of pupils should be kept in mind.

The aims and objectives of Teaching Science at different stages have been summarized in the proceedings of the All India Seminar on the Teaching of Science in Secondary Schools, published by Ministry of Education in 1956. They are as follows:

1. Primary Level

The aims and objectives of Teaching Science at Primary School level should be

1. Arousing and maintaining interest in nature and in the physical and social environment, arousing love for nature and its sources.

2. Developing the habit of observation, exploration, classification and systematic way of thinking.

3. Developing the child's powers of manipulative, creative and inventive faculties.

4. Developing neat and orderly habits.

5. Inculcation of habits of healthful living.

2. Middle School Level

In addition to the above, the following aims and objectives are suitable for inculcation at the Middle School, level.

1. Acquisition of a kind of information concerning nature and science which may also serve as the basis for a late General Science Course.

2. Developing the ability to reach generalisation and to apply them for solving every problem.

3. Understanding the impact of science upon one way of life.

4. Developing interest in scientific hobbies.

5. Inspiring children by stories about scientists and their discoveries.

3. High and Higher Secondary Levels

At the high and higher secondary stage, the aims of General Science teaching should be,

1. To familiarize the pupil with the world in which he lives and to make him understand the impact of science on society so as to enable him adjust himself to his environment.

2. To acquaint him with the 'scientific method' and to enable him to develop the scientific attitude.

3. To give the pupil a historical perspective, so that he may understand the evolution of the scientific development.

.M. Kothari Commission (1964-66)-10+2 Pattern

The Indian Education Commission (1964-66) has suggested the aims and objectives of teaching science at various levels:

1. Lower Primary Stage

(i) At the lower primary stage the accent should be on the child's environment-social, physical and biological.

(ii) In classes I and II, the accent should be on cleanliness and formation of healthy habits.

(iii) Development of power of observation.

(iv) In classes III and IV the study should also include personal hygiene and sanitation.

(v) In classes IV and V children should be taught the roman alphabets. This is essential as the internationally accepted symbols for the units of the scientific measurement and the symbols for chemical elements and compounds are written in the Roman alphabet.

(vi) Developing proper understanding of the main facts, concepts, principles and processes in the physical and biological environment.

2. Higher Primary Stage

(i) At this stage emphasis may shift to the acquisition of knowledge together with the ability to think logically, to draw conclusions and to make decisions at a higher level.

Hi) Science should be taught as physics, chemistry, biology, and astronomy. A disciplinary approach to science learning instead of general science would be more effective in providing the necessary scientific base to young people.

3. Secondary stage
(i) At the secondary stage science should be taught as a discipline of the mind and a preparation for higher education.
*(ii)*At the lower secondary class's physics, chemistry, biology and earth sciences should be taught as compulsory subjects.

(iii) At the higher secondary stage there should be diversification of courses and provision for specialisation.

TOPIC 5 : SCIENCE CURRICULUM AT SECONDARY LEVEL

At the secondary stage, the beginning made at the earlier stage to introduce science as a discipline is to be further strengthened without emphasis on formal rigour. Concepts, principles and laws of science may now appear in the curriculum appropriately but stress should be on comprehension and not on mere formal definitions. The organization of science content around different themes as being practiced seems appropriate at the secondary stage, but the curricular load needs to be substantially reduced to make room for the additional elements of design and technology, and other co-curricular and extra-curricular activities.

At the secondary school stage, concepts that are beyond direct experience may come to occupy an important place in the science curriculum. Since not all phenomena are directly observable, science also relies on inference and interpretation. For example, we use inference to establish the existence and properties of atoms, or the mechanism of evolution. By this time, however, students should have developed the critical ability to evaluate the epistemological status of facts that they encounter in science.

Experimentation, often involving quantitative measurement, as a tool to discover/verify theoretical principles should be an important part of the curriculum at this stage. The technological modules introduced at this stage should be more advanced than at the upper primary stage. The modules should involve design, implementation using the school workshop, if possible, and testing the efficacy of the modules by qualitative and quantitative parameters. Experiments (and, as far as feasible, the technological modules) should be part of the content of the secondary stage textbook, to avoid their marginalization or neglect. However, this part of the textbook should be subject to internal assessment only. The theoretical test at this stage including that for the Class X external Board examination should have some questions based on the experiments/technological modules included in the textbook. Participation in co-curricular activities must be regarded as equally important at this stage. These may involve taking up projects (in consultation with teachers) that bear on local issues and involve the problem-solving approach using science and technology.

The various components of the science curriculum indicated above should be integrated imaginatively. The entire upper primary and secondary school curriculum should have horizontal integration and vertical continuity.

TOPIC 6: INTEGRATED SCIENCE BOOKS

- **QUALITIES OF GOOD SCIENCE BOOKS AND ITS EFFECTIVE USE**

In the teaching-learning process, the text-book occupies an important place. There is a saying "As is the text-book, so is the teaching and learning". A good text-book can even replace class-room teaching. The science text-book should aim at aiding the pupils in the development of their personalities, in developing open mindedness, developing appreciation and understanding of nature and not merely stuffing their minds with facts.

1. The author: A good text-book is judged, at face, by the author, his qualification and experience.
2. Mechanical features of the text-book:

(a) The print and paper used and the binding of the text-book should be attractive. It should be hard and durable.

(b) The printing should be clear, legible and appropriately spaced.

(c) The book should be well-illustrated with diagrams, sketches and pictures.

(d) The size of the print, the language and experiments discussed should suit the age of the child and standard of the child.

3. The subject matter-its nature and organisation:

(a) The subject-matter should be developed as far as possible in psychological sequence. Care must be taken of the mental growth and interest of pupils.

(b) There should be consistency of the subject-matter and the text-book should satisfy the objectives of science teaching.

(c) Each chapter should begin with a brief introduction and end with a summary. ^

(d) Subject-matter should lead to the inculcation of scientific attitudes, disciplinary and cultural values.

(e) Each chapter should contain assignments at the end.

(f) During treatment of subject-matter, numerical examples should find place where necessary.

(g) Headings and sub-headings are given in bold letters.

(h) Each text-book should contain detailed Table of Contents and an index.

(i) The language of the book should be simple, clear, lucid, scientific and precise. The English equivalents of the terms should be always given in brackets.

(J) The text-book should give suggestions for improving scientific apparatus.

{k) Examples in the text-book should be given from local environment and from life experience.

(l) During the treatment of science subject in the text-book, care should be taken to see that it is correlated with other subjects like craft, social environment and physical environment.

(m) Each text-book should be accompanied by a laboratory manual.

Besides these characteristics, the UNESCO Planning Mission has given some principles of writing text-books in U.S.S.R. and other countries. They are as follows:

(i) It should be first of all according to the requirements of the syllabus. It should also help in the improvement of the syllabus.

(ii) The facts, concepts etc., should be modern and within the comprehension of the pupils.

(iii) The contents should contain not only the established facts but also the problems which are being researched and thereby, arousing the interest in the pupils in these problems.

(iv) It should help in linking up science with life and practice. The pupils should be equipped with 'know-how' utilizing the knowledge in everyday life.

(u) The whole content of the text-book should be aimed at shaping the integrated modern scientific outlook which ensures success in mastering scientific knowledge and solution of the problems of vital issues. The content should be simple, brief, exact, definite and accessible.

- **CRITERIA FOR EVALUATION OF INTEGRATED SCIENCE TEXTBOOK**

In an ideal education system, a textbook is only one of the diverse tools for curricular transaction. In India, for the great majority of school-going children, as also for their teachers, the textbook is the only accessible and affordable curriculum resource. Consequently, we must use the textbook as one of the primary instruments for universalization of good science education in the country. Textbooks must help realize the basic curricular objectives of different stages, discussed earlier. A major problem today is the practice of rote learning, largely a result of the prevailing examination system Textbooks should help counter this tendency by raising meaningful and interesting questions, and by emphasizing applications and problem-solving. They should systematically establish linkages of many kinds with everyday experiences, within and between topics, between different curricular areas and across the years of schooling. Such linkages would form powerful Rein forcers of learning.
To be fair to the past efforts in textbook-writing we must add that dealing with the various issues noted earlier is not an easy task. The problem is greatly compounded by the overpowering examination system that is discussed later. In any case, the development of a science curriculum that will satisfy the various criteria of validity is a highly challenging intellectual endeavour. Perhaps there is no single perfect solution to the problem. Perhaps there exist multiple partial solutions only, each suited to specific contexts. This is precisely

why we recommend that curricular choices and textbook writing in our country should be20 characterized by diversity and alternative approaches. The national agencies should certainly continue their efforts to produce quality textbooks. States should be encouraged to develop multiple versions of their textbooks reflecting different local contexts; they could prepare different books for different districts, if possible. In case that is not possible, teachers and educationists should together prepare supplementary materials at local levels that can be integrated with the materials in the textbooks in use. Alternative writing of textbooks by individuals / NGOs / institutions should be encouraged. A reliable and efficient process of accreditation of the textbooks may be required to keep a check on purely commercial interests and to promote genuine creative textbook writing in the country.

UNIT II : PLANNING, DESIGHING AND TRANSLATION OF INSTRUCTION,

TOPIC 1: DEVELOPMENT OF UNITE PLAN, LESSON PLAN USING VARIETY OF APPROCHES.

STEPS FOR DEVELOPING UNIT PLAN OR LESSON PLANE.

1. **Figuring out the "big picture" and worthwhile goals**

- Based on consultation with the CT, standards documents, and district objectives, etc., what will be the main idea for the unit, and the learning objectives?
- What do I know about this content and what do I need to learn in order to teach it?
- What are the "big ideas" that I want students to learn? What are key skills and strategies needed to learn these big ideas (e.g., reading, writing, oral language skills and strategies)?
- How are these big ideas connected to each other (draw a concept map)?
- How does this content connect with students? What do different students already know about this? How does it enter their lives? What is their proficiency in using skills and strategies (e.g., reading, writing, oral language skills and strategies) needed to learn the content? How can I find out?
- Based on the above, how can I tailor the objectives and main ideas for the unit to match my teaching situation?
- What central problem or question will connect all the lessons in this unit? What is the desired student response to this question?
- Why is the selected content important for students to learn?
- What resources (books, audiovisuals, magazines, museums, computer programs, web sites, etc.) are available to support my teaching and students' learning? How good are they?

2. Instructional Plan

- What are some activities/tasks that I can engage students in that will promote their learning and growth (e.g., conceptual change, in-depth understanding of key concepts, strategic use of skills and strategies)?
- Which activities are likely to have the most impact on my students' understanding and provide necessary support throughout the learning process?
- How do the activities I am considering match up to the unit objectives? Do I address each objective in multiple lessons/activities to give students adequate time and support to really understand?
- What sequence of activities will best support students in undergoing significant change in their knowledge and understanding? (Consider a conceptual change instructional model for some subject matter areas: elicit students' ideas to the central question, let students explore their own ideas, provide activities to challenge students to change and expand their initial ideas, explain new ideas, give students multiple chances to apply and use new ideas, engage students in reflecting on their learning and growth.)

3. Designing daily lesson plans

- What, specifically, do I want students to learn from this lesson that will contribute to the students' understanding of the unit's main ideas and objectives?
- Is the lesson developmentally appropriate?
- How can I help students see the links between this activity and other lessons?
- Does the activity clearly link to previous and future activities?
- What will be easy or hard for students? How will I accommodate and provide support for individual differences? (See sections below on "Providing Academic,
- Social, and Language Support for All Learners" and "Putting it Together" and companion document "Designing Lessons for Diverse Learners."
- How will I engage students in learning?
- How will I start?
- What teaching strategies will I use?
- What activities will students engage in? Why?
- How much time will be devoted to different parts of the lesson?
- What directions will I need to give, and how should I present them?
- What materials are needed and when will I prepare and organize them?
- What questions should I be prepared to ask? How might students respond?
- How will students represent their learning?
- What classroom management issues do I need to consider and plan for (organization of groups, procedures, transitions, handling student lack of cooperation, etc.)?

4. Developing Performance Assessment(s)

- How will I assess student learning throughout the unit and in some kind of culminating activity (pre and post tests, projects, assignments)? How will students demonstrate their learning?
- Does my assessment match the objectives and central problem or question? How will I document and analyze the students' responses to these assessment strategies?
- How will they show that they have acquired the knowledge and/or skills I am trying to teach?
- How will I know that the students have achieved the desired learning outcomes?
- What evidence will I accept that students have learned?
- Reflecting while teaching
- What are different students learning or misunderstanding? What evidence do I have?
- What kind of records should I keep to help me assess student learning throughout the unit/lesson?
- Where do we go next? What are some of the alternatives and what reasons do I have for choosing a particular course of action?
- How can I take into account differences among students and promote genuine learning for all?
- In what ways can I better engage students who are not functioning members of the learning community? What can I learn about them that will help me help them become more successful?

5. Reflecting after teaching a unit

- How can I best analyze my students' learning from this unit?
- What did I learn about my students, content, and myself as a teacher?
- What went well? What were the surprises?
- What would I do differently and why?
- What do I need to learn more about?

6. Providing Academic, Social and Language Support for All Learners

- Before you can make decisions about adapting curriculum and teaching methods, you need to have a basic understanding of the nature of specific disabilities, learning styles and knowledge of your students' cultural and linguistic backgrounds. Be sure you take time to get to know each learner well enough to become aware of his/her particular needs, and be sure to let your CT or field instructor know if you need more information.
- It is essential that you be clear about your lesson objectives before you begin thinking about providing particular types of support.

- You need to determine what tasks, skills, background knowledge are necessary for the completion of the lesson: psychomotor, cognitive, affective, cultural, and linguistic.
- There are different areas where various types of support can be considered. The teacher can make changes in the way the lesson is taught, the materials that are used, the structure of the classroom, and the way the objectives are demonstrated to meet the needs of students with disabilities, different learning styles and/or different cultural or linguistic backgrounds.

7. Putting It Together: Essential Questions for Academic, Social and Linguistic Support

Based on the items above, a teacher who is thinking about providing academic, social and linguistic support can use the questions below to address these issues:

- What are the academic demands of this lesson? What components of this lesson need to be adapted while still maintaining high expectations? How will I know whether each student is able to meet the lesson objective?
- What do I want the students to learn and be able to demonstrate upon completion of this lesson?
- What are the tasks/skills/background knowledge needed for the completion of this lesson?
- What are the student's strengths and weaknesses? What are the student's preferred learning styles and ways of communicating?
- What tasks/skills/background knowledge will be challenging for the student?
- How can the student make use of his/her strengths?
- What scaffolding and explicit instruction is needed (e.g., Think Sheets to help organize ideas; Editing and Revising guides; visual organizers to help children understand where they are in the process of completing the task)?
- When and how can I make supports optional (e.g., when are they no longer needed) so control of activities is transferred to the learner?
- What are the social demands of this lesson (e.g., cooperation, listening, sharing, following directions)? How can I help each learner meet these demands?
- Do I have major routines in place that help learners know what is expected?
- Have I provided modeling, thinking aloud, and rubrics that help learners understand the particular task to be done and how it is to be done?
- Have I provided language (helper words) and modeled when/how to use them
- (e.g., who, what, when; sentence starters)?
- Have I provided visual cues (e.g., lists of expected behaviors) as reminders to all students and to reduce demands on those with memory processing problems?

- What are the linguistic demands of this lesson? How can I help each learner meet these demands?
- Does my lesson employ multiple strategies, lots of student input, and a range of learning options (e.g., listening, speaking, reading and writing)?
- Do all students have multiple opportunities to speak, make mistakes, and rely on the success of communication to develop their linguistic capacities?
- Am I careful to avoid the use of slang, idioms and phrasal verbs (e.g., get over, get by, get through, get around) that are confusing to those whose first language is not English?
- Do I use ample non-verbal cues (e.g., gestures, pictures, concrete objects) to assist in comprehension?
- Am I aware of each student's cultural preferences and traditions for communicating (e.g., eye contact; language routines; what to be called humour)?
- Are objects in my classroom labelled in multiple languages to acknowledge the first language of each learner?
- Since all language acquisition is literacy development, do students whose first language is not English have opportunities to use their first language?

TOPIC 2: TEACHING LEARING PROCESS WITH A FOCUS ON :

1. **INQUIRY APPROACH**

inquiry-based approach to teaching and learning is potential to increase intellectual engagement and foster deep understanding through the development of a hands-on, minds-on and 'research-based disposition' towards teaching and learning. Inquiry honours the complex, interconnected nature of knowledge construction, striving to provide opportunities for both teachers and students to collaboratively build, test and reflect on their learning.

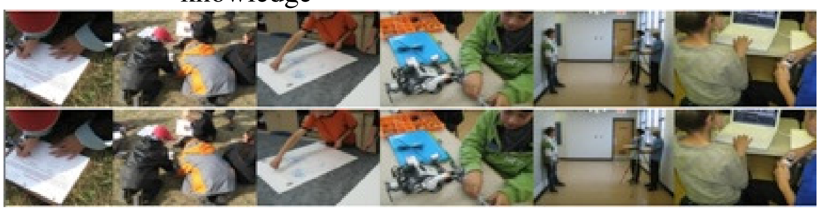
It is crucial to recognize that inquiry-based teaching should not be viewed as a technique or instructional practice or method used to teach a subject. Rather, inquiry starts with teachers as engaged learners and researchers with the foundational belief that the topics they teach are rich, living and generous places for wonder and exploration.

Inquiry is not merely 'having students do projects' but rather strives to nurture deep, discipline-based way of thinking and doing with students.

As as entry point, inquiry involves learners:

- 1

- ✦tackling real-world questions, issues and controversies
- ✦developing questioning, research and communication skills
- ✦solving problems or creating solutions
- ✦collaborating within and beyond the classroom
- ✦developing deep understanding of content knowledge
- ✦participating in the public creation and improvement of ideas and knowledge



Inquiry is a umbrella term that covers a number of other approaches to teaching and learning. Teaching practices that utilize a disposition of inquiry learning include:

2

- ✦problem-based learning: learning that starts with an ill-structured problem or case-study
- ✦project-based learning: students create a project or presentation as a demonstration of their understanding
- ✦design-based learning: learning through the working design of a solution to a complex problem
- As contrasted with more traditional forms of teaching and learning, inquiry emphasizes the process of learning in order to develop deep understanding in students in addition to the intended acquisition of content knowledge and skills. Inquiry draws upon a constructivist learning theories where understanding is built through the active development of conceptual mental frameworks by the learner. This approach is supported and enhanced by a broad research basewhich has identified three key implications for effective instructional practices:

- 1.Students come to the classroom with preconceptions about the world. This means teaching practices must draw out and work with students preexisting understandings and make student 'thinking' visible and central to the learning.
- 2.Competence in an area of study requires factual knowledge organized around conceptual frameworks to facilitate knowledge retrieval and application. Classroom activities should be designed to develop understanding through in-depth study of curriculum topics.
- 3.Meta-cognition (thinking about thinking) helps students take control of their learning. Opportunities for students to define learning goals and monitor their own understanding need to be embedded into classroom tasks.

Classroom tasks that are worthy of students time and attention, relevant, connected to the world and organized around the 'big ideas' of a subject can develop understanding, intellectual interest and engagement with students.

If we are to make use of these important findings from the learning sciences, inquiry should be viewed as a highly-structured and thoughtfully designed-endeavour. As contrasted with 'minimal-guided' inquiry which has been shown to be marginally effective as a teaching technique, (Hattie) classroom tasks that are worthy of students time and attention, relevant, connected to the world and organized around the 'big ideas' of a subject can develop understanding and intellectual interest and engagement with students.

For inquiry to be effective requires significant intellectual investment on the part of teachers to design learning tasks that are connected to the disciplines, to their students' lives, and to the world, while focused toward clear and achievable learning targets. It requires that teachers see themselves as learners and researchers of both the subjects they teach and their professional practice as a whole.

Inquiry as Playing the "Whole Game"

One way to conceptualize inquiry based learning is the notion of "playing the whole game," an idea by David Perkins, professor at the Harvard Graduate School of Education. Perkins begins with the belief that teachers generally approach the complexity of teaching in one of two ways:

1. *Students learn isolated skills and knowledge*, starting with the simple building blocks of a particular topic and then building to more complex ideas. While this appeals to common sense (think of the efficiency of a automobile assembly line), the problem with this approach is the removal of any context to the learning, making deep understanding of the content less likely. Perkins calls this approach *elementitis*, where learning is structured exclusively around disconnected skills and fragmented pieces of information.

2. *Students learn about a particular topic.* This approach is frequently utilized in history and science classes, where students are taught about other people's ideas but rarely if ever given the opportunity to produce and refine their own ideas. Perkins calls this *aboutitis* where learning is equated with consuming knowledge or information, without developing the critical thinking or creative, knowledge-building skills necessary to transfer knowledge to novel situations.

The solution that Perkins offers to the typical classroom experience is what he calls *learning by wholes*, structuring learning around opportunities to experience or engage in the topic as it would exist outside of school. Using the metaphor of a baseball game, Perkins believes that the experience of most students involves either learning isolated skills (i.e., only ever throwing a ball) or learning about the game (i.e., studying baseball statistics or the history of baseball) without ever getting out onto the field and participating in an actual game. In a classroom setting, this means providing opportunities for students to experience the 'whole game' of mathematical thinking or scientific problem solving or historical analysis of primary source artifacts.

It is important to note that focusing on the elements of a topic, or learning about a topic are not necessarily bad approaches to teaching and learning. Rather, they are important tools for teachers to use in a classroom environment. However, the issue arises when learning is focused solely on *elementitis* or *aboutitis*, the usual practice in most classrooms. With an inquiry-based, or whole-game approach, authenticity and relevant learning tasks such as the decomposition lab or the Cigar Box Project provide the necessary context and engagement into which learning the elements or background information about a topic can be embedded in a more productive way.

This notion by Perkins leads us to an important point, that an inquiry-based approach is most effective when it is carefully designed and structured by teachers. Inquiry should not be confused with 'discovery learning' where students are left to explore and develop understanding on their own. Rather, to be most effective inquiry should be seen as a complex combination of structured learning with intentional opportunities for students to create, design, imagine and develop new possibilities. In fact, both of the examples shared so far were carefully and collaborative planned by a group of educators and mentors.

Inquiry as "Play"

An analogy when considering the design and implementation of inquiry is the notion of play. Here we might consider play not merely as a childish activity or games but rather in the way put forth by John Seely Brown; play as the creative tension that exists between rules and freedom, between what is known and unknown.

Just as play requires rules to keep a game going, inquiry needs structure and boundaries to be effective. As compared with more traditional delivery models of teaching and learning that focus only on pre-existing knowledge or skills, inquiry remains open to the unknown, to the 'not yet.' As teachers are considering inquiry in a particular topic it becomes helpful to consider how students might 'play' within in topic, that is, maintain an emphasis on what is already known (the foundational concepts or key-ideas) while allowing for space for the unknown where students can create, design, interpret or participate.

Structuring Inquiry with Liberating Constraints

Another approach that frames inquiry as a carefully designed experience for students is the notion of liberating or enabling constraints (Davis, Sumara and Luce-Kapler, 2000). "Liberating constraints describes the balance between freedom and constraint that creates conditions for learning and creativity." (p. 87) This is the act of structuring learning, not in the sense of a pre-determined, closed plan of action, but rather an organic, biological understanding of structure, where organisms respond and adapt to changing conditions. The authors refer to the etymology of structure as "describing how things spread out or pile up in ways that can't be pre-determined, but that aren't completely random either." (p. 49)

Here again we see how powerful learning occurs in the space between what is known and structured and what is yet to be. When designing learning around liberating constraints, teachers should balance the authentic constraints put on a task from within the discipline or topic itself with space for students to participate in the experience through their own creativity and individual voices and experiences.

Moving From Theory to Practice

So far we have addressed inquiry as a complex approach to teaching and learning that strives to foster deep understanding in students by providing opportunities for active involvement in learning. The challenge for teachers is to move inquiry from being a theory or idea to being a disposition that unpins how teachers view their students, subjects and their own teaching practice.

One exemplary organization who focuses on inquiry is the Galileo Educational Network from Calgary, Alberta. In addition to providing research, resources and professional development on teaching and learning from an inquiry stance, the Galileo Network has also created theGalileo Inquiry Rubric. Designed with purpose of making inquiry more concrete and accessible, the Galileo rubric is intended to be used by teachers in the design and evaluation of inquiry-based teaching.

The goal of this document is to explore a modified version of Galileo Inquiry rubric, built around 8 elements of strong, inquiry-based practice:

- 1.Authenticity
- 2.Deep Understanding
-
- 3.Performances of Understanding
- 4.Assessment
- 5.Appropriate Use of Technology
- 6.Connecting with Experts
- 7.Student Success
- 8.Ethical Citizenship

2. PROBLEM SOLVING APPROACH

There are some problems for which students know the strategy to solve as soon as they examine the problems. However, for particularly hard problems, they do not know right-away how they can solve the problem. The progress on such problems often comes from heuristics or 'rules of thumb' that are likely to be useful, but are not guaranteed to solve problems. As a result, the progress on a problem takes the form of multiple explorations or search of different ideas. Progress on a typical problem would involve a student trying out a lot of different leads using such heuristics. Work on the problem solving may go through different phases such as trying to understand the problem, working on a specific approach, getting stuck and trying to get unstuck, critically examining solutions or communicating. The work may involve going back and forth between these different phases of work. On this site, we would now be providing a variety of different suggestions for attacking the problem. Many of these are rules of thumb or heuristics. These heuristics can be described in the form of <condition, action> form where conditions describe problem situations in which these should be applied and actions describe what should be done.

Are you about to start working on a problem?

If you are starting the work on a problem or if you are stuck and you do not know how to progress on a problem, try to understand the problem. Ask the following:
What is given and what is to be found?
Is it possible to draw a picture or a diagram of the context described in the problem?

Can you paraphrase the problem?

Can you come up with specific examples corresponding to the problem?

Have you thought out an approach to attack the problem?

If the general approach to solving the problem is obvious to you, create a plan to solve the problem based on this approach and carry out this plan.

If you know a related or similar problem, you can use the knowledge of solution of the related problem to come with a plan.

Otherwise, you may be feeling stuck.

Are you feeling stuck?

Many different approaches can be tried to get unstuck. One approach is to try working a simpler version of the problem, and use the solution to the problem to get insights that are useful in solving the original problem.

When you come a surprise or an 'Aha' moment, try studying the observations that triggered it in more detail and try observing how these could be used in progressing on the problem.

Alternatively, you may just try to understand the problem better and use relevant suggestions.

If you are discouraged with a few failed attempts, read this quote from the famous scientist, Edison. An assistant asked, "Why are you wasting your time and money? We have had failure after failure, almost a thousand of them. Why do you continue to pursue this impossible task?" Edison said, "We haven't had a thousand failures, we've just discovered a thousand ways to not invent the electric light."

Are you busy working out details?

Monitor how you are progressing and backtrack if needed.

Do not forget to look for patterns, the unusual and surprises.

Look for any surprise, understand it and its implication for the problem

Are you done solving a problem or a sub-problem or inferring a key conclusion?

Critically examine your hypotheses and solutions. Done solving the problem? If it works, check each step. Can you see clearly that the step is correct? Can you prove that it is correct?

Learn from reflection
•Specialize/ generalize heuristics (including meta-cognitive heuristics), Learn new heuristics
· If the plan does not produce solution in a short time, then check from time to time: why are you doing what you are doing? are you progressing? This is self-monitoring.
· If your plan fails, examine why it did not work. Writing with a rubric or a template can help in recalling and studying what you have done so far. Organize the information. Ask:

Can you conclude about the approaches that won't work? What else did you learn? Do you see any patterns?

Are you about to communicate your conclusions to a teacher or to partners?

Final part of your work on a problem is to communicate your conclusions. What is communicated may differ depending on the situation. Sometimes, you are expected to report only the answer to the problem. Sometimes, you are expected to show your work. Sometimes, you may be doing collaborative problem solving. In collaborative problem solving, it is important to be a good communicator. Helping others on problems that you have solved can help you develop skills needed to become a good math communicator. The aspects of such communication include explaining your solution to someone else clearly, understanding someone else's solution and providing feedback on it at various levels of detail. After you create an explanation for your solution, examine carefully if you have justified each step in the work.

3. PROJECT METHOD

The **project method** is a medium of instruction which was introduced during the 18th century into the schools of architecture and engineering in Europe when graduating students had to apply the skills and knowledge they had learned in the course of their studies to problems they had to solve as practicians of their trade, for example, designing a monument, building a steam engine.[1] In the early 20th Century, William Heard Kilpatrick[2] expanded the project method into a philosophy of education. His device is child-centred and based in progressive education. Both approaches are used by teachers worldwide to this day.[3] Unlike traditional education, proponents of the project method attempt to allow the student to solve problems with as little teacher direction as possible. The teacher is seen more as a facilitator than a deliver of knowledge and information.

Students in a project method environment should be allowed to explore and experience their environment through their senses and, in a sense, direct their own learning by their individual interests. Very little is taught from textbooks and the emphasis is on experiential learning, rather than rote and memorization. A project method classroom focuses on democracy and collaboration to solve "purposeful" problems.

Kilpatrick devised four classes of projects for his method: construction (such as writing a play), enjoyment (such as experiencing a concert), problem (for instance, discussing a complex social problem like poverty), and specific learning (learning of skills such as swimming).

The term project is no longer reserved for the planned undertaking calling for the constructive thought and action. Project means almost any undertaking. It is activity oriented buy it is more than the simple activity. It advocates of this the education should be related to the life situation. It the experience centered teaching activity. The main focus of this strategy is socializing the child and developing the problem solving ability.

Definition

1. A project is a whole-hearted purposeful activity proceeding in a social environment – W. H. Kilpatrick.
2. A problem is a problematic act carried to completion in its natural selection – R. L. Stevenson.
3. Project is a voluntarily undertaking which involves constructive effort or thought and eventuates into objective results – Thomas and Lang.

Types

According to Kilpatrick there are four types of projects. They are:

1. Constructive project:
Practical or physical tasks such as construction of article, making a model, digging the well and playing drama are done in this type of projects.

2. Aesthetic project:
Appreciation powers of the students are developed in this type of project through the musical programmes, beautification of something, appreciation of poems and so on.

3. Problematic project:
In this type of project develops the problem solving capacity of the students through their experiences. It is based on the cognitive domain.

4. Drill project:
It is for the mastery of the skill and knowledge of the students. It increases the work efficacy and capacity of the students.

Other types

Individual and Social (Group) projects:
In individual project every students solve the problem in their own according to their interest, capacity, attitude and needs. It develops the problem solving qualities individually and not the social qualities. In the other hand Group projects the problem is solved by the group of pupil in the class. Here the social, citizenship qualities and synergism are develops.

Simple and Complex project:
In the simple projects the students are completing only one work at a time. They are also focus the work in the one subject or one area only. It gives the deep information about the project in a one angle. The students get deeper knowledge about the problem deeper and broader.

In the complex project the students are carried out more than one work at a time. They are focuses on the work in various subject and angles. Here the students get the knowledge about the work in various activities and dimensions.

Principles

1. Principle of Purposefulness

The project should be purposeful, and that should have some main objective. The objective should give the enthusiasm and work to the students, otherwise that will be a wastage of time and energy.

2. Principle of Utility

The project should be useful to the students and the society. It will give some value to the students. From the good project the students as well as the society get the benefit a lot.

3. Principle of Freedom

The students are free to select the topic and execute the work according to their well and wish, interest, attitude and capacity. The teacher just a guide and give a guidelines to execute that.

4. Principle of Activity

Project means the purposeful activity, at the end of the project the students gain knowledge through their activity. It is based on the principle of learning by doing.

5. Principle of Reality

Project should be real and related to the life situation of the students and the society. Only then they would be able to complete the project naturally and really. Imaginary problems are not taken up in the project.

6. Principle of Social Development

A good project focuses society needs, social development, and usefulness to the society. A single project solves the problem of the thousands of the people or the society.

7. Principle of Planning

The student develops prior planning in advance about the project. They find solutions for - How? When? What? Where? Why? So, good project develops the problem solving capacity and prior planning for the execution.

Steps

Project method has the following steps:

1. Creating Situation

In the first step teacher creates the proper situation to the students in the class. He puts up the knowledge about the project method procedure, steps, and uses to the students. After that he should give the proper motivation through conversation about the day to day life problems to the students.

2. Selection of the problem

Then the teacher helps the students to select the problem and guide them. Here the students are having freedom to choose the topic or problem based on their interest and ability. Before choosing the topic the principles should be taken in to an account.

3. Planning

The teacher discuss with the students about the problem in various angles and points. He should create the situation to the discussion with the students and they are allowed to talk freely and openly. After the free expression of the students' opinion about the problem, the teacher writes down the whole programme of action stepwise on the blackboard. The grouping is made by the teacher based on the interest and ability of the students.

4. Execution

The students are stating their work in this step. They are collecting the relevant information/data and materials at first. The teacher should give the time and right to the students according to their own speed, interest and ability. If need arises, he will provide the necessary help and guidelines to the students. He demands the groups to complete the project in the particular time.

5. Evaluation

Here the students evaluating their task. They determine whether the objects are achieved or not. After that they criticize and express their feeling about the task freely. They report the planning, selecting the task, execution and the entire thing are discussed in the class. The entire things are collectively reported to the teacher.

6. Reporting and Recording

It is the last step of the project method in which each and every step of the work are reported. The reported things are recorded in a certain order in a book form. The record is useful for the further use and future reference about the project. It reveals many ideas about the concern project. The book formatted report is submitted to the teacher at the end.

Advantages

1. It is students centered, activity based method.
2. Students involves whole-heartedly in the learning process according to their needs, attitude, interest and ability.

3. This method is related to the life situation of the students.
4. This method develops the problem solving ability to the students.
5. It makes the students as independent.
6. It gives the real work experience to the students.
7. It develops the social qualities and synergism in the students' heart.
8. It develops the responsibility realization of the students.
9. By this the students organizes the planning things in an order.

Limitations

1. It is a time consuming method.
2. It is difficult to complete the prescribed syllabus in a particular time.
3. It is a very costly method.
4. It is not applicable for the lower classes.
5. All topics are not able to teach through this method.
6. It is not applicable for the all schools.
7. It needs so many materials for the execution.

CONSTRUCTIVIST APPROACH

Constructivist teaching is based on constructivist learning theory. Constructivist teaching is based on the belief that learning occurs as learners are actively involved in a process of meaning and knowledge construction as opposed to passively receiving information. Learners are the makers of meaning and knowledge. Constructivist teaching fosters critical thinking, and creates motivated and independent learners. This theoretical framework holds that learning always builds upon knowledge that a student already knows; this prior knowledge is called a schema. Because all learning is filtered through pre-existing schemata, constructivists suggest that learning is more effective when a student is actively engaged in the learning process rather than attempting to receive knowledge passively. A wide variety of methods claim to be based on constructivist learning theory. Most of these methods rely on some form of guided discovery where the teacher avoids most direct instruction and attempts to lead the student through questions and activities to discover, discuss, appreciate, and verbalize the new knowledge

Characteristics of Constructivist Teaching

One of the primary goals of using constructivist teaching is that students learn how to learn by giving them the training to take initiative for their own learning experiences.

According to Audrey Gray the characteristics of a constructivist classroom are as follows:

1. the learners are actively involved

2. the environment is democratic
3. the activities are interactive and student-centered
4. the teacher facilitates a process of learning in which students are encouraged to be responsible and autonomous

Examples of constructivist activities

Furthermore, in the constructivist classroom, students work primarily in groups and learning and knowledge are interactive and dynamic. There is a great focus and emphasis on social and communication skills, as well as collaboration and exchange of ideas.[1] This is contrary to the traditional classroom in which students work primarily alone, learning is achieved through repetition, and the subjects are strictly adhered to and are guided by a textbook. Some activities encouraged in constructivist classrooms are:

- Experimentation: students individually perform an experiment and then come together as a class to discuss the results.
- Research projects: students research a topic and can present their findings to the class.
- Field trips. This allows students to put the concepts and ideas discussed in class in a real-world context. Field trips would often be followed by class discussions.
- Films. These provide visual context and thus bring another sense into the learning experience.
- Class discussions. This technique is used in all of the methods described above. It is one of the most important distinctions of constructivist teaching methods.

Constructivist approaches can also be used in online learning. For example, tools such as discussion forums, wikis and blogs can enable learners to actively construct knowledge. A contrast between the traditional classroom and the constructivist classroom is illustrated below:

The Traditional Classroom • Begins with parts of the whole–Emphasizes basic skills • Strict adherence to fixed curriculum • Textbooks and workbooks • Instructor gives/students receive • Instructor assumes directive, authoritative role • Assessment via testing / correct answers • Knowledge is inert • Students work individually

The constructivist Classroom • Begin with the whole – expanding to parts • Pursuit of student questions / interests • Primary Sources / manipulative materials • Learning is interaction – building on what students already know • Instructor interacts / negotiates with students • Assessment via student works, observations, points of view, tests. Process is as important as product • Knowledge is dynamic / change with experiences • Students work in groups Source : Thirteen Ed Online (2004)

Because existing knowledge schemata are explicitly acknowledged as a starting point for new learning, constructivist approaches tend to validate individual and cultural differences and diversity.

Role of teachers

In the constructivist classroom, the teacher's role is to prompt and facilitate discussion. Thus, the teacher's main focus should be on guiding students by asking questions that will lead them to develop their own conclusions on the subject. Parker J. Palmer (1997) suggests that good teachers join self, subject, and students in the fabric of life because they teach from an integral and undivided self, they manifest in their own lives, and evoke in their students, a capacity for connectedness".

David Jonassen identified three major roles for facilitators to support students in constructivist learning environments:

- Modeling
- Coaching
- Scaffolding

A brief description of the Jonassen major roles are:

Modeling – Jonansen describes Modeling as the most commonly used instructional strategy in CLEs. Two types of modeling exist: behavioural modeling of the overt performance and cognitive modeling of the covert cognitive processes. Behavioural modeling in Constructivist Learning Environments demonstrates how to perform the activities identified in the activity structure. Cognitive modeling articulates the reasoning (reflection-in-action) that learners should use while engaged in the activities.

Coaching – For Jonassen the role of coach is complex and inexact. She acknowledges that a good coach motivates learners, analyzes their performance, provides feedback and advice on the performance and how to learn about how to perform, and provokes reflection and articulation of what was learned. Moreover, she posits that coaching may be solicited by the learner. Students seeking help might press a "How am I Doing?" button. Or coaching may be unsolicited, when the coach observes the performance and provides encouragement, diagnosis, directions, and feedback. Coaching naturally and necessarily involves responses that are situated in the learner's task performance (Laffey, Tupper, Musser, & Wedman, 1997).

Scaffolding - Scaffolding is a more systemic approach to supporting the learner, focusing on the task, the environment, the teacher, and the learner. Scaffolding provides temporary frameworks to support learning and student performance beyond their capacities. The concept of scaffolding represents any kind of support for cognitive activity that is provided by an adult when the child and adult are performing the task together (Wood & Middleton, 1975).

Constructivist Learning Environments (CLEs)

Jonassen has proposed a model for developing constructivist learning environments (CLEs) around a specific learning goal. This goal may take one of several forms, from least to most complex:

- Question or issue
- Case study

- Long-term Project
- Problem (multiple cases and projects integrated at the curriculum level)

Jonassen recommends making the learning goals engaging and relevant but not overly structured.

In CLEs, learning is driven by the problem to be solved; students learn content and theory in order to solve the problem. This is different from traditional objectivist teaching where the theory would be presented first and problems would be used afterwards to practice theory.

Depending on students' prior experiences, related cases and scaffolding may be necessary for support. Instructors also need to provide an authentic context for tasks, plus information resources, cognitive tools, and collaborative tools.

Constructivist assessment

Traditionally, assessment in the classrooms is based on testing. In this style, it is important for the student to produce the correct answers. However, in constructivist teaching, the process of gaining knowledge is viewed as being just as important as the product. Thus, assessment is based not only on tests, but also on observation of the student, the student's work, and the student's points of view. Some assessment strategies include:

- Oral discussions. The teacher presents students with a "focus" question and allows an open discussion on the topic.
- KWL(H) Chart (What we know, What we want to know, What we have learned, How we know it). This technique can be used throughout the course of study for a particular topic, but is also a good assessment technique as it shows the teacher the progress of the student throughout the course of study.
- Mind Mapping. In this activity, students list and categorize the concepts and ideas relating to a topic.
- Hands-on activities. These encourage students to manipulate their environments or a particular learning tool. Teachers can use a checklist and observation to assess student success with the particular material.
- Pre-testing. This allows a teacher to determine what knowledge students bring to a new topic and thus will be helpful in directing the course of study.

An example of a lesson taught with a Constructivist background

A good example of a lesson being taught in a constructivist way, with the teacher mediating learning rather than directly teaching the class is shown by the example of Faraday's candle. There are various forms of this lesson, but all are developed from the Christmas lectures Faraday gave on the functioning of candles. In open constructivist lessons using these lectures as a basis, students are encouraged to discover for themselves how candles work. They do this first by making simple observations, from which they later build ideas and hypotheses which they then go on to test. The teacher acts to encourage this learning. If successful, students can use this lesson to understand the components of combustion, an important chemistry topic.

TOPIC 5: SCIENCE LABORATORY: MANAGEMENT AND ORGANIZATON

A **laboratory** is a facility that provides controlled conditions in which scientific research, experiments, and measurement may be performed.

Labs used for scientific research take many forms because of the differing requirements of specialists in the various fields of science. A physics lab might contain a particle accelerator or vacuum chamber, while a metallurgy lab could have apparatus forecasting or refining metals or for testing their strength. A chemist or biologist might use a wet laboratory, while a psychologist's lab might be a room with one-way mirrors and hidden cameras in which to observe behaviour. In some laboratories, such as those commonly used by computer scientists, computers (sometimes supercomputers) are used for either simulations or the analysis of data collected elsewhere. Scientists in other fields will use still other types of laboratories.

Despite the great differences among laboratories, some features are common. The use of workbenches or countertops at which the scientist may choose to either sit or stand is a common way to ensure comfortable working conditions for the cabinets for the storage of laboratory equipment is quite common. It is traditional for a scientist to record an experiment's progress in a laboratory notebook, but modern labs almost always contain at least one computer workstation for data collection and analysis.

Scientific laboratories can be found in schools and universities, in industry, in government or military facilities, and even aboard ships and spacecraft. A laboratory might offer work space for just one to more than thirty researchers depending on its size and purpose. Recently, a new type of laboratory called Open Laboratory has emerged. Its format allows the sharing of space, equipment, support staff between different research groups and also fosters information exchange through communications across fields

LABORATORY SPACE

A lab could just be a single room or a large building with provision for separate rooms for specific work. The size depends upon the purpose for which it is required. Single owner personal pathology or microbiology labs used for some routine tests are generally very small. The physics, chemistry, botany and zoology labs of school/college are larger in size. Public and private research institutions have several big labs. Labs are variously designed. For instance, the biology lab of a college is different from chemistry, physics or computer labs.

Before we discuss labs any further it is necessary that we become familiar with the usage of the Term laboratory. The term could be used for a single room if it is equipped for performing experiments. In colleges, you will find botany, zoology, physiology and microbiology laboratories. In common parlance these together with other units and ancillaries are also referred to as laboratories. Therefore we find that the term laboratory is not used very specifically. While we are discussing the various units (rooms) of a lab, we shall use the term Main Lab instead of lab for the room/unit where experimental work is performed.

Often the main lab in a teaching institution is The typical size is somewhere between 40 and 80 square metres.

It is of utmost importance that any lab has adequate space within which lab workers can work.

Ample space is required for the safe conduct of lab work and for efficiency and maintenance. Therefore, it is necessary to decide how much space is ideal per lab worker?

According to the Oxford dictionary a laboratory is a room or building fitted out for scientific experiments, research, teaching or the manufacture of drugs and chemicals. Various suggestions have been made by different organizations as to the space that should be provided for each lab worker. The Laboratory Investigation Unit (LIU) of the Department of

Education and Science (UK) introduced the concept of the Laboratory Unit (Lab Unit). This is a self-contained area within a lab that supports the work of two or three workers. The LIU suggests that in practice, it is unlikely that fewer people will be working together. Thus if all the requirements for this group of workers are provided in terms of space, services, storage, etc. any larger lab can be a multiple of the Lab Unit. This introduces the idea of modular lab design.

The LIU suggests that some 12 m of bench space is needed for two to three workers. This includes space for sinks (and the dead space alongside each sink), and fume cupboards. This 12 m

run would be best accommodated by two 6 m runs separated by about 2 m. Allowing 0.5m for the depth of benching, the dimensions of the Lab Unit will be 6m□3m.

Even if unattainable in some situations, the idea of LIU is helpful for calculating the number of students that can be accommodated in a given lab. We can propose that a minimum of two metres bench space should be allotted per person. Whatever the condition be, sufficient space must be allowed for work and circulation.

DESIGNS OF LABORATORIES

The overall philosophy of the design could be fixed or flexible.

Traditionally the labs are of fixed design i.e. all benches, cupboards and services are rigidly fixed.

Let us first try to list the typical features of a traditionally designed lab below:

a. Benches are firmly attached to the floor and, perhaps also to the walls,

b. Services are usually screwed and clamped to bench legs and the underside of lab benches,

c. The general design approach is one of permanency and substantial construction.

The strength of the design lies in its physical strength. In certain circumstances this may be an important factor where, for example, many people carry out varied tasks in the lab, e.g. in a school. However, in a fixed design lab a change in lab layout would cause major disruption.

Flexible Design Laboratories

Flexible lab design adopts the strategy of keeping furniture, benches and services free-standing so that they can be easily moved. Many labs show a continual pattern of change in usage, and 'flexible' design helps to overcome the potential inherent disruption. Flexible design is quite suitable for private multipurpose labs.

In case one wants to build a lab there is no hard and fast rule. The choice of design depends on a real life need. To opt for a high degree of flexibility in every case or to be completely biased to the traditional approach would suggest that no account is taken of the real needs. The most important point as far as the approach to the design is concerned is to be able to answer the following question positively: Services means gas, water and electricity. Can the features incorporated in the design be justified? In other words, will the design meet requirements for the present as well as in the future?

Partition Walls

At times it may be necessary to divide the lab space in order to confine an area for specific work.

Such matters as partition walls should be included in the plans. Either load-bearing walls or temporary partitions can create the division. Load bearing walls, for example offer little flexibility but can be used for permanent fixing. Although partition walls offer considerable flexibility in contrast to structural walls, this flexibility can easily be lost by fixing benches, shelves and services to a partition wall. If at some future stage a conversion is, undertaken, major work may be required to remove the fixtures, which have" been attached to the partition. Clearly, while you design the lab you should take this into account and avoid making permanent attachments to partition walls.

MAIN LABORATORY IN RELATION TO OTHER ROOMS

Suppose you wish to choose the location for the main lab (where students perform practicals) then you should think about whether the chosen room will be ideal and what its relationship to nearby rooms will be.

You should consider the use of adjacent rooms. If the proposed activities in the main lab will result in a lot of noise or vibration, it should not be located next to a rest room or library! Of more importance is the relationship between a main lab and related accommodation. For example, a school has two biology labs. These should be located as near as possible to each other, perhaps separated only by a preparation room - see Fig. 2.1 (Unit 2).

Widely labs should be avoided as this leads to considerable difficulties for the technical staff. All the labs should be near each other and, ideally in a separate wing, which can be isolated in the case of fire

BENCHING, SURFACES, FURNITURE, AND STORAGE

Often labs are rectangular Since in most cases benching is firmly fixed and drainage is only available along walls

Once the position of benches is decided one must consider suitable work tops, cupboards and storage units, shelving and so on.

Bench tops should be sealed to the walls, impervious to water and resistant to disinfectants, acids,alkalis, organic solvents and moderate heat.

Two main factors in the choice of work tops to be considered are:

1. The cost of the material, and

2. The nature of the lab work.

In a school lab, for example, wood or laminated surfaces are likely to be used. In a biology lab the important factor is to be able to sterilize the surface easily in which case a formica surface is probably the best. For wood surfaces, teak is the best type of wood, but it is expensive. The suitability of other types of wood can also be explored.

Keeping in view the type of work to be performed a variety of materials are used for bench surfaces. These are timbers (solid wood), PVC, quarry tiles, Kota stone, granite, glazed tiles, Formica and metal.

The selection of lab furniture is very important. You should make sure that it is sturdy. The furniture can be purchased from some standard firms, which provide a catalogue also. In case you have some specific requirement you can get it made from a local dealer.

Storing facilities are also taken into account while planning a lab. Generally, the storage units are 'hung' underneath a bench and shelving units and cupboards hung from a rail around the room.

Commonly the units are of wood or steel. They are demountable and can be easily removed.

Store space must be adequate to hold supplies for immediate use and thus prevent clutter on bench tops and in aisles. Additional long-term storage space conveniently located outside the working area should also be provided. As far as storage in the lab is concerned only equipment and consumables required for day-to-day use should be stored. Obviously an exception would be specialised large equipment, which may have to be housed in the lab even though it is used only occasionally.

Many labs have totally inadequate storage space. Here under-bench storage assumes a far greater importance. Indeed, it can become the major method of storage. Under-bench storage is inconvenient, with low shelves making access difficult (Figs. 1.5 and 1.6).Fig. 1.5: Under bench storage

The insides of under-bench units are dark. They often get dirty and collect items that should have been thrown away years ago. Staff is often reluctant to throw away equipment and use the statement 'we used that back in, let me see 1975, we could still have a use for it'. You need to adopt an aggressive policy towards storage, stipulating that anything which is not needed in the very near future should be stored elsewhere, and that which has outlived its usefulness should be thrown away. Now-a-days equipment becomes outdated in a few years so it is best to throw away the old stuff unless one plans to display it in some exhibition.

If you want to use under-bench storage then some of these units will need to take trays, which slot into units or are fitted with movable shelves. A more convenient way is to place a movable (wheeled) unit under the bench. Since a single unit would be quite large and difficult to move out, a few small units (each of approximately 1½ feet length) can be placed instead. Since each small unit has wheels they move like trolleys and when fitted under the bench give the appearance of a single unit.

Many shelving units are required in a lab to store chemicals. Besides closed shelves, several open shelves may also be necessary. For example in a chemistry and biology lab open shelves are useful for keeping bottles required for daily practicals. Open shelves could be placed between two benches so those students working on either bench can use them.

VENTILATION, LIGHTING, HEATING AND COOLING

Ventilation, lighting, and heating are often treated as related and will be considered as such here.

Proper ventilation in a lab is necessary for health and safety and for efficient working. Lighting which is too bright or too dull may lead to tired eyes, headaches, and again an increased incidence of accidents. Also, working conditions that are too hot or too cold, too, dry or too damp are unpleasant to work in and may result in accidents. Thus control of all these factors is important for a safe and comfortable working environment.

Let us consider these factors in detail.

.1 Ventilation

The reasons for requiring ventilation are:

(a) Removal of excess heat due to ovens, hot plates, Bunsen burners, body heat, etc.

(b) Control of humidity from respiration, steam baths, etc. High humidity with high heat can be very uncomfortable.

(c) Reduction of fumes, odours. Usually taken care of by mechanical extractor systems.

Ventilation can either be provided by natural or mechanical means.Fig. 1.9: Arrangement for ventilation, lighting and cooling in a laboratory

Windows provide an uncontrollable flow of air, and although louvered windows are better, they tend to be draughty. Excessive draughts must be avoided on safety grounds, as Bunsen burners may be extinguished or delicately poised apparatus disturbed.

Mechanical or forced ventilation can be provided by extractor fans, which at the time of installation can be set high up thereby reducing any draughts. Extractor fans provide a more constant flow of air and avoid the problems of open windows.

For general low level extraction, fans can be installed in windows or walls. If window fans are fitted it is a good idea for them to be reversible, so they can also be used to draw in fresh air.

Air conditioning units are considered in the following section on heating, and the use of fume cupboards, an example of forced ventilation, will also be discussed in section 1.10.

2 Lighting

Adequate lighting is necessary for any kind of work. Natural lighting is most acceptable to the lab worker. little artificial lighting will be required. This is known as a 'shallow lab. The "deep" lab with windows in only one short wall will present a darker environment that will need permanent supplementary artificial lighting (PSAL) in all conditions: see Fig. 1.10b. However, a considerable amount of lab work takes place in labs, which by necessity will require PSAL. Various types of lighting are available and the amount of light required will depend on the design of the lab. Illumination should be adequate for all kinds of activity. Undesirable reflections and glare should be avoided.

Artificial lighting is provided either by incandescent bulbs (heated tungsten filament) or by. fluorescent tubes. While light bulbs may give rise to light of a more acceptable 'colour' they do have the disadvantage of producing excessive shadows. Although 'daylight fluorescent tubes are available, the lighting provided by this means is often rather harsh and artificial. On the other hand it does give a good distribution of light. Machinery in workshops may require individual lighting. Also individual lighting may be necessary for intense work, e.g., soldering intricate circuits; see Fig. 1.11c. Positioning of all lighting is important to give an effective distribution of light.

3 Heating and Cooling

In zones that are very cold, heating arrangements for the lab may be necessary. One major problem in laboratories is that of trying to achieve even heating without using up too much valuable wall space, or giving localised hot spots.

One of the solutions involves the installation of heating pipes. But there are chances that the chemicals, which are not toxic at normal temperatures when spilt unnoticed onto heating pipes, may create a hazardous atmosphere. A better solution is running the pipes in boxed-in sections under the window wall, with adjustable grilles below the window. Nothing can then be placed directly on the heating pipes nor can chemicals be easily spilt on to heated-surfaces.

The following are common heating systems:

(a) Radiators: Traditional radiators are too susceptible to corrosion from spills etc. to be of any great use in most labs, although they could be used in physics and biology labs. They are also dust traps and give only localised heating.

(b) Local heating: Local heating by electric fires is very expensive and highly dangerous.

Even more hazardous are the fan-assisted heaters which can draw flammable vapours over a heated element.

(c) Air conditioning: Air conditioning units control both temperature and humidity by supplying air that has been heated/cooled, dried/dampened in a series of accurate processes. This form of control provides the most acceptable way of controlling the lab environment. However, for a school it is prohibitively expensive and its use is usually restricted to the industrial or research lab

FLOORING

The floor should be smooth but slip-resistant. The choice of covering for the lab floor is governed by a number of considerations, which include:

1. Cost;

2. Safety;

3. Chemical resistance;

4. Wear; and

5. Environmental factors, e.g. comfort, ease of cleaning, noise reduction and warmth.

Most lab floors have a concrete base. Floors should include watertight up stands around all services that enter through floors, and along the walls, particularly floors above ground level.

ACCESS TO AND FROM THE LABORATORY

Any lab design must take into account that the lab worker must be able to gain access to and from the experimental area. Sufficient distance must be allowed between benches for the safe movement of people, so that colleagues are not disturbed.

As even in the best run establishment accidents can happen, all laboratories and preparatory rooms should be provided with at least two escape routes as widely separated as possible. Note that door positions in ideal lab arrangements by checking back with Figs. 1.10. If an accident occurred near one of these doors escape would still be possible using the other door.

Likewise, the design of the whole building should allow for various escape routes. For example, more than one set of stairs should be provided and these should preferably be constructed throughout with non-combustible materials.

Access routes either inside or outside the lab must not be blocked or hindered in any way. This means that cupboards, spare desks etc. should never be kept in corridors.

SECURITY AND SAFETY

When designing a lab the problems associated with security and vandalism must be taken into account. Doors should be fitted with security locks, and the room kept locked when not in use.

Ground floor rooms may need locks on the windows. Fire doors must be provided and these should be fitted with crush bars or similar mechanisms.

Safety system should cover fire and electrical emergencies.

TOPIC 6 : INSTRUCTIONAL AIDS

A teacher's purpose is to help student learn. Instructional aides are meant to help communicate information: not dazzle or entertain. Hand outs must be simple and easy to follows. Keep board work organize clean. Keep teaching focused, but support student learning through proper use of instructional aids

ADVANTAGES OF INSTRUCTIONAL MATERIALS

- Instruction becomes more motivating.
- Learning becomes more interactive.
- The time required for instruction can be reduced.
- Video recordings help bring reality to the classroom.
- Flexibility in instruction is possible.

THE SELECTION OF AN INSTRUCTIONAL MATERIAL

- Its availability
- Its appropriateness to the lesson under consideration.
- The physical facilities in the classroom e.g. power supply, darkened room, chairs etc.
- Size of the class. Is it a small class or a large class? Is it crowded or not?
- Age and nature of the learners.
- Cost of the materials.
- The information to be delivered on the TV or radio should not violate culture norms.
- The teacher's skill and competence in using the material.

Teaching aids

1. PRINTED OR WRITTEN MATERIALS

   Written materials form the basis for formal schooling. Teachers use written materials to get new ideas and new information and students develop their reading skills and also get information from these.

   - Advantages
     - Printed materials are durable.
     - Readers can use them over and over again as reference materials.
     - Textbooks are usually graded to suit the level of the learner.
     - Magazines, newspapers and storybooks may deal with local affairs and are more interesting to read than textbooks.
     - Students can read and learn at their own speed.
     - Students can learn on their own without teachers.
     - A well-written textbook guide can help teacher to be more effective.
   - Disadvantages
     - Printed materials are very expensive.
     - Learners must be literate (able to read) to learn from print.
     - Many classrooms do not have safe places to store written materials.
     - Printed materials must be protected against insects and moisture.

2. TAPES AND RECORDINGS
   - Advantages
     - The advantage of recordings (films, TV and audio cassettes) is that the teacher and learners can control the pacing. They can replay lessons as often as they like, go faster or slower through the course, and move at their own speed.
     - Even illiterate listeners can understand the message if it is their own language.
   - Disadvantages
     - Tapes and other recordings and the playback apparatus are expensive.
     - All aural aids require that the listeners are fluent in the language used.
     - These aids need a power source.
3. THE WRITING BOARD

   The writing board is the most common and widely used visual aid. Contrast on the writing board can be achieved by making heavy or light strokes with marker. You can also use various colours. The writing board can be used for:
     - Jotting on quick information, for writing down spelling and new words and for drawing diagrams and simple illustrations as needed.
     - Developing the lesson.
     - Writing the lesson outline on the board before the lesson so that instead of having a pause to write, teacher can simply refer to what has already been written.
   - Using the writing board effectively.
     - Keep the writing board surface well maintained.
     - Position it in front of the class so that all pupils are able to see what is written on it.
     - Make sure that your work on the writing board is well planned, arranged and organised.
     - Writing should be horizontal and straight with uniform and well-formed letters.
     - The words and sentences should be well spaced for easy reading.
     - Main headings come out better when written in capital letters.
     - Sub-headings can be written in small letters and can be made to stand out by underlining them or using coloured markers which can be clearly seen from the back of the class.
     - Use simple, clear and interesting illustrations to convey messages e.g. diagram, pictures, graphs, etc.
     - Pause regularly. Go to the back of the classroom and evaluate what is written on the writing board.
   - Disadvantages of the writing board
     - Writing on them is not easy and needs practice.
     - What is displayed does not remain available for repeated use.
     - If you do not arrange your work well, the work may confuse the learners.
4. CHARTS

These can be used in two ways. The teacher may use them at the front of the class to illustrate or make clear certain points during the lesson. They may also be used as wall displays to provide additional or background materials for the topics being covered. Commercially produced wall displays are usually very attractive but might not be suitable because they were not made for particular needs. To produce charts, you need a chart paper, newsprint markers in different colours, a lead pencil, rubber, ruler, coloured pencils, and a table to work on. Following are some suggestions for making these visual aids:

- Drawings should be large and clear enough to be seen from the back of the class.
- Draw first with pencil and then draw over the outline with a thick marker.
- Draw faint straight lines first so that all words are in line.
- Letters should have adequate and equal spaces between them.
- Write in either capital or small letters.
- Do not correct mistakes by crossing out, putting in a missing letter, or drawing over incorrect lines. Either start again or stick a piece of paper over the error or the correction to be made.

- Advantages of charts
  - Can be used to explain ideas in terms of shapes, colours, lines and pictures and to show steps in a process.
  - Can be prepared ahead of time.
  - Very useful for revision or repetitive sessions.
- Disadvantages of charts
  - Ready made charts reduce flexibility.
  - Need a lot of time to make.

5. FLANNEL BOARD

A flannel board helps in story telling, reading, teaching mathematics or any other subject. A flannel board can be used to show diagrams, assemble parts, and classify different things or concepts. Results of group discussions can also be shown on flannel boards. The pictures or word cards to be displayed should have at the back, sand paper or other things that stick on cloth but can easily come off the board.

- Advantages of flannel board.
  - Cut-outs are prepared in advance and hence save lesson time.
  - Allows step-by-step presentation.
  - Matter prepared can be preserved for future use.
- Disadvantages of flannel board
  - Making a flannel board and the cuttings takes a lot of time.
  - The flannel cloth is not readily available and it is also expensive.
- Techniques of using the flannel board
  - Plan layouts in advance.
  - Rehearse before presentation in the classroom.
  - Sort the cutouts or cards to be used in order of presentation.
  - Presentation should be interesting enough to attract and hold attention.
- How to make a flannel board

- Get a piece of an old clean blanket of any size, preferably one square metre.
- Pin or sew it on a cardboard to make it firm.
- Stick sand paper at the back of the pictures or words intended to use on flannel board.

6. WORD-CARD FILE

Before having children read silently for meaning or reading a passage aloud, meaning, pronunciation and recognition must be taught for new and difficult words that are in the textbook. This word list will help to prepare the children to recognize words, pronounce them and read them with meaning.

- Find a box in which to file and hold all of word cards for the year.
- Make alphabet dividers so that the words can be easily located, for each lesson.
- Cut word card strips from heavy paper.
- The words must be written in very large letters, so that every child in the room can read them easily when the teacher holds them up.
- While preparing each lesson:
  - look at the word-list for that lesson.
  - Look in word box to find each word.
  - Make a word card for the missing words.
- After each lesson:
  - File each word in the word-box, using alphabetical order.
  - A capable student can do this, this will help the students learn.
  alphabetical order, and help them remember how to read the words.

7. MODELS

A model is a three-dimensional object that is made to show some aspects of a real thing. A model can be smaller, larger or can be the same size. A model will show some important features of the real thing, but cannot show all of them.

- Advantages of Models
  - The most effective use of a model is to have the students make their own models. This is a good test of whether they understand a concept and it will help them remember.
  - Models simplify the concept to make it easier for the child to understand.
  - Materials to make models are not expensive. You can use things that are thrown away, such as scraps of wood, cloth, tins, paper cardboards, plastic containers, clay, glue, sawdust, wood, fibers and other things from the local environment.

8. PICTURE FILE

- Purpose: Each primary teacher is to collect and organize set of pictures to use in teaching language, social studies and science.
- Materials:

Ten file folders or large sheets of strong paper, marking pen, old magazines, newspaper, and calendars.

- Step One:
  Mark each file cover with a topic name based on topics of the primary syllabus, as follows: Maps, People, Animals, Plants, Earth, Matter and Energy, Health and Safety, Natural Resources and Work, Government and countries, Transportation, Communication, and Other.
- Step Two: Find a box that will hold your files.
- Step Three: Organise them in a way that will help you locate each file quickly.
- Step Four: Cut out pictures of all kinds and put them into the appropriate file.

9. MAKE A LARGE-SCALE WALL MAP FROM A SMALL MAP

- Purpose: Classroom teachers will be able to teach children how to do this useful social studies activity.
- Specific objectives: Children will be able to:
  - Practice math skills as they measure and mark the small map and the large map.
  - Practice eye-hand coordination as they draw the outlines in each block.
  - Be able to use a grid system to locate places on a map.
  - Learn specific locations of places on the map.

- Step One: Draw lines on the small map to make ½ inch squares.
- Step Two: Beginning with the left square at the top, number the squares across the top from 1 to …. as many as you have.
- Step Three: Beginning with the left square at the top, alphabetise the squares down the left side from top to bottom, from A to…….
- Step Four: Find a large piece of paper and draw lines to make 3 cm squares or to make a larger map 6cm squares.
- Step Five: Number squares across the top and alphabetise down the side exactly as you did on the small map.
- Step Six: Block by block, draw the map. Find block A-1 on the small map and block A-1 on the large blank paper. Look carefully to see how the lines on the small map fit into the block. Copy Block A-1 as exactly as you can into Block A-1 on the blank paper.
  Now find Block B-1 and draw it. Continue, block by block until you have completely copied the map. Colour the map so that it suits your teaching purposes: All maps and globes use blue to represent water.
- Land form (physical features) maps use the following map key:
  - Seacoasts and plains: green
  - Hills: yellow
  - Plateaus: tan
  - Mountains: brown

- Very high mountains: red
- Political maps use different colours to show country/nation boundaries.

10. Realia (real objects)

This means using real objects such as animals, plants or any other thing in the teaching, e.g. alive frog for study rather than its picture. Sometimes it is useful and convenient to motivate learners by using real things. This helps to make points clearer and leads to effective learning. It also helps pupils to develop their own ideas or concepts from what is being seen or observed.

TOPIC 6 : PLANNING AND EXECUTION ON EXTENED EXPERIENCE

1. **SCIENCE EXHIBITION**

Science exhibition is a form of exhibition where contestants present their science project . it is the setup where students whether, inside the school or outside the school participate in groups with their projects . Group of viewers visit there one by one . it is also a type of completion . here the best project is awarded with certificates

2. **SCIENCE FAIR**

A **science fair** is generally a competition where contestants present their science project results in the form of a report, display board, and models that they have created. Science fairs allow students in grade schools and high schools to compete in science and/or technology activities.

Although writing assignments that take a long time to complete and require multiple drafts are fairly common in US schools, large projects in the sciences (other than science fairs) are rare. Science fairs also provide a mechanism for students with intense interest in the sciences to be paired with mentors from nearby colleges and universities, so that they can get access to instruction and equipment that the local schools could not provide.

In the United States, science fairs first became popular in the early 1950s, with the ISEF, then known as the National Science Fair. Interest in the sciences was at a new high after the world witnessed the use of the first two atomic weapons and the dawn oftelevision. As the decade progressed, science stories in the news, such as Jonas Salk's vaccine for polio and the launch ofSputnik, brought science fiction to reality and attracted increasing numbers of students to fairs.

Common science fair topics are Botany, Engineering, Behavioral, Physics, Medicine/Health, Weather, Zoology, Microbiology, Biology etc.

TOPIC 7: SCIENCE CLUB

A science club is an out-of-school-hours club that offers children the chance to do science-related activities that extend and enhance the science they experience in the classroom.
Each science club is different, as the club programme reflects the interests of the children, the club organiser and the facilities available. Most clubs use the opportunity to explore areas of science not covered by the curriculum and to give the club members plenty of opportunities to do practical science.
A science club can be run in a lunch break or after school. Some organisations are able to offer special Saturday clubs.
A science club session typically lasts for about 45 minutes. In this time, the members might complete a challenge, plan a science project or have a special scientific visitor.

The benefits of running a science club

Research shows that 'Out of School Hours Learning' (often known as OSHL, OSL or OOSHL) or 'Study Support' is widely recognised to lead to improvements in school performance. This can manifest as improved motivation and a positive impact on attitudes. In addition, in one study in Northern Ireland 84% of post-primary principals said that it contributed to raised attainment.

There are benefits for:

PUPILS

- Practice at the process skills needed in science.
- Increased opportunity to develop and practice thinking, speaking and listening skills.
- Opportunities to experience a wider range of science topics, hence broadening their enthusiasm for science.

TEACHERS AND TEACHING ASSISTANTS

- To learn about new topics and try out new ideas, in a less pressured environment.

THE SCHOOL

- To celebrate science.
- Raising the profile of science within the school.
- A positive change in attitude to science lessons

TOPIC 8: SCIENCE QUIZZES

A **quiz** is a form of game or mind sport in which the players (as individuals or in teams) attempt to answer questions correctly. In some countries, a quiz is also a brief assessment used in education and similar fields to measure growth in knowledge, abilities, and/or skills.

Quizzes are usually scored in points and many quizzes are designed to determine a winner from a group of participants - usually the participant with the highest score.

In an educational context, a quiz is usually a form of a student assessment, but often has fewer questions of lesser difficulty and requires less time for completion than a test. This use is typically found in the US, Canada, and some colleges in India. For instance, in a mathematics classroom, a quiz may check comprehension of a type of mathematical exercise.

UNIT III: EVALUATION IN INTEGRATED SCIENCE

TOPIC 1 : EVALUATION CONCEPT AND IMPORTANCE

Child as he develops under the care of the teacher. Records, however, should not beconsidered as ends but as service tools to help the teacher understand the learners to interpret behaviour, and to define immediate and long-term needs.

Evaluation should be comprehensive. It should take into account the learner'sindividual character, his background, and the immediate environmental factors.Data should include the individual's health physiologic needs, emotionaladjustments, mental characteristics, talents and aptitudes, values and attitudes social relationship and competence, ability to function effectively in his environment and in the whole realm of his interest, aspirations, and goals

Evaluation uses a variety of instruments, tools, and techniques. Theseinstruments should be valid, reliable, and practical from the standard points of time effort, and facilities of the school. There are teacher made and standardize tests ,anecdotal records, rating scales, samples of pupils work, sociograms, diaries, and journals. The teacher should choose the technique suited to the individual pupil concerned and to the specific purpose foe which the evaluation is being made.8. Objective measurement and subjective judgment are both essential in evaluation. Records should be specific and as, far as possible objective. Subjective estimate are made objective by the inclusion of specific incidents and illustrations.9. Diagnosis and remedial work are phase of the evaluative process. Test results should be used for the improvement of instructions. Results should be carefully interpreted and necessary follow-up work should be done accordingly.10. Evaluation should be descriptive. Although the uses of terms like superior, good, average, and poor is better than the use of figures, these terms still leave much to be desired from the standpoint of evaluation.

A descriptive concrete statement about the child is more meaningful and significant to teachers, to parents, and to children than any blanket judgment that merely indicates that the child has passed.

Chronological age. The child should grow in his ability to attac k problems analytically and to think critically. The analysis of thought processes is difficult and complicated but teachers can watch for improvement in the children's ability (a) to select the significant from the trivial, (b) to connect ideas and draw conclusions, (c)to ask intelligent questions and (d) to do some critical thinking. The child should show increasing ability to use the work skills and increasing comprehension of material being studied, organizing it for use, and adapting it to his purpose. There should be evidence of the child's ability to get along with people-children and adult's alike- Under many and differing conditions. He should learn to cooperate with others and adapt himself to group situations. Examination of the activities children are engaged in as individuals and as a groups and the purpose s promoted through these activities will give a clear picture of the child as he develops socially, mentally , and physically.

Characteristics of an Evaluation Program

An evaluation program should be designed to cover as many important outcomes as possible. This should include a variety of methods for securing and recording theevidence. Through observation during class discussions, individual c ommitteereports, and supervised study, the teacher learns a great deal about each pupil. Test still provide the more concrete and detailed evidence. Test yieldevidence in a convenient form. This important thing, however, is to recognize thatthe tests should be used to supplement, rather than to supplant, the evidencecollected through observation. Accordingly, an important aspect of teaching skill isability to devise suitable tests for specific outcomes and to integrate the use of tests into the sequence of learning activities.Both the learning activities and the appraisal procedures should be based onclearly defined outcomes. Learning situations should provide opportunities for useful observation. Some situations should be specially designe d to revealunderstanding, critical thinking, and ability to apply what had been learned. Tests,though designed primarily as a means of evaluation may also be used to stimulate. Stated in more general terms, the procedures use to measure pupil progress are those required to obtain evidence of pupil progress toward educational objectives.

Evaluation Devices

There are various techniques in evaluating pupil growth as specified in our goals. The effectiveness of these techniques depends upon the skill of their user. Self-evaluation techniques. There are several ways by which children may be guided to do self-evaluation. They can be encouraged to keep diaries, preserve samples of their work, and keep records. They can compare recent achievements withy records of earlier achievements with records of earlier achievements. They may also rate themselves on an appropriate checklist at intervals of time. Self-evaluation develops in the child self-control, self-direction, and wise judgment. Teaching Evaluation. Evaluation includes a variety of methods for securing and recording the evidence needed to provide information on pupil progress. The teacher who is completely aware of what he is looking for collects evidence from practically all learning activities. He continually collects information on the child'sprogress. To these, he utilize observational procedures, teacher – made tests,standardized achievements tests, and achievement test batteries.Observational procedures. The teacher, in his daily contacts with pupils,collects information as revealed in discussions and o ther situations. Suchinformation is very valuable. However, there is the possibility that records may not be available when the teacher needs them and important behaviour may beoverlooked. Standard procedures have been adapted to guard against thesepossibilities. The most commonly used of these are anecdotal records, checklists ,and rating scales. Anecdotal records. Many teachers find it convenient to keep a pad on their table ready for note taking. This pad is designed for two kinds of entries: whathappened and what it probably means. Any interpretation of the me aning of behavior is tentative and subject to revision as more anecdotes are collected. EX. What happened: In a discussion of how carpenters use instruments to make linear measurements, Jose offered to bring his father's rule that is calibrated to tenths of an inch Interpretation: this indication of interest is encouraging because Jose had not been cooperative in the past

TOPIC 2: TECHNIQUES OF EVALUATION IN THEORY AND PRACTICE

Evaluation for education, learning and change – theory and practice. Evaluation is part and parcel of educating – yet it can be experienced as a burden and an unnecessary intrusion. We explore the theory and practice of evaluation and some of the key issues for informal and community educators, social pedagogues youth workers and others. In particular, we examine educators as connoisseurs and critics, and the way in which they can deepen their theory base and become researchers in practice.

Contents: introduction · on evaluation · three key dimensions · thinking about indicators · on being connoisseurs and critics · educators as action researchers · some issues when evaluating informal education · conclusion · further reading and references· acknowledgements · how to cite this article

A lot is written about evaluation in education – a great deal of which is misleading and confused. Many informal educators such as youth workers and social pedagogues are suspicious of evaluation because they see it as something that is imposed from outside. It is a thing that we are asked to do; or that people impose on us. As Gitlin and Smyth (1989) comment, from its Latin origin meaning 'to strengthen' or to empower, the term evaluation has taken a numerical turn – it is now largely about the measurement of things – and in the process can easily slip into becoming an end rather than a means. In this discussion of evaluation we will be focusing on how we can bring questions of value (rather than numerical worth) back into the centre of the process. Evaluation is part and parcel of educating. To be informal educators we are constantly called upon to make judgements, to make theory, and to discern whether what is happening is for the good. We have, in Elliot W. Eisner's words, to be connoisseurs and critics. In this piece we explore some important dimensions of this process; the theories involved; the significance of viewing ourselves as action researchers; and some issues and possibilities around evaluation in informal and community education, youth work and social pedagogy. However, first we need to spend a little bit of time on the notion of evaluation itself.

On evaluation

Much of the current interest in evaluation theory and practice can be directly linked to the expansion of government programmes (often described as the 'New Deal') during the 1930s in the United States and the implementation of various initiatives during the 1960s (such as Kennedy's 'War on Poverty') (see Shadish, Cork and Leviton 1991). From the 1960s-on 'evaluation' grew as an activity, a specialist field of employment with its own professional bodies, and as a body of theory. With large sums of state money flowing into new agencies (with projects and programmes often controlled or influenced by people previously excluded from such political power) officials and politicians looked to increased monitoring and review both to curb what they saw as 'abuses', and to increase the effectiveness and efficiency of their programmes. A less charitable reading would be that they were both increasingly concerned with micro-managing initiatives and in controlling the activities of new agencies and groups. Their efforts were aided in this by developments in social scientific research. Of special note here are the activities of Kurt Lewin and the interest in action research after the Second World War.

As a starter I want to offer an orienting definition:

Evaluation is the systematic exploration and judgement of working processes, experiences and outcomes. It pays special attention to aims, values, perceptions, needs and resources.

There are several things that need to be said about this.

First, evaluation entails gathering, ordering and making judgments about information in a methodical way. It is a research process.

Second, evaluation is something more than monitoring. Monitoring is largely about 'watching' or keeping track and may well involve things like performance indicators. Evaluation involves making careful judgements about the worth, significance and meaning of phenomenon.

Third, evaluation is very sophisticated. There is no simple way of making good judgements. It involves, for example, developing criteria or standards that are both meaningful and honour the work and those involved.

Fourth, evaluation operates at a number of levels. It is used to explore and judge practice and programmes and projects (see below).

Last, evaluation if it is to have any meaning must look at the people involved, the processes and any outcomes we can identify. Appreciating and getting of flavour of these involves dialogue. This makes the focus enquiry rather than measurement – although some measurement might be involved (Rowlands 1991). The result has to be an emphasis upon negotiation and consensus concerning the process of evaluation, and the conclusions reached.

Three key dimensions

Basically, evaluation is either about *proving* something is working or needed, or*improving* practice or a project (Rogers and Smith 2006). The first often arises out of our accountability to funders, managers and, crucially, the people are working with. The second is born of a wish to do what we do better. We look to evaluation as an aid to strengthen our practice, organization and programmes (Chelimsky 1997: 97-188).

To help make sense of the development of evaluation I want to explore three key dimensions or distinctions and some of the theory associated.

Programme or practice evaluation? First, it is helpful to make a distinction between programme and project evaluation, and practice evaluation. Much of the growth in evaluation has been driven by the former.

Programme and project evaluation. This form of evaluation is typically concerned with making judgements about the effectiveness, efficiency and sustainability of pieces of work. Here evaluation is essentially a management tool. Judgements are made in order to reward the agency or the workers, and/or to provide feedback so that future work can be improved or altered. The former may well be related to some form of payment by results such as the giving of bonuses for 'successful' activities, the invoking of penalty clauses for those deemed not to have met the objectives set for it and to decisions about giving further funding. The latter is important and necessary for the development of work.

Practice evaluation. This form of evaluation is directed at the enhancement of work undertaken with particular individuals and groups, and to the development of participants (including the informal educator). It tends to be an integral part of the working process. In order to respond to a situation workers have to make sense of what is going on, and how they can best intervene (or not intervene). Similarly, other participants may also be encouraged or take it upon themselves to make judgements about the situation. In other words, they evaluate the situation and their part in it. Such evaluation is sometimes described as educative or pedagogical as it seeks to foster learning. But this is only part of the process. The learning involved is oriented to future or further action. It is also informed by certain values and commitments (informal educators need to have an appreciation of what might make for human flourishing and what is 'good'). For this reason we can say the approach is concerned with praxis – action that is informed and committed

These two forms of evaluation will tend to pull in different directions. Both are necessary – but just how they are experienced will depend on the next two dimensions.

Summative or formative evaluation

Evaluations can be summative or formative. Evaluation can be primarily directed at one of two ends:

- To enable people and agencies make judgements about the work undertaken; to identify their knowledge, attitudes and skills, and to understand the changes that have occurred in these; and to increase their ability to assess their learning and performance (**formative evaluation**).
- To enable people and agencies to demonstrate that they have fulfilled the objectives of the programme or project, or to demonstrate they have achieved the standard required (**summative evaluation**).

Either can be applied to a programme or to the work of an individual. Our experience of evaluation is likely to be different according to the underlying purpose. If it is to provide feedback so that programmes or practice can be developed we are less likely, for example, to be defensive about our activities. Such evaluation isn't necessarily a comfortable exercise, and we may well experience it as punishing – especially if it is imposed on us (see below). Often a lot more is riding on a summative evaluation. It can mean the difference between having work and being unemployed!

Banking or dialogical evaluation? Last, it is necessary to explore the extent to which evaluation is dialogical. As we have already seen much evaluation is imposed or required by people external to the situation. The nature of the relationship between those requiring evaluation and those being evaluated is, thus of fundamental importance. Here we might useful employ two contrasting models. We can usefully contrast the dominant or traditional model that tend to see the people involved in a project as objects, with an alternative, dialogical approach that views all those involved as subjects. This division has many affinities to Freire's (1972) split between banking and dialogical models of education.

Exhibit 1: Rowlands on traditional (banking) and alternative (dialogical) evaluation

Joanna Rowlands has provided us with a useful summary of these approaches to evaluation. She was particularly concerned with the evaluation of social development projects.

The characteristics of the traditional (banking) approach to evaluation:

1. A search for objectivity and a 'scientific approach', through standardized procedures. The values used in this approach… often reflect the priorities of the evaluator.

2. An over-reliance on quantitative measures. Qualitative aspects…, being difficult to measure, tend to be ignored.

3. A high degree of managerial control, whereby managers can influence the questions being asked Other people, who may be affected by the findings of an evaluation, may have little input, either in shaping the questions to be asked or reflecting on the findings.

4. Outsiders are usually contracted to be evaluator in the belief that his will increase objectivity, and there may be a negative perception of them by those being evaluated'.

The characteristics of the alternative (dialogical) approach to evaluation

1. Evaluation is viewed as an integral part of the development or change process and involves 'reflection-action'. Subjectivity is recognized and appreciated.

2. There is a focus on dialogue, enquiry rather than measurement, and a tendency to use less formal methods like unstructured interviews and participant observation.

3. It is approached as an 'empowering process' rather than control by an external body. There is a recognition that different individuals and groups will have different perceptions. Negotiation and consensus is valued concerning the process of evaluation, and the conclusions reached, and recommendations made

4. The evaluator takes on the role of facilitator, rather than being an objective and neutral outsider. Such evaluation may well be undertaken by 'insiders' – people directly involved in the project or programme.

Adapted from Joanna Rowlands (1991) *How do we know it is working? The evaluation of social development projects*, and discussed in Rubin (1995: 17-23)

We can see in these contrasting models important questions about power and control, the way in which those directly involved in programmes and projects are viewed. Dialogical evaluation places the responsibility for evaluation squarely on the educators and the other participants in the setting (Jeffs and Smith 2005: 85-92).

Thinking about indicators

The key part of evaluation, some may argue, is framing the questions we want to ask, and the information we want to collect such that the answers provide us with the*indicators* of change. Unfortunately, as we have seen, much of the talk and practice around indicators in evaluation has been linked to rather crude measures of performance and the need to justify funding (Rogers and Smith 2006). We want to explore the sort of indicators that might be more fitting to the work we do.

In common usage an indicator points to something, it is a sign or symptom. The difficulty facing us is working out just what we are seeing might be a sign of. In informal education – and any authentic education – the results of our labours may only become apparent some time later in the way that people live their lives. In addition, any changes in behaviour we see may be specific to the situation or relationship (see below). Further, it is often difficult to identify who or what was significant in bringing about change. Last, when we look at, or evaluate, the work, as E Lesley Sewell (1966) put it, we tend to see what we are looking for. For these reasons a lot of the outcomes that are claimed in evaluations and reports about work with particular groups or individuals have to be taken with a large pinch of salt.

Luckily, in trying to make sense of our work and the sorts of indicators that might be useful in evaluation, we can draw upon wisdom about practice, broader research findings, and our values.

Exhibit 2: Evaluation – what might we need indicators for?

We want to suggest four possible areas that we might want indicators for:

The number of people we are in contact with and working with. In general, as informal educators we should expect to make and maintain a lot of *contacts*. This is so people know about us, and the opportunities and support we can offer. We can also expect to involve smaller numbers of *participants* in groups and projects, and an even smaller number as *'clients'* in intensive work. The numbers we might expect – and the balance between them – will differ from project to project (Jeffs and Smith 2005: 116-121). However, through dialogue it does seem possible to come some agreement about these – and in the process we gain a useful tool for evaluation.
The nature of the opportunities we offer. We should expect to be asked questions about the nature and range of opportunities we offer. For example, do young people have a chance to talk freely and have fun; expand and enlarge their experience, and learn? As informal

educators we should also expect to work with people to build varied programmes and groups and activities with different foci.

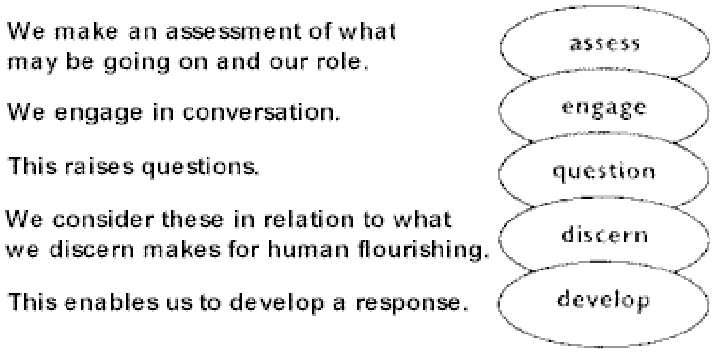
The quality of relationships available. Many of us talk about our work in terms of 'building relationships'. By this we often mean that we work both *through* relationship, and *for* relationship (see Smith and Smith forthcoming). This has come under attack from those advocating targeted and more outcome-oriented work. However, the little sustained research that has been done confirms that it is the relationships that informal educators and social pedagogues form with people, and encourage them to develop with others, that really matters (see Hirsch 2005). Unfortunately identifying sensible indicators of progress is not easy – and the job of evaluation becomes difficult as a result.

How well people work together and for others. Within many of the arenas where informal education flourishes there is a valuing of working so that people may organize things for themselves, and be of service to others. The respect in which this held is also backed up by research. We know, for example, that people involved in running groups generally grow in self-confidence and develop a range of skills (Elsdon 1995). We also know that those communities where a significant number of people are involved in organizing groups and activities are healthier, have more positive experiences of education, are more active economically, and have less crime (Putnam 1999). (Taken from Rogers and Smith 2006)

For some of these areas it is fairly easy to work out indicators. However, when it comes to things like relationships, as Lesley Sewell noted many years ago, 'Much of it is intangible and can be felt in atmosphere and spirit. Appraisal of this inevitably depends to some extent on the beholders themselves' (1966: 6). There are some outward signs – like the way people talk to each other. In the end though, informal education is fundamentally an act of faith. However, our faith can be sustained and strengthened by reflection and exploration.

On being connoisseurs and critics

Informal education involves more than gaining and exercising technical knowledge and skills. It depends on us also cultivating a kind of artistry. In this sense, educators are not engineers applying their skills to carry out a plan or drawing, they are artists who are able to improvise and devise new ways of looking at things. We have to work within a personal but shared idea of the 'good' – an appreciation of what might make for human flourishing and well-being (see **Jeffs and Smith** 1990). What is more, there is little that is routine or predictable in our work. As a result, central to what we do as educators is the ability to 'think on our feet'. Informal education is driven by conversation and by certain values and commitments (Jeffs and Smith 2005).



Describing informal education as an art does sound a bit pretentious. It may also appear twee. But there is a serious point here. When we listen to other educators, for example in team meetings, or have the chance to observe them in action, we inevitably form judgments about their ability. At one level, for example, we might be impressed by someone's knowledge of the income support system or of the effects of different drugs. However, such knowledge is useless if it cannot be used in the best way. We may be informed and be able to draw on a range of techniques, yet the thing that makes us special is the way in which we are able to combine these and improvise regarding the particular situation. It is this quality that we are describing as artistry.

For Donald Schön (1987: 13) artistry is an exercise of intelligence, a kind of knowing. Through engaging with our experiences we are able to develop maxims about, for example, group work or working with an individual. In other words, we learn to appreciate – to be aware and to understand – what we have experienced. We become what Eisner (1985; 1998) describes as 'connoisseurs'. This involves very different qualities to those required by dominant models of evaluation.

Connoisseurship is the art of appreciation. It can be displayed in any realm in which the character, import, or value of objects, situations, and performances is distributed and variable, including educational practice. (Eisner 1998: 63)

The word connoisseurship comes from the Latin *cognoscere*, to know (Eisner 1998: 6). It involves the ability to see, not merely to look. To do this we have to develop the ability to name and appreciate the different dimensions of situations and experiences, and the way they relate one to another. We have to be able to draw upon, and make use of, a wide array of information. We also have to be able to place our experiences and understandings in a wider context, and connect them with our values and commitments. Connoisseurship is something that needs to be worked at – but it is not a technical exercise. The bringing together of the different elements into a whole involves artistry.

However, educators need to become something more than connoisseurs. We need to become critics.

If connoisseurship is the art of appreciation, criticism is the art of disclosure. Criticism, as Dewey pointed out in *Art as Experience*, has at is end the re-education of perception… The task of the critic is to help us to see.

Thus… connoisseurship provides criticism with its subject matter. Connoisseurship is private, but criticism is public. Connoisseurs simply need to appreciate what they encounter. Critics, however, must render these qualities vivid by the artful use of critical disclosure. (Eisner 1985: 92-93)

Criticism can be approached as the process of enabling others to see the qualities of something. As Eisner (1998: 6) puts it, 'effective criticism functions as the midwife to perception. It helps it come into being, then later refines it and helps it to become more acute'. The significance of this for those who want to be educators is, thus, clear. Educators also need to develop the ability to work with others so that they may discover the truth in situations, experiences and phenomenon.

Educators as action researchers

Schön (1987) talks about professionals being 'researchers in the practice context'. As Bogdan and Biklen (1992: 223) put it, 'research is a frame of mind – a perspective people take towards objects and activities'. For them, and for us here, it is something that we can all undertake. It isn't confined to people with long and specialist training. It involves (Stringer 1999: 5):

• A problem to be investigated.

• A process of enquiry

• Explanations that enable people to understand the nature of the problem

Within the action research tradition there have been two basic orientations. The British tradition – especially that linked to education – tends to view action research as research oriented toward the enhancement of direct practice. For example, Carr and Kemmis provide a classic definition:

Action research is simply a form of self-reflective enquiry undertaken by participants in social situations in order to improve the rationality and justice of their own practices, their understanding of these practices, and the situations in which the practices are carried out (Carr and Kemmis 1986: 162).

The second tradition, perhaps more widely approached within the social welfare field – and most certainly the broader understanding in the USA – is of action research as 'the systematic collection of information that is designed to bring about social change' (Bogdan and Biklen 1992: 223). Bogdan and Biklen continue by saying that its practitioners marshal evidence or data to expose unjust practices or environmental dangers and recommend actions for change. It has been linked into traditions of citizen's action and community organizing, but in more recent years has been adopted by workers in very different fields.

In many respects, this distinction mirrors one we have already been using – between programme evaluation and practice evaluation. In the latter, we may well set out to explore a particular piece of work. We may think of it as a case study – a detailed examination of one setting, or a single subject, a single depository of documents, or one particular event (Merriam 1988). We can explore what we did as educators: what were our aims and concerns; how did we act; what were we thinking and feeling and so on? We can look at what may have been going on for other participants; the conversations and interactions that took place; and what people may have learnt and how this may have affected their behaviour. Through doing this we can develop our abilities as connoisseurs and critics. We can enhance what we are able to take into future encounters.

When evaluating a programme or project we may ask other participants to join with us to explore and judge the processes they have been involved in (especially if we are concerned with a more dialogical approach to evaluation). Our concern is to collect information, to reflect upon it, and to make some judgements as to the worth of the project or programme, and how it may be improved. This takes us into the realm of what a number of writers have called community-based action research. We have set out one example of this below.

Exhibit 3: Stringer on community-based action research

A fundamental premise of community-based action research is that it commences with an interest in the problems of a group, a community, or an organization. Its purpose is to assist people in extending their understanding of their situation and thus resolving problems that confront them….

Community-based action research is always enacted through an explicit set of social values. In modern, democratic social contexts, it is seen as a process of inquiry that has the following characteristics:

- It is *democratic*, enabling the participation of all people.
- It is *equitable*, acknowledging people's equality of worth.
- It is *liberating*, providing freedom from oppressive, debilitating conditions.
- It is *life enhancing*, enabling the expression of people's full human potential. (Stringer 1999: 9-10)

The action research process

Action research works through three basic phases:

Look - building a picture and gathering information. When evaluating we define and describe the problem to be investigated and the context in which it is set. We also describe what all the participants (educators, group members, managers etc.) have been doing.

Think – interpreting and explaining. When evaluating we analyse and interpret the situation. We reflect on what participants have been doing. We look at areas of success and any deficiencies, issues or problems.

Act – resolving issues and problems. In evaluation we judge the worth, effectiveness, appropriateness, and outcomes of those activities. We act to formulate solutions to any problems.

(Stringer 1999: 18; 43-44;160)

We could contrast with a more traditional, banking, style of research in which an outsider (or just the educators working on their own) collect information, organize it, and come to some conclusions as to the success or otherwise of the work.

Some issues when evaluating informal education

In recent years informal educators have been put under great pressure to provide 'output indicators', 'qualitative criteria', 'objective success measures' and 'adequate assessment criteria'. Those working with young people have been encouraged to show how young people have developed 'personally and socially through participation'. We face a number of problems when asked to approach our work in such ways. As we have already seen, our way of working as informal educators places us within a more dialogical framework. Evaluating our work in a more bureaucratic and less inclusive fashion may well compromise or cut across our work.

There are also some basic practical problems. Here we explore four particular issues identified by Jeffs and Smith (2005) with respect to programme or project evaluations.

The problem of multiple influences. The different things that influence the way people behave can't be easily broken down. For example, an informal educator working with a project to reduce teen crime on two estates might notice that the one with a youth club open every weekday evening has less crime than the estate without such provision. But what will this variation, if it even exists, prove? It could be explained, as research has shown, by differences in the ethos of local schools, policing practices, housing, unemployment rates, and the willingness of people to report offences.

The problem of indirect impact. Those who may have been affected by the work of informal educators are often not easily identified. It may be possible to list those who have been worked with directly over a period of time. However, much contact is sporadic and may even take the form of a single encounter. The indirect impact is just about impossible to quantify. Our efforts may result in significant changes in the lives of people we do not work with. This can happen as those we work with directly develop. Consider, for example, how we reflect on conversations that others recount to us, or ideas that we acquire second- or third-hand. Good informal education aims to achieve a ripple effect. We hope to encourage learning through conversation and example and can only have a limited idea of what the true impact might be.

The problem of evidence. Change can rarely be monitored even on an individual basis. For example, informal educators who focus on alcohol abuse within a particular group can face an insurmountable problem if challenged to provide evidence of success. They will not be able to measure use levels prior to intervention, during contact or subsequent to the completion of their work. In the end all the educator will be able to offer, at best, is vague evidence relating to contact or anecdotal material.

The problem of timescale. Change of the sort with which informal educators are concerned does not happen overnight. Changes in values, and the ways that people come to appreciate themselves and others, are notoriously hard to identify – especially as they are happening. What may seem ordinary at the time can, with hindsight, be recognized as special.

Workarounds

There are two classic routes around such practical problems. We can use both as informal educators.

The first is to undertake the sort of participatory action research we have been discussing here. When setting up and running programmes and projects we can build in participatory research and evaluation from the start. We make it part of our way of working. Participants are routinely invited and involved in evaluation. We encourage them to think about the processes they have been participating in, the way in which they have changed and so on. This can be done in ways that fit in with the general run of things that we do as informal educators.

The second route is to make linkages between our own activities as informal educators and the general research literature. An example here is group or club membership. We may find it very hard to identify the concrete benefits for individuals from being member of a particular group such as a football team or social club. What we can do, however, is to look to the general research on such matters. We know, for example, that involvement in such groups builds social capital. We have evidence that:

In those countries where the state invested most in cultural and sporting facilities young people responded by investing more of their own time in such activities (Gauthier and Furstenberg 2001).

The more involved people are in structured leisure activities, good social contacts with friends, and participation in the arts, cultural activities and sport, the more likely they are to do well educationally, and the less likely they are to be involved even in low-level delinquency (Larson and Verma 1999).

There appears to be a strong relationship between the possession of social capitaland better health. 'As a rough rule of thumb, if you belong to no groups but decide to join one, you cut your risk of dying over the next year *in half*. If you smoke and belong to no groups, it's a toss-up statistically whether you should stop smoking or start joining' (ibid.: 331). Regular club attendance, volunteering, entertaining, or church attendance is the happiness equivalent of getting a college degree or more than doubling your income. Civic connections rival marriage and affluence as predictors of life happiness (Putnam 2000: 333).

This approach can work where there is some freedom in the way that you can respond to funders and others with regard to evaluation. Where you are forced to fill in forms that require the answers to certain set questions we can still use the evaluations that we have undertaken in a participatory manner – and there may even be room to bring in some references to the broader literature. The key here is to remember that we are educators – and that we have a responsibility foster learning, not only among those we work with in a project or programme, but also among funders, managers and policymakers. We need to view their requests for information as opportunities to work at deepening their appreciation and understanding of informal education and the issues and questions with which we work.

Conclusion

The purpose of evaluation, as Everitt *et al* (1992: 129) is to reflect critically on the effectiveness of personal and professional practice. It is to contribute to the development of 'good' rather than 'correct' practice.

Missing from the instrumental and technicist ways of evaluating teaching are the kinds of educative relationships that permit the asking of moral, ethical and political questions about the 'rightness' of actions. When based upon educative (as distinct from managerial) relations, evaluative practices become concerned with breaking down structured silences and narrow prejudices. (Gitlin and Smyth 1989: 161)

Evaluation is not primarily about the counting and measuring of things. It entails valuing – and to do this we have to develop as connoisseurs and critics. We have also to ensure that this process of 'looking, thinking and acting' is participative.

TOPIC 3: COMPREHENSIVE AND COUNTINIOUS EVALUATION

Continuous and comprehensive evaluation is an education system newly introduced by Central Board of Secondary Education in India, for students of sixth to tenth grades. The main aim of CCE is to evaluate every aspect of the child during their presence at the school. This is believed to help reduce the pressure on the child during/before examinations as the student will have to sit for multiple tests throughout the year, of which no test or the syllabus covered will be repeated at the end of the year, whatsoever. The CCE method is claimed to bring enormous changes from the traditional *chalk and talk* method of teaching, provided it is implemented accurately.

New scheme of evaluation

As a part of this new system, student's marks will be replaced by grades which will be evaluated through a series of curricular and extra-curricular evaluations along with academics. The aim is to reduce the workload on students and to improve the overall skill and ability of the student by means of evaluation of other activities. Grades are awarded to students based on work experience skills, dexterity, innovation, steadiness, teamwork, public speaking, behavior, etc. to evaluate and present an overall measure of the student's ability. This helps the students who are not good in academics to show their talent in other fields such as arts, humanities, sports, music, athletics, etc.

Marks and grades

In CCE, the marks obtained in an exam are usually not revealed. However, equivalent grades, which would be deduced using a special method by the teachers during evaluation would be revealed. This is considered as a drawback since a child with 92 marks will get the same grade as the child with 100 marks and their talents cannot be recognized by anyone else other than their teachers. Though this system might have some drawbacks it instills this value that students need to compete with themselves to get a better grade and not with others. The grading system is as follows-

pattern of Education

Unlike CBSE's old pattern of only one test at the end of the academic year, the CCE conducts several. There are two different types of tests. Namely, the *formative* and the *summative*. Formative tests will comprise the student's work at class and home, the student's performance in oral tests and quizzes and the quality of the projects or assignments submitted by the child. Formative tests will be conducted four times in an academic sesssion, and they will carry a 40% weightage for the aggregate. In some schools, an additional written test is conducted instead of multiple oral tests. However, at-least one oral test is conducted.

The summative asssesssment is a three-hour long written test conducted twice an year. The first summative or *Summative Assessment 1* (SA-1) will be conducted after the first two formatives are completed. The second (SA-2) will be conducted after the next two formatives. Each summative will carry a 30% weightage and both together will carry a 60% weightage for the aggregate. The summative assessment will be conducted by the schools itself. However, the question papers will be partially prepared by the CBSE and evaluation of the answer sheets is also strictly monitored by the CBSE. Once completed, the syllabus of one summative *will not* be repeated in the next. A student will have to concentrate on totally new topics for the next summative.

At the end of the year, the CBSE processes the result by adding the formative score to the summative score, i.e. 40% + 60% = 100%. Depending upon the percentage obtained, the board will deduce the CGPA and thereby deduce the grade obtained. In addition to the summative assessment, the board will offer an optional online aptitude test that may also be used as a tool along with the grades obtained in the CCE to help students to decide the choice of subjects in further studies. The board has also instructed the schools to prepare the report card and it will be duly signed by the principal, the student and the Board official.

Often during the evaluation of Social Science papers, the following concepts are observed.

- Investigation of the situation - What is the question and what is to be explained.
- Deductive Method - What does the student know and how can he use it to explain a situation.
- Co-relation with a real life situation - Whether the situation given matches any real life situation, like tsunamis, floods, tropical cyclones, etc.
- Usage of Information Technology - Can the problem be solved with the use of IT? If yes, how?

In addition to that, various assignments can be given such as projects, models and charts, group work, worksheet, survey, seminar, etc. The teacher will also play a major role. For example, they give remedial help, maintain a term-wise record and checklists, etc.

TOPIC 4: NEED AND IMPORTANCE OF CLASS TEST

One of the most dreaded parts of school life has to be the class test. All the way through school, children have to take tests in one form or another. From first grade onwards, there will be some point at which children have to go over everything they have learned.

School tests take various forms - oral question and answer sessions, multiple choice questions, essay questions, practical demonstrations, and written short questions. These methods vary depending on the subject studied and the age of the students.

Testing is extremely important however, because without it no teacher can really know how much the students have learned. This is necessary, not only in terms of the students but also for the teacher so that he or she can know where the class is holding when preparing the material for the next lessons. It can also show who the weaker and stronger students are - who needs extra help and who needs more of a challenge.

For the student, testing is a good idea because this is an ideal opportunity to pause, take stock of the material studied over the recent period, and process it so that it is properly understood. In addition, there is always the satisfaction of passing the test and really feeling that you know something. And if you don't pass, there is the challenge of having to relearn the material and make sure that you do know it next time.

Building self-esteem from one's successes and strengthening the character by dealing with one's failures are both important lessons in life that a child can take with them into adult life and forever.

A **test** or **examination** is an assessment intended to measure a test taker's knowledge, skill, aptitude, physical fitness, or classification in many other topics (e.g., beliefs). A test may be administered orally, on paper, on a computer, or in a confined area that requires a test taker to physically perform a set of skills. Tests vary in style, rigor and requirements. For example, in a closed book test, a test taker is often required to rely upon memory to respond to specific items whereas in an open book test, a test taker may use one or more supplementary tools such as a reference book or calculator when responding to an item. A test may be administered formally or informally. An example of an informal test would be a reading test administered by a parent to a child. An example of a formal test would be a final examination administered by a teacher in a classroom or an I.Q. test administered by a psychologist in a clinic. Formal testing often results in a grade or a test score.[1] A test score may be interpreted with regards to a norm or criterion, or occasionally both. The norm may be established independently, or by statistical analysis of a large number of participants.

A standardized test is any test that is administered and scored in a consistent manner to ensure legal defensibility.[2] Standardized tests are often used in education, professional certification, psychology (e.g., MMPI), the military, and many other fields.

A non-standardized test is usually flexible in scope and format, variable in difficulty and significance. Since these tests are usually developed by individual instructors, the format and difficulty of these tests may not be widely adopted or used by other instructors or institutions. A non-s tandardized test may be used to determine the proficiency level of students, to motivate students to study, and to provide feedback to students. In some instances, a teacher may develop non-standardized tests that resemble standardized tests in scope, format, and difficulty for the purpose of preparing their students for an upcoming standardized test.[3] Finally, the frequency and setting by which a non-standardized tests are administered are highly variable and are usually constrained by the duration of the class period. A class instructor may for example, administer a test on a weekly basis or just twice a semester. Depending on the policy of the instructor or institution, the duration of each test itself may last for only five minutes to an entire class period.

In contrasts to non-standardized tests, standardized tests are widely used, fixed in terms of scope, difficulty and format, and are usually significant in consequences. Standardized tests are usually held on fixed dates as determined by the test developer, educational institution, or governing body, which may or may not be administered by the instructor, held within the classroom, or constrained by the classroom period. Although there is little variability between different copies of the same type of standardized test (e.g., SAT or GRE), there is variability between different types of standardized tests.

Any test with important consequences for the individual test taker is referred to as a high-stakes test.

A test may be developed and administered by an instructor, a clinician, a governing body, or a test provider. In some instances, the developer of the test may not be directly responsible for its administration. For example, Educational Testing Service (ETS), a nonprofit educational testing and assessment organization, develops standardized tests such as the SAT but may not directly be involved in the administration or proctoring of these tests. As with the development and administration of educational tests, the format and level of difficulty of the tests themselves are highly variable and there is no general consensus or invariable standard for test formats and difficulty. Often, the format and difficulty of the test is dependent upon the educational philosophy of the instructor, subject matter, class size, policy of the educational institution, and requirements of accreditation or governing bodies. In general, tests developed and administered by individual instructors are non-standardized whereas tests developed by testing organizations are standardized.

TOPIC 5: DIAGNOSTIC TEST AND REMEDIAL MEASURES AND MONITORING LEARNER'S PROGRESS

Just as doctor diagnoses a patient to find the nature, type and extent of his disease before prescribing medicine, a teacher of science applies Diagnostic test to diagnose the particular strength and weakness of the students. Through this test, weakness and difficulties of students in the instructional material consisting of one or mere type of Science are diagnosed.

In diagnostic test both background and performance of the students are needed. Diagnostic tests are qualitative not the quantitative. Diagnostic test can easily be understood with the following example- A bottle contains milk. Two questions can be arisen.

How much milk is there in bottle and why is it full or empty? Question about the quantity of milk comes in Achievement test while about quality, why the bottle is empty or full comes in Diagnostic test. Hence, from the following example, and easy understanding can be made, from the following example Diagnostic test sire qualitative not quantitative.

It undertakes to provide a picture of strengths and weakness of pupil in learning. So diagnostic tests are purely meant for diagnosing the weakness deficiency and difficulties of students related to the specific area and aspects of the formal and informal learning of a subject.

These are constructed not to assess the level of achievements or gains in the learning experiences of the pupils but to reveal the weaknesses and learning difficulties

Characteristics of Diagnostic Test in Science

1. It needs an expert of specialist to identify the cause for wrong answers.

2. In Diagnostic test no scores is made for correct answers, only wrong responses are find out into view in the sequence of contents.

3. It fully emphasizes on all learning and teaching points.

4. It adopts objective type tests only.

5. It arranges the items in learning sequence so as to help transfer to learning position.

6. It is a base to form tutorial groups so as help the poor students to develop their performance removing their difficulties.

7. It finds out weakness or deficiency of a child in learning of a contents.

TOPIC 6: ACHIEVEMENT TEST : ITS CONSTRUCTION AND ADMINISTRATION

Achievement is the accomplishment or proficiency of performance in a given skill or body of knowledge. Therefore, it can be said that achievement implies the overall mastery of a pupil on a particular context. Any measuring instrument that measures the attainments or accomplishments of a pupil's achievement must be valid and reliable.

Testing is a systematic procedure for comparing the behavior of two or more persons. This way an achievement test is an examination to reveal the relative standing of an individual in the group with respect to achievement.

As achievement is the competence of a person in relation to a domain of knowledge An Achievement Test is a test of knowledge or proficiency based on something learned or taught. The purpose of an achievement test is to determine student's knowledge in a particular subject area.

Characteristics of Good Measurement Instruments:

Measurement tools can be judged on a variety of merits. These include practical issues as well as technical ones. All instruments have strengths and weaknesses no instrument is perfect for every task. Some of the practical issue that need to be considered includes:

Criteria of a good measuring instrument

Practical Criteria	Technical Criteria
* Ease in administration	* Reliability
* Cost	* Validity
* Time and effort required for respondent to complete measure	
* Acceptability	

Practical Criteria:

Ease in administration:

A test is good only when the conditions of answering are simple (scientific and logical). Its instruction should be simple and clear.

Cost:

A good test should be in expensive, not only from the view point of money but also from the view point of time and effort taken in the construction of a test. Fortunately there is no direct relationship between cost and quality.

Time and effort required for respondent to complete measure:

Generally the time given to students is always in short supply however the students too do not accept very long tests. Therefore a test should neither be very long nor very short.

Acceptability:

A good test should be acceptable to student to whom its being given without regard to any specific situation that is the question given in the test should be neither very difficult nor very easy.

Technical Criteria

Along with the practical issues, measurement tools may be judged on the following:

Consistency (Reliability): -

Reliability of a test refers to its consistency or stability. A test good reliability means that the test taker will obtain the same test score over repeated testing as long as no other extraneous factors have affected the score. Reliability is the extent to which the measurements resulting from a test are the result of characteristics of those being measured. For example, reliability has elsewhere been defined as "the degree to which test scores for a group of test takers are consistent over repeated applications of a measurement procedure and hence are inferred to be dependable and repeatable for an individual test taker" (Berkowitz, Wolkowitz, Fitch, and Kopriva, 2000).

Technically, the theoretical definition of reliability is the proportion of score variance that is caused by systematic variation in the population of test-takers. This definition is population-specific. If there is greater systematic variation in one population than another, such as in all public school students compared with only eighth-graders, the test will have greater reliability for the more varied population. This is a consequence of how reliability is defined. Reliability is a joint characteristic of a test and examinee group, not just a characteristic of a test. Indeed, reliability of any one test varies from group to group

Reliability is the quality of a test which produces scores that are not affected much by chance. Students sometimes randomly miss a question they really knew the answer to or sometimes get an answer correct just by guessing; teachers can sometimes make an error or score inconsistently with subjectively scored tests.

Reliability of a measuring instruments depends on two factors-

1. Adequacy in sampling

2. Objectivity in scoring

A good instrument will produce consistent scores. An instrument's reliability is estimated using a correlation coefficient of one type or another. For purposes of learning research, the major characteristics of good scales include:

• **Test-retest Reliability**:

The test-retest reliability method is one of the simplest ways of testing the stability and reliability of an instrument over time**.** In test-retest reliability the same test is administer to the same sample on two different occasions. This approach assumes that there is no substantial change in the construct being measured between the two occasions.. The ability of an instrument to give accurate scores from one time to another. Also known as temporal consistency.

A test-retest reliability coefficient is obtained by administering the same test twice and correlating the scores. In concept, it is an excellent measure of score consistency because it allows the direct measurement of consistency from administration to administration. This coefficient is not recommended in practice, however, because of its problems and limitations. It requires two administrations of the same test with the same group of individuals. The amount of time allowed between measures is critical. The shorter the time gap, the higher the correlation; the longer the time gap, the lower the correlation If the time interval is short, people may be overly consistent because they remember some of the questions and their responses. If the interval is long, then the results are confounded with learning and maturation, that is, changes in the persons themselves

Alternate-form reliability

Most standardized tests provide equivalent forms that can be used interchangeably. For this purpose first have two parallel forms are created . One way to accomplish this is to create a large set of questions that address the same construct and then randomly divide the questions into two sets. You administer both instruments to the same sample of people. The correlation between the two parallel forms is the estimate of reliability. These alternate forms are typically matched in terms of content and difficulty. The correlation of scores on pairs of alternate forms for the same examinees provides another measure of consistency or reliability. Even with the best test and item specifications, each test would contain slightly different content and, as with test-retest reliability, maturation and learning may confound the results..

• **Split-half Reliability**:

The consistency of items within a test. There are two types of item coherence: which assesses the consistency of items in one-half of a scale to the other half. In split-half reliability. As the name suggests, split-half reliability is a coefficient obtained by dividing a test into halves we randomly divide all items that purport to measure the same construct into two sets. We administer the entire instrument to a sample of people and calculate the total score for each randomly divided half. by correlating the scores on each half, and then correcting for length The split can be based on odd versus even numbered items, randomly selecting items, or manually balancing content and difficulty. This approach has an advantage in that it only requires a single test administration. Its weakness is that the resultant coefficient will vary as a function of how the test was split. It is also not appropriate on tests in which speed is a factor

• **Internal consistency reliability:**

It estimates the consistency among all items in the instrument. Internal consistency. Internal consistency focuses on the degree to which the individual items are correlated with each other and is thus often called homogeneity. Several statistics fall within this category. The best known are Cronbach's alpha, the Kuder-Richardson Formula 20 (KR-20) and the Kuder-Richardson Formula 21 (KR-21). The **Kuder-Richardson Formula 20** (KR-20) first published in 1937 is a measure of internal consistency reliability for measures with dichotomous choices. It is analogous to Cronbach's α, except Cronbach's α is also used for non-dichotomous (continuous) measures. A high KR-20 coefficient (e.g., >0.90) indicates a homogeneous test.

• **Inter-rater reliability**:

inter-rater reliability, inter-rater agreement, or concordance is the degree of agreement among raters. This type of reliability is assessed by having two or more independent judges score the test. The scores are then compared to determine the consistency of the raters estimates. One way to test inter-rater reliability is to have each rater assign each test item a score. For example, each rater might score items on a scale from 1 to 10. Next, you would calculate the correlation between the two rating to determine the level of inter-rater reliability. Another means of testing inter-rater reliability is to have raters determine which category each observations falls into and then calculate the percentage of agreement between the raters. So, if the raters agree 8 out of 10 times, the test has an 80% inter-rater reliability rate.

The degree to which different observers or raters give consistent scores using the same instrument, rating scale, or rubric. Also called Scoring agreement.

Suggestions for improving the reliability

The best suggestions for improving the reliability of classroom tests are:

- **Start planning the test and writing the items well ahead of the time the test is to be given**. A test written hurriedly at the last minute is not likely to be a reliable test

- · **Write clear directions and use standard administrative procedures.**
  - **Pay more attention to the careful construction of the test questions**.Phrase each question clearly so that students know exactly what you want. Try to write items that discriminate among good and poor students and are of an appropriate difficulty level.
  - **Write longer tests.** The number of items are needed in order to provide reliable measurement. depends on the quality of the items, the difficulty of the items, the

range of the scores, and other factors. So include as many questions as you think the students can complete in the testing time available.

Meaningfulness (Validity):

Validity is the quality of a test which measures what it is supposed to measure. It is the degree to which evidence, common sense, or theory supports any interpretations or conclusions about a student based on his/her test performance. More simply, it is how one knows that a math test measures students' math ability, not their reading ability.

Validity like reliability also depends upon certain factors, they are -

1. Adequacy in sampling

2. Objectivity in scoring

3. Aim

Thus, a valid measurement tool does a good job of measuring the concept that it purports to measure. It is important to remember that the validity of an instrument only applies to a specific purpose with a specific group of people.

A test is valid when it

- produces consistent scores over time.
- correlates well with a parallel form.
- measures what it purports to measure.
- can be objectively scored.
- has representative norms.

Forms of Validity

• Construct validity:

Construct validity refers to the extent to which a test captures a specific theoretical construct or trait and it overlaps with. Construct validity establishes that the instrument is truly measuring the desired construct. This is the most important form of validity, because it really subsumes all of the other forms of validity.

To asses the test's internal consistency. That is, if a test has construct validity, scores on the individual test items should correlate highly with the total test score. This is evidence that the test is measuring a single construct

also developmental changes. tests measuring certain constructs can be shown to have construct validity if the scores on the tests show predictable developmental changes over time.
and experimental intervention, that is if a test has construct validity, scores should change following an experimental manipulation, in the direction predicted by the theory underlying the construct.

• Convergent validity:
We can create **2 different methods to measure the same variable and when they correlate we have demonstrated convergent validity.** A type of validity that is determined by hypothesizing and examining the overlap between two or more tests that presumably measure the same construct. In other words, convergent validity is used to evaluate the degree to which two or more measures that theoretically should be related to each other are, in fact, observed to be related to each other.
Comparison and correlation of scores on an instrument with other variables or scores that should theoretically be similar. A test has convergent validity if it has a high correlation with another test that measures the same construct

Divergent validity
a test's divergent validity is demonstrated through a low correlation with a test that measures a different construct. When we create **2 different unrelated methods to measure the same variable and when they do not correlate. We have demonstrated divergent validity**.
The goal of divergent validity is that to demonstrate we are measuring one specific construct and not combining two different constructs.

• Discriminant validity:
Comparison of scores on an instrument with other variables or scores from which it should theoretically differ. Measures that should not be related are not. Discriminant validity examines the extent to which a measure correlates with measures of attributes that are different from the attribute the measure is intended to assess.

• Factor structure:
A statistical at the internal consistency of an instrument, usually one that has subscales or multiple parts. The items that are theoretically supposed to be measuring one concept should

correlate highly with each other, but have low correlations with items measuring a theoretically different concept.

• **Content validity**:

Content validity of a test refers to the adequacy of sampling of the content across construct or trait being measured. Given the published literature or particular trait, are all aspects of that concept represented by items on the test. It establishes that the instrument includes items that comprise the relevant content domain. A test has content validity if it measures knowledge of the content domain of which it was designed to measure knowledge. Another way of saying this is that content validity concerns, primarily, the adequacy with which the test items adequately and representatively sample the content area to be measured. (For example, . a math achievement test would lack content validity if good scores depended primarily on knowledge of English, or if it only had questions about one aspect of math only or a test of English grammar should include questions on subject-verb agreement, but should not include items that test algebra skills)

• **Face validity**:

A subjective judgment about whether or not on the "face of it" the tool seems to be measuring what you want it to measure. : or when a test appears valid to examinees who take it, personnel who administer it and other untrained observers. It is perhaps the simplest type of validity. Face validity can refer to a single item or to all of the items on a test and it indicates how well the item reveals the purpose or meaning of the test item or the test itself. Face validity is not a technical sense of test validity; just because a test has face validity does not mean it will be valid in the technical sense of the word.

• **Criterion-related validity also called Concurrent validity or Predictive validity**

Refers to the comparison of scores on a test with some other external measure of performance .The other measure should be theoretically related to the first measure and their relationship can be assessed by a simple correlation coefficient .The instrument "behaves" the way it should given your theory about the construct This validity is a concern for tests that are designed to predict someone's status on an external criterion measure. A test has criterion-related validity if it is useful for predicting a person's behavior in a specified situation.

• Concurrent validity:

Comparison of scores on some instrument with current scores on another instrument. If the two instruments are theoretically related in some manner, the scores should reflect the theorized relationship. In concurrent validation, the predictor and criterion data are collected at or about the same time. This kind of validation is appropriate for tests designed to asses a person's current criterion status.

In concurrent validity a proposed test is given to a group of participants who complete other theoretically related measures concurrently (at the same point in time).

• Predictive validity:

Comparison of scores on some instrument with some future behavior or future scores on another instrument. The instrument scores should do a reasonable job of predicting the future performance. In Predictive validation, the predictor scores are collected first and criterion data are collected at some later/future point. this is appropriate for tests designed to asses a person's future status on a criterion

With predictive validity the new test is given to a group of partecipants who are followed overtime to see how well the original assessment predicts some important variable at a later point in time

Relationship between reliability and validity

· If a test is unreliable, it cannot be valid.

- For a test to be valid, it must reliable.
- However, just because a test is reliable does not mean it will be valid.

- Reliability is a necessary but not sufficient condition for validity!

Construction procedure of an Achievement Test:

If a test has to be really made valid, reliable and practical, then it will have to be suitably planned. For it, qualitative improvement in the test will have to be effected. For this, the following facts should be kept in view:

* The principles available tests will have to be kept in view so that a test can be

planned.

* Kill will have to be acquired in constructing and writing different types of questions. For it are required thoughtful thinking, determination of teaching objectives, analysis of content and types of questions to be given.

General precautions:
Ebel, in his book Measuring Educational Achievement, has suggested the following precautions in test construction:

1. It should be decided when the test has to be conducted in the context of time and frequency.
2. It should be determined how many questions have to be included in the test.
3. It should be determined what types of questions have to be used in the test.
4. Those topics should be determined from which questions have to be constructed. This decision is taken keeping in view the teaching objectives.
5. The level of difficulty of questions should be decided at the beginning of the test.
6. It should be determined if any correction has to be carried out for guessing.
7. The format and type of printing should be decided in advance.
8. It should be determined what should be the passing score.
9. In order to control the personal bias of the examiner there should be a provision for central evaluation. A particular question should be checked by the same examiner.
10. A rule book should be prepared before the evaluation of the scripts.

To construct an achievement test the steps referred below if followed will make the test objective, reliable and valid -

First step:
Selection of Teaching Objectives for Measurement: At first those teaching objectives should be selected from all teaching objectives of subject teaching which have to be made the basis for test construction. There can be several causes of selecting these teaching objectives which have to determine related teaching, such as how much content has been studied, what is the need of student' what is the importance of specific topics in the content etc. For it, the following table can be used:

Teaching Objectives	Selected Teaching Objectives	Reason for Selections
1. All objectives of the cognitive domain (knowledge, comprehension, application, analysis, synthesis, evaluation) 1. All objectives of the affective domain (receiving, responding, valuing, conceptualization) 2. All skills of psychomotor domain (drawing skill, computational skill, constructional skill, observational skill, problem-solving skill)	1.Knowledge 2.Comprehension 3.Application (Drawing)	

Second step:

Assigning Weightage to Selected Objectives: After these objectives have been selected, a teacher assigns Weightage to these objectives keeping the tasks done and importance of objectives. It is desirable to use the following table.

S. No.	Selected Teaching Objectives	Score	Percentage
1.	Knowledge		
2.	Comprehension		

3.	Application		
4.	Skill		
	Total		

Third step:

Weightage to Content: Content is used as the means of realizing objectives and questions have to be constructed on its basis. Therefore, it becomes necessary to give Weightage to it. There is distinction in the nature, importance and scope of each topic. Therefore, the Weightage should be given to these facts in view; else the test would not represent the whole subject.

S. No.	Topics	Number of Items	Score	Percentage
1.	——			
2.	——			
3.	——			
4.	——			
5.	——			

Fourth step:

Giving Weightage to the Type of Items

In this step, a teacher determines the number of items, their types, their relative marks. For it, it would be convenient to use the following table:

S. No.	Type of Items	Number of Items	Score	Percentage
1.	Long answer type			

2.	Short answer type			
3.	Objective type			

Fifth step:

Determining Alternatives: At this level, it is determined how many alternatives or options should be given according to the type of questions. Giving alternatives influences the reliability and validity of a test; therefore, it is suggested that alternatives should not be given in objective type questions, while in essay type questions only internal choice can be given.

Sixth step:

Division of Sections: If the scope or types of questions is uniform, them it is not necessary to divide the test into sections. However, if it is diverse and different types of questions have been specified and the nature of the test seems to be heterogeneous, then a separate section should be made comprising each type of item.

S. No.	**Sections**	**Type of items**	**Score**	**Percentage**
	A	Objective type		
1.	B	Long answer type		
2.	C	Short answer type		

Seventh step:

Estimation of Time: At this step estimation of the total time the whole test is likely to calculate. Time is estimated on the basis of type and number of items. Some time should be reserved for distribution and collection of answer sheets. The following table can be used for convenience.

S. No.	**Type of Items**	**Number of Items**	**Time (in minutes)**
1.	Objective type		

2.	Long answer type		
3.	Short answer type		

Eighth step:

Preparation of Blueprint: A blueprint provides a bird's eye view of the entire test. In it we can see the topics, teaching objectives, and types of questions, number of items and distribution of scores and their mutual relationships. A blueprint is the basis for test construction. A format is given below-

L- Long Answers Type S- Short Answers Type O-Objective Answers Type

Ninth step:

Preparation of score key:

A score key increases the reliability of a test So that the test constructer should provide the procedure for scoring the answer script. Directions must be given whether the scoring will be made by a scoring key (When the answer is recorded on the test paper) or by scoring stencil (when the answer is recorded on separate answer sheet) and how marks will be awarded to the test items.

In case of essay type items it should be indicated whether to score with **'point method'**or with the **'rating method'**. In the point method each answer is compared with a set of ideal answers in the scoring key. Then a given number of points are assigned. In the rating method the answers are rated on the bases of degrees of quality and determines the credit assigned to each answer.

When the students do not have sufficient time to answer the test or the students are not ready to take the test at that particular time. They guess the correct answer. In that case to eliminate the effect of gusseting some measures must be employed..But there is lack of agreement among psycho-matricians about the value of correction formula so far as validity and reliability are concerned In the words of Ebel ;neither the instruction nor penalties will remedy the problem of guessing. Keeping in view the above opinioned and to avoid this situation the test constructor should give enough time for answering the test idea.

Thus in order to bring objectivity in a test , it is essential that a tester should be fully clear about the type of answer expected from a question. For this, if they are acquainted with the right answers. Then diversity in scoring can be eradicated.

First try-out of the test:

At this stage the initial format of the test is administered on a small representative sample. After that the process of item analysis be used to calculate difficulty level and discriminative value. There are a variety of techniques for performing an item analysis, which is often used, for example, to determine which items will be kept for the final version of a test. Item analysis is used to help "build" reliability and validity are "into" the test from the start. Item analysis can be both qualitative and quantitative. The former focuses on issues related to the content of the test, eg. content validity. The latter primarily includes measurement of item difficulty and item discrimination.

An item's difficulty level is usually measured in terms of the percentage of examinees who answer the item correctly. This percentage is referred to as the item difficulty index, or "p".
Item discrimination refers to the degree to which items differentiate among examinees in terms of the characteristic being measured (e.g., between high and low scorers). This can be measured in many ways. One method is to correlate item responses with the total test score; items with the highest test correlation with the total score are retained for the final version of the test. This would be appropriate when a test measures only one attribute and internal consistency is important.
This initial format is administered on small representative sample group. After that the process of item analysis is used in order to calculate the difficulty level, discriminative value and alternative (in multiple choice items).

First of all in the context of multiple choice items the appropriate choice is also selected and that alternative is rejected which has been opted by the least number of students.

Generally, a test is constructed for average students, Naturally the division according to ability grouping is an essentiality. Generally the ability distribution used in normal probability curve provided the basis for the distribution.

On the basis of N.P.C., it is advisable that a test must not be constructed for extreme cases, such as backward or gifted students. Therefore the items which have been solved by top gifted students and the items solved by the below most dullard students must be eliminated from the test as they must be treated as to difficult or to easy test items.

In the context of difficulty level, the following difficulty levels are suggested for the selection of questions as per Katz (1959) also recommendation-

S.N0.	Types of items	Difficulty Level %
1.	Long answer type	50%
2.	Alternatives 5	60%
3.	Alternatives 4	62%
4.	Alternatives 3	66%
5.	Alternatives 2	75%

In the same way which may be measuring the same content area twice as (e.g. who was the founder of Mughal empire in India? And Which empire was formed by Baber in India?) both questions refer to one content area that Baber established the mughal empire in india. Out of these two questions one question be treated as bogus and must be excluded from the test.

In the same way the discriminating power of the items be calculated and the questions with least discriminating power must be excluded from the test. Generally the items having 25 hundred discriminating value are considered suitable from a test.

Preparation of final test:

The test will provide useful information about the students' knowledge of the learning objectives. Considering the questions relating to the various learning objectives as separate subtests, the evaluator can develop a profile of each student's knowledge of or skill in the objectives.

The final test is constructed after the above analysis for this a suitable format is prepared and norms are specified. Also, instructions for examinees be prepared.

The test constructed in accordance to the above referred procedure will definitely assumes a purpose or an idea of what is good or desirable from the stand point of individual or society or both.

UNIT IV :PROFESSIONAL DEVELOPMENT OF INTEGRATED SCIENCE TEACHER

TOPIC 1 : NEED FOR PROFESSIONAL DEVELOPMENT AT INDIVIDUAL LEVEL, ORGANIZATIONAL LEVEL AND GOVERNMENT LEVEL

In many countries, the role and functioning of schools are changing and so is what is expected of teachers.

Teachers are asked to teach in increasingly multicultural classrooms; to place greater emphasis on integrating students with special learning needs in their classrooms; to make more effective use of information and communication technologies for teaching; to engage more in planning within evaluative and accountability frameworks; and to do more to involve parents in schools. No matter how good pre-service training for teachers is, it cannot be expected to prepare teachers for all the challenges they will face throughout their careers. Education systems therefore seek to provide teachers with opportunities for in-service professional development in order to maintain a high standard of teaching and to retain a high-quality teacher workforce. As OECD's comparative review on teachers noted (OECD, 2005):

Effective professional development is on-going, includes training, practice and feedback, and provides adequate time and follow-up support. Successful programmes involve teachers in learning activities that are similar to ones they will use with their students, and encourage the development of teachers' learning communities. There is growing interest in developing schools as learning organisations, and in ways for teachers to share their expertise and experience more systematically.The development of teachers beyond their initial training can serve a number of objectives (OECD, 1998),

including:

• to update individuals' knowledge of a subject in light of recent advances in the area;

• to update individuals' skills, attitudes and approaches in light of the development of new teaching techniques

and objectives, new circumstances and new educational research;

• to enable individuals to apply changes made to curricula or other aspects of teaching practice;

• to enable schools to develop and apply new strategies concerning the curriculum and other aspects of

teaching practice;

• to exchange information and expertise among teachers and others, e.g. academics, industrialists; and

• to help weaker teachers become more effective.

To examine these issues, TALIS adopts a broad definition of professional development among teachers:

"Professional development is defined as activities that develop an individual's skills, knowledge, expertise and other characteristics as a teacher."

The definition recognises that development can be provided in many ways, ranging from the formal to the informal. It can be made available through external expertise in the form of courses, workshops or formal qualification programmes, through collaboration between schools or teachers across schools (e.g. observational visits to other schools or teacher networks) or within the schools in which teachers work. In this last case, development can be provided through coaching/mentoring, collaborative planning and teaching, and the sharing of good practices.

. Teachers were first asked to indicate whether or not they had

participated in each of the following activities:

• courses/workshops (e.g. on subject matter or methods and/or other education-related topics);

• education conferences or seminars (at which teachers and/or researchers present their research results

and discuss education problems);

• qualification programme (e.g. a degree programme);

• observation visits to other schools;

• participation in a network of teachers formed specifically for the professional development of

teachers;

• individual or collaborative research on a topic of professional interest; and

• mentoring and/or peer observation and coaching, as part of a formal school arrangement.

Teachers were able to indicate participation in multiple activities.

TALIS then asked teachers how many days of professional development they had attended in the 18 months

prior to the survey and how many of these days were compulsory. Table 3.1 gives this information.

As TALIS was interested in professional development activities beyond the more structured types listed

above, teachers were also asked whether or not they had participated in the following less formal

professional development activities:

• reading professional literature (e.g. journals, evidence-based papers, thesis papers); and

• engaging in informal dialogue with peers on how to improve teaching.

Analysis of participation in these activities and their impact is included in Tables 3.2 and 3.8.

TALIS asked teachers about their professional development activities, their impact, the support they received for undertaking them, the extent to which they wanted more than they had engaged in and the barriers they felt had prevented them from doing so, and the areas of their work they found most in need of further development. Therefore, almost all of the results in this chapter are based on teachers' reports. The exception is the discussion of induction and mentoring policies in schools, which reports school principals' responses regarding the existence of such policies in their schools.

In interpreting the results, it is important to bear in mind the self-reporting nature of the survey responses. For example, teachers' reports about the impact of their development activities represent their perceptions; they are not part of an independent evaluation of the effectiveness of these activities. Nevertheless, teachers' perceptions are important and can be expected to influence their behaviour. Also teachers' views about their development needs are to be distinguished from an external assessment of these needs will examine the relation between teachers' reports of their development needs and the policies and practices that are in place to assess and appraise teachers' work.

TOPIC 2: TECHNOLOGY INTEGRATION : PLANNING WITH iNTEGRATING TECHNOLOGY FOR ENQUIRY AND MODAL FOR INTEGRATED SCIENCE AT SECONDARY SCHOOL LEVEL

Technology Integration is the use of technology tools[citation needed] in general content areas in education in order to allow students to apply computer and technology skills to learning and problem-solving. Generally speaking, the curriculum drives the use of technology and not vice versa.[1][2]

The International Society for Technology in Education (ISTE) has established technology standards for students, teachers and administrators in K-12 classrooms. The ISTE, a leader in helping teachers become more effective users of technology, offers this definition of technology integration:

"Curriculum integration with the use of technology involves the infusion of technology as a tool to enhance the learning in a content area or multidisciplinary setting... Effective integration of technology is achieved when students are able to select technology tools to help them obtain information in a timely manner, analyze and synthesize the information, and present it professionally. The technology should become an integral part of how the classroom functions — as accessible as all other classroom tools. The focus in each lesson or unit is the curriculum outcome, not the technology." [3]

Integrating technology with standard curriculum gives students a sense of power, but also allows for more advanced learning among broad topics. Technology contributes to global development and diversity in classrooms and helps develop upon the fundamental building blocks needed for students to achieve more complex ideas.

National Educational Technology Standards (NETS) served as a roadmap since 1998 for improved teaching and learning by educators. As stated above, these standards are used by teachers, students, and administrators to measure competency and set higher goals to be skillful.

The Partnership for 21st Century Skills is a national organization that advocates for 21st century readiness for every student. Their most recent Technology plan was released in 2010, "Transforming American Education: Learning Powered by Technology." This plan outlines a vision "to leverage the learning sciences and modern technology to create engaging, relevant, and personalized learning experiences for all learners that mirror students' daily lives and the reality of their futures. In contrast to traditional classroom instruction, this requires that students be put at the center and encouraged to take control of their own learning by providing flexibility on several dimensions." Although tools have changed dramatically since the beginnings of educational technology, this vision of using technology for empowered, self-directed learning has remained consistent.

Constructivism in Technology Integration

Constructivism is a crucial component of technology integration. It is a learning theory that describes the process of students constructing their own knowledge through collaboration and inquiry-based learning. According to this theory, students learn more deeply and retain information longer when they have a say in what and how they will learn. Inquiry-based learning, thus, is researching a question that is personally relevant and purposeful because of its direct correlation to the one investigating the knowledge. As stated by Jean Piaget, constructivist learning is based on four stages of cognitive development. In these stages, children must take an active role in their own learning and produce meaningful works in order to develop a clear understanding. These works

are a reflection of the knowledge that has been achieved through active self-guided learning. Students are active leaders in their learning and the learning is student-led rather than teacher–directed.

Many teachers use a constructivist approach in their classrooms assuming one or more of the following roles: facilitator, collaborator, curriculum developer, team member, community builder, educational leader, or information producer.

Tools

Various tools have or are being used in technology integration[Some examples of such tools are:

Interactive whiteboards

Interactive whiteboards are used in many schools as replacements for standard whiteboards and provide a way to allow students to interact with material on the computer. In addition, some interactive whiteboards software allow teachers to record their instruction and post the material for review by students at a later time

- 3D virtual environments are also used with interactive whiteboards as a way for students to interact with 3D virtual learning objects employing kinetics and haptic touch the classroom. An example of the use of this technique is the open-source project Edusim.
- Research has been carried out to track the worldwide Interactive Whiteboard market by Decision Tree Consulting (DTC), a worldwide research company. According to the results, interactive Whiteboards continue to be the biggest technology revolution in classrooms, across the world there are over 1.2 million boards installed, over 5 million classrooms are forecast to have Interactive Whiteboards installed by 2011, Americas are the biggest region closely followed by EMEA, and Mexico's Enciclomedia project to equip 145,000 classrooms is worth $1.8 billion and is the largest education technology project in the world.
- Interactive whiteboards can accommodate different learning styles, such as visual, tactile, and audio.

Interactive Whiteboards are another way that technology is expanding in schools. By assisting the teacher to helping students more kinestically as well as finding different ways to process there information throughout the entire classroom.

Student Response Systems

Student response systems consist of handheld remote control units, or response pads, which are operated by individual students. An infrared or radio frequency receiver attached to the teacher's computer collects the data submitted by students. The CPS (Classroom Performance System), once set, allows the teacher to pose a question to students in several formats. Students then use the response pad to send their answer to the infrared sensor. Data collected from these systems is available to the teacher in real time and can be presented to the students in a graph form on an LCD projector. The teacher can also access a variety of reports to collect and analyze student data. These

systems have been used in higher education science courses since the 1970s and have become popular in K-12 classrooms beginning in the early 21st century.

Audience Response Systems (ARS) can help teachers analyze, and act upon student feedback more efficiently. For example, with polleverywhere.com, students text in answers via mobile devices to warm-up or quiz questions. The class can quickly view collective responses to the multiple-choice questions electronically, allowing the teacher to differentiate instruction and learn where students need help most.

Combining ARS with peer learning via collaborative discussions has also been proven to be particularly effective. When students answer an in-class conceptual question individually, then discuss it with their neighbors, and then vote again on the same or a conceptually similar question, the percentage of correct student responses usually increases, even in groups where no student had given the correct answer previously.

Among other tools that have been noted as being effective as a way of technology integration are podcasts, digital cameras, smart phones, tablets, digital media, and blogs.

Mobile Learning

A mobile device is essentially any device that is portable and has internet access and includes, tablets, smart phones, cell phones, e-book readers, and mp3 players.[14] As mobile devices become increasingly common personal devices of K-12 students, some educators seek to utilize downloadable applications and interactive games to help facilitate learning. This practice can be controversial because many parents and educators are concerned that students would be off-task because teachers cannot monitor their activity.[15] This is currently being troubleshooted by forms of mobile learning that require a log-in, acting as a way to track engagement of students.[16]

Benefits

According to findings from four meta-analyses, blending technology with face-to-face teacher time generally produces better outcomes than face-to-face or online learning alone. Research is currently limited on the specific features of technology integration that improve learning. Meanwhile, the marketplace of learning technologies continues to grow and vary widely in content, quality, implementation, and context of use.

Research shows that adding technology to K-12 environments, alone, does not necessarily improve learning. What matters most to implementing mobile learning is how students and teachers use technology to develop knowledge and skills and that requires training. Successful technology integration for learning goes hand in hand with changes in teacher training, curricula, and assessment practices.

An example of teacher professional development is profiled in Edutopia's Schools That Work series on eMints, a program that offers teachers 200 hours of coaching and training in technology integration over a two year span. In these workshops teachers are trained in practices such as using interactive whiteboards and the latest web tools to facilitate active learning. In a 2010 publication of Learning Point Associates, statistics showed that students of teachers who had participated in eMints had significantly higher standardized test scores than those attained by their peers.

Project-based activities

CyberHunt

a cyberHunt, or internet scavenger hunt, is a project-based activity which helps students gain experience in exploring and browsing the internet. A CyberHunt may ask students to interact with the site (i.e.: play a game or watch a video), record short answers to teacher questions, as well as read and write about a topic in depth. There are basically 2 types of cyberhunts:

- A simple task, in which the teacher develops a series of questions and gives the students a hypertext link to the URL that will give them the answer.
- A more complex task, intended for increasing and improving student internet search skills. Teachers ask questions for students to answer using a search engine.

WebQuests

WebQuests are student-centered, web-based curricular units that are interactive and use Internet resources. The purpose of a webQuest is to use information on the web to support the instruction taught in the classroom. A webQuest consists of an introduction, a task (or final project that students complete at the end of the WebQuest), processes (or instructional activities), web-based resources, evaluation of learning, reflection about learning, and a conclusion.

WISE

The Web-based Inquiry Science Environment (WISE) provides a platform for creating inquiry science projects for middle school and high school students using evidence and resources from the Web. Funded by the U.S. National Science Foundation, WISE has been developed at the University of California, Berkeley from 1996 until the present. WISE inquiry projects include diverse elements such as online discussions, data collection, drawing, argument creation, resource sharing, concept mapping and other built-in tools, as well as links to relevant web resources.

Virtual field trip

A Virtual field trip is a website that allows the students to experience places, ideas, or objects beyond the constraints of the classroom

ePortfolio

An ePortfolio is a collection of student work that exhibits the student's achievements in one or more areas over time. Components in a typical student ePortfolio might contain creative writings, paintings, photography, math explorations, music, and videos.

The Models of Integrated Science Education

Objectives:

- To meet up with and carefully analyse one of the possible models of integrated science education emphasizing the classification of the subjects taught;
- Define the advantages of integrated science education;
- Understand the levels of integration in science education.

Information	**Nature of activity**	**Subjects involved**
Facts	Prior knowledge • making prediction • asking questions Shared experience • observation • collecting information/data	Learning about • social education • science • environmental education • personal development • technology studies
Concepts	Processing information • listing • grouping • categorising • classifying • labelling • organising ideas	Learning through • language • art • drama • mathematics • movement • music
Generalisations	Synthesising • making statements • generalising • looking for relationships	Learning about • social education • science • environmental education • personal development • technology studies
Further	Refinement and extension of	

information	knowledge • elaborating • justifying • reflecting	

Figure 2. A model of integrated learning (Pigdon, Woolley, 1993)

The authors think that the pattern of integrated teaching is delivered to classify the knowledge of subjects, to include the overall ideas of how the world acts. Two groups of subjects are specified:

- the subjects of content (social sciences, natural sciences, environment sciences, the evolution of personality, technologies);
- the subjects of a process (language, art, drama, mathematics, music, plastics). Integration creates opportunities for learners to investigate, conclude, process information, improve knowledge and impart information on different topics without embarrassment and leaving the barriers of traditional subjects behind. One of the practical arguments for integration, particularly in the middle school years, is that it enhances pupil engagement with school. Several studies show that providing an authentic curriculum, well connected to pupils` needs and interests and to the world outside of school, can result in reduced alienation and increased participation and engagement (Venville, Wallace, Rennie, Malone, 2002).

The process of the integration (in the light of content, forms, activity, etc.) of natural sciences is acclaimed to be very important. We suppose that the model defining the key components of the integration process at every level is possible.

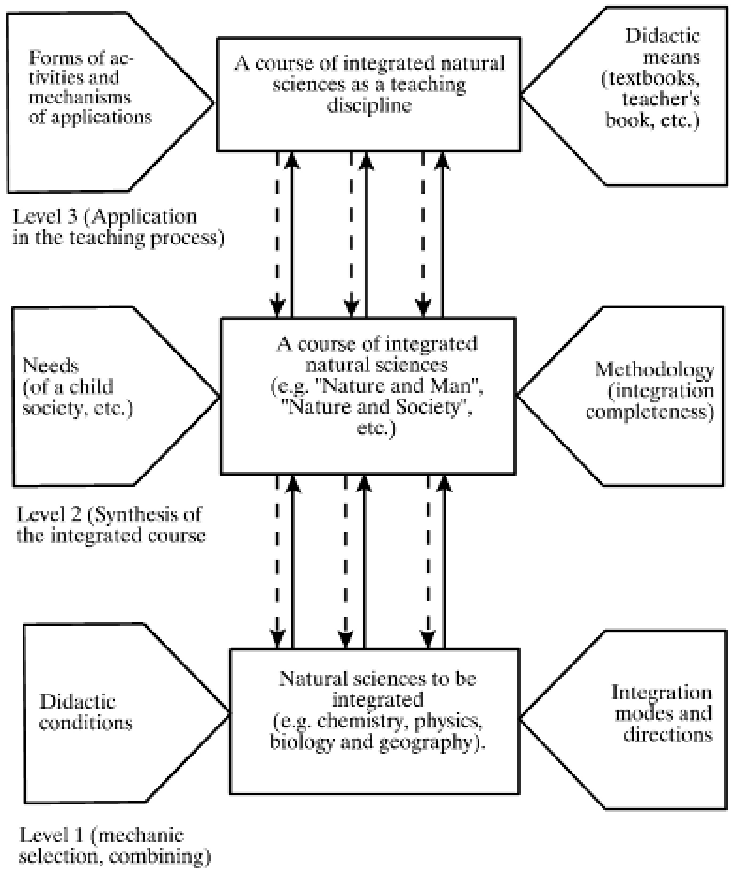


Figure 3. The model of the process of natural sciences integration (Lamanauskas, 2003)

Three fundamental levels can be sorted out:

- mechanic selection and combining / the main components are didactic conditions and integration trends and methods /;
- synthesis of the integrated course / the main components are needs and integration methodology (completeness)/;
- application in the teaching process / the main components are activity forms and application mechanisms and the complex of didactic means (textbooks, workbooks, teacher's books, extra didactic material, computer programmes, etc. /

A close correlation and interaction exists between these levels. The correlation is not equivalent (level 1 ↔ level 3). The integrated course of natural sciences as a teaching subject, as a matter of fact, is not changed but refreshed and complemented regarding the essential alterations of the educational system. In case of infraction of at least one of the links, integrated teaching will not be effective.

Also is interesting the Berlin-White Integrated Science and Mathematics Model developed to address the need for a definition of the integration of science and mathematics education. There are six main aspects (Berlin, White, 1994):

- ways of learning;
- ways of knowing;
- process and thinking skills;
- content knowledge;
- attitudes and perceptions;
- teaching strategies.

It is obvious, that the choice of model of integration first of all depends on what form of integration prevails, for example:

- integration of experiences;
- integration of students activities;
- social integration;
- integration of knowledge;
- integration as a curriculum design etc.

Also, it is possible to notice varied levels of integration (Palmer, 1991, p. 59):

- developing cross-curriculum subobjectives within a given curriculum guide;
- developing model lessons that include cross-curricular activities and assessments;
- developing enrichment or enhancement activities with a cross-curricular focus including suggestions for cross-curricular "contacts" following each objective;
- developing assessment activities that are cross-curricular in nature;
- including sample planning wheels in all curriculum guides.

According A.Miller, teachers who use cooperative, integrated methods will produce students more competent in using problem-solving techniques, in communicating effectively and in working cooperatively. Finally, it can be mentioned that at the heart of the interdisciplinary educational philosophy (interdisciplinary science education) is the psychological theory of constructivism.

Tasks (assignments)

1. Name the advantages of integrated science education:

Subject field	Social field

2.
3. What is the basis for classifying subjects into two groups presented in the integrated model of science education K. Pigdon and M. Woolley (1993)?

Case study

In state X, following the approved educational curriculum developed for comprehensive school, primary school classes are taught a course on the world study covering 2 parts - *Social Education* and *Science Education* – which are relatively singled out to underline the problems and links between the topics occurring in every field of education. The course book on this subject freely operates the topics included in both parts and retains notional and subject coherence. In turn, the area of science education consists of 4 components:

- research of nature;
- animate nature (component of biology);
- substances and their variations (component of chemistry);
- physical phenomena (component of physics).

Moreover, science education closely relates not only to social but also to technological-artistic training, mathematics and languages. These subjects either complement one another or make the complete entirety.

The concentre of basic school is divided into three parts having a different degree or extent of sciences integration:

- integrated course on sciences *Nature and Human* including biology, physics, chemistry, earth science, healthy living, ecology, technology and agriculture is taught in forms 5 and 6. The course on sciences is properly integrated considering all subjects taught;
- still maintaining close interdisciplinary relations in forms 7 and 8, biology, chemistry and physics are taught as separate subjects;
- revision courses on biology, chemistry and physics are taught in forms 9 and 10;
- from the point of view of structure, the field of education in forms 11 and 12 consists of 4 subjects:
  1. biology;
  2. chemistry;
  3. physics;
  4. integrated sciences.

The students choose an appropriate course on sciences – physics, chemistry, biology or integrated sciences. Those who are not intend to study sciences in the future or do not think of any other activity related to sciences but still want to gain more knowledge about this area of study, choose either general courses on separate sciences or the integrated course on sciences. The students interested in carrying on the studies of sciences or those who would like to keep proceeding with this field choose the advanced courses on separate sciences. Although the courses on physics, chemistry and biology are most frequently taught separately in secondary school, these sciences have much in common – concepts and conceptions, methodological principles, solving science and practical issues etc. Thus, a deeper **integration** of the content of science education is pursued. In addition, the content of science education often relates to the problems of ecology, healthy living, demographical situation and the use of technologies and nature. Plenty of contacts can be noticed between sciences and mathematics.

The integrated course on sciences for secondary school students of forms 11 and 12 focuses on the learners preferring a humanitarian profile and those who are not going to proceed with professional science activities in the future. This course concentrates on modern achievements in science, life experience and environmental problems. All topics are examined in broad outline, the evolution of sciences is discussed as a method of acknowledging nature, the issues of personal and public life are highlighted, natural phenomena and scientific ideas are carefully analysed and observation and experimentation are carried out. The integrated course on sciences is devoted to help the student with pursuing general science education and developing the ability to distinguish between scientific and non-scientific issues as only a sufficiently sophisticated person can be actively involved in solving the problems of a modern country. The course assists the learners in perceiving the significance of sustainable development ideas and protecting biosphere and the quality of public life.

Questions to Case Study

1. What is the level of integration at every stage of comprehensive school?
2. Indicate the observed key components having influence on your position.

Summary

There are different models of integrated science education. Teachers can choose suitable model of integration depending on different circumstances. The main circumstances - a level of knowledge of students, presence of accompanying didactic materials, quantity of students in a class, support of administration of school, etc. In a school practice more often as a core of integration three main subjects - chemistry, physics and biology - act. Science teachers can use interdisciplinary integration or integration inside teaching subject. The real problem to teaching integrated science courses is that there are no enough appropriate models or widely-accepted materials available. Integrated science courses gives for teachers a chance to really take a broader look at the nature of science in new ways. It is not the simply teaching. It is obvious that primary goal of integrated science is to teach students how science is done, how to analyze problems and situations, and how to investigate scientific (or pseudo-scientific) claims. Educators and researchers agree that teaching integrated science is a suitable approach for producing scientifically literate citizens. In general, integrated science is a great idea for the students

REFFRENCES AND BIBLIOGRAPHY

Chauhan. S.S (1985), Innovation in teaching-Learning Process, Delhi, Vikas PublishingHouse.

Das. R.C (1985), Science Teaching in school, Sterling Publishers Pvt. Ltd., New Delhi.

Dass R.C., Parsi.B.K & Singh, .L.C. (1975), Effective of Microteaching in Training of Teachers, NCERT, Delhi.

Gupta, S.K. (1983), Technology of Science Education Vikas Publishing House Pvt. Ltd.,New Delhi.

Jangira. N.K & Ajit Singh (1982), Core Teaching Skills, The Micro-teaching Approach,New Delhi:NCERT.

Mangal, S.K. (1995). Teaching of physical and life science, AVG Book Depot, Karol Bagh.

Radha Mohan (2004), Innovative Science Teaching for Physical Science- Prentice Hall of India Pvt. Ltd., New Delhi.

Sharma R.A. (1991), Technology of Teaching R. Lall Book Depot, Meerut.

Siddiqui N.N. and Siddiqui M.N. (1994). Teaching of science today tomorrow, Doaba House, Nai Sarak, Delhi.

Sood J.K (1987), Teaching of life science, Kohli Publishers Chandigarh.

Vaidya N (1997), The impact of Science Teaching Oxford & IBH Publication Co, New

Delhi.

http://www.esperanceshs.wa.edu.au/_pages/learning_areas/science/Department%202010/Courses/Year%2011%20and%2012/integrated%201a/Documents/syllabus%20documents/syllabus%20documents/ISC%20SCOPE%20SEQUENCE.pdf

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

http://www.ehow.com/info_8367618_qualities-science-textbooks.html

http://ictnz.com/Inquiry%20Learning/inquirydefinition.htm

http://www.teachinquiry.com/index/Introduction.html

http://www.dynamicflight.com/avcfibook/inst_aids/

http://www.edutopia.org/technology-integration

http://en.wikipedia.org/wiki/Technology_integration

http://en.wikipedia.org/wiki/Educational_evaluation

http://drjj.uitm.edu.my/DRJJ/OBE%20FSG%20Dec07/OBEJan2010/DrJJ-Measure-assess-evaluate-ADPRIMA-n-more-17052012.pdf

http://www.vkmaheshwari.com/WP/?p=181

http://www.encyclopedia.com/doc/1G2-3045000017.html

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