



Department of Distance Education
Punjabi University, Patiala
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B.ED.-1 (Semester-1) PAPER : IV & V (PART-I) OPT. (VI)
(TEACHING OF SCIENCE)

Section: B

LESSON NO. :

SECTION-B

- 2.1 : Science Text Book: Meaning, importance and qualities, a critical analysis of science text book of state board and NCERT.
- 2.2 : Learning Experiences: Concept and Edgar Dale's cone of Learning Experience.
- 2.3 : Teaching Aids: importance uses and classification of Teaching aids, Integrating ICT in Science Teaching

Science textbook- Meaning, Importance & qualities, a critical analysis of science text book of state Board and NCERT**Structure**

2.1.1 Introduction

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2.1.3 Science textbook

2.1.3.1 Meaning

2.1.3.2 Importance

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2.1.4 A critical analysis of science textbook of state board and NCERT

2.1.5 Summary

2.1.6 Keywords

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2.1.8 Suggested readings

2.1.9 Self-check exercise

2.1.1 Introduction

The textbook is a learning instrument to support teaching learning process. It reflects and establishes standards. The textbook supplements the class-work and help the pupils in understanding of concepts and principles of science. The textbook is a record of racial thinking organised for instructional purpose. Science textbook stimulate the self-directed activities of the learner. It helps the learners to understand different concepts and fundamental principles of science in a scientific way.

2.1.2 Objectives

After going through this lesson learners will be able to:

- Understand importance of science textbook
- Discuss qualities of science textbook
- Analyze science textbook critically

2.1.3 Science textbook

Science textbook is an instructional asset which has a valuable place in the classroom. It provides understanding of scientific concepts and different principles of science. Science textbook provides help in systematic revision after the course has been finished.

2.1.3.1 Meaning

The text-book is an instructional asset which reflects and establishes standards. Textbooks are always a significant factor in teaching-learning process. Textbook reflects the rising standards of scholarships, expands the scope of educational goals. Textbooks of science are a need of the hour and are used to supplement classroom instructions. Textbooks provide additional information to students. According to Paul, "A textbook is a book for classroom use carefully prepared by experts in the field and equipped with usual teaching device". Alfred defined a textbook as "A record of racial thinking organized for instructional purpose". Lang defined "A textbook is standard book for any particular branch of study and may be either basic or supplementary".

2.1.3.2 Importance

- Textbooks help the pupils to understand basic concepts, principles, theories, laws and derivations of science.
- Textbooks encourage students to develop self-study skills and increase their concentration while self-learning.
- Science textbooks supplement the class-work and helps in providing scientific concepts, principles and theories.
- Textbooks provide proper understanding at home of what has been done in the laboratory, during demonstration lessons and during experimentation in the class.
- These help in the realization of the objectives of teaching science in the class for which the science textbooks are meant.
- The students learn at their own pace with the help of books. In other words books are meant for all irrespective of individual differences.
- Gifted students learn extra material from different books and supplements additional information.
- Whereas, slow learners get help from books to complete their routine work. Textbooks of science are helpful for students in completion of home assignments.
- Teachers plan their lessons according to objectives of science and textbooks.

- Also teachers can recapitulate the subject materials with the help of books. The systematic revision was done with the help of books.

2.1.3.3 Qualities

- Science textbook is a determinant of what science should be taught. It provides syllabus developed by specialists in the field of science. Competitive persons should become writers of textbooks.

The qualities of a good textbook of science are as follows:

- Academic Aspect
- Mechanical Aspect
- Academic Aspect : The content of textbook of science should be according to objectives of science.
- The content in the textbook should be accurate and authentic.
- Textbook should be according to the requirement of the syllabus.
- There should be correlation between and within units and chapters of book so that students can easily understand the subject matter, illustrations, examples and quotes written in the textbook.
- Subject matter in the textbook should correlate science with daily life.
- It should be properly illustrated, material should be organised.
- Textbook is useful for understanding of learners to provide diagrams, sketches and subject material clearly, precisely, with comprehensiveness, printed properly on a good quality paper.
- Textbook should cover the entire syllabus arranged systematically prescribed for a class.
- Headings and subheadings should be given in bold type wherever required.
- The subject matter written in the book should be in increasing order of difficulty means according to the psychological principles.
- Self-check exercises should be given at the end of each chapter.
- Text book should contain adequate terminology. Language of the textbook should be simple and understandable according to age and mental level of students.
- As textbooks help individualized instruction, it is possible for students to learn at their own speed.
- The presentations should provide suggestions and implications for adoption of innovations and instructional strategies by the science teacher.
- Textbooks helps to organise and provide unity for class instructions as it has list of suggested activities, challenging home assignments, suggested readings to meet individual's requirements.

- Vocabulary used in the textbook should be appropriate to the mental level of the students.
- Sentences used in the textbook should be concise and precise.
- Spellings, punctuations and use of grammar should be accurate in the textbook.
- Glossary of technical terms should be included in the book.
- The exercises should promote the spirit of enquiry and curiosity among students.
- Exercises written in the book should cater individual differences among learners.
- The title page should convey accurate and complete information.
- Bibliography should be given in a proper format.

The textbook contains detailed information, self-explanatory diagrams in an organised manner. It will become more useful for students when teacher understands the comprehensiveness of the book.

- **THE AUTHOR:** A good textbook is judged at face, by the author, his qualification and experience.
- **MECHANICAL FEATURES OF THE TEXTBOOK:** The print and paper used and the binding should be attractive, hard and durable. The printing should be clear, legible and appropriately spaced. Pictures, photographs, drawings, or diagrams add much to any material developed for children. These should be as carefully selected, prepared, or considered as the written word. They should be simple without being inaccurate if at all possible. They should be fitted carefully to the script, and as far as possible do what the written word cannot do. The location of the pictures, illustrations, or diagrams is also important. It should be easy for the reader to find the picture and then refocus on the text without loss of time or delay in thought development.
- **VOCABULARY:** Vocabulary should also be considered carefully for the older, even high school, readers. Older readers can handle more difficult vocabulary, including sophisticated scientific terms and constructions, and take great pride in so doing. However, they are able to read and participate more actively if they find the reading intriguing, challenging, and, at the same time, not difficult.

- **THE SUBJECT MATTER-ITS NATURE AND ORGANIZATION:** The subject matter should be developed as far as possible in psychological sequence, Care must be taken of the mental growth and interest pupils. There should be consistency of the subject matter and the textbook should satisfy objectives of science teaching. Each chapter should begin with an introduction and end with a summary. Subject matter should lead to the inculcation of scientific attitudes, disciplinary and cultural values. Each chapter should contain assignments at the end. There should be an inclusion of Edutainment activities for enrichment of science. Headings and sub-headings are given in bold letters. Science as a subject should be correlated to other subjects and accompanied by a laboratory manual.
- **EXPERIMENTATION** Many basic processes such as those described or indicated are included in experimentation. Any time an author has included descriptions of experiments already done or can propose experiments to be done, interest is heightened for most young readers. Children get a lot of pleasure and excitement from what they believe to be “a real science experiment.” Because of this the word has often been used in less than appropriate ways, and care should be exercised in the use of the word “experiment.”
- **EVALUATION:** A real plus in evaluation for any book for children is the knowledge that it will continue to be functional for them after they have “put the book down.” After they have finished reading the book they may spend considerable time thinking about what they have read, asking questions based upon what they have read, duplicating some of the activities or experiments described, or developing related activities or experiments in a creative way.

What are the essential characteristics of a good textbook of science?

Discuss the importance of science textbook.

2.1.4 A critical analysis of science textbook of state board and NCERT

Teachers have to recommend good textbooks to the students. There are a number of procedures to evaluate textbooks which involves the following criteria:

- Academic experience of the author
- Qualitative up gradation of the content
- Organised subject material
- Preciseness in material
- Objectivity of the content
- Conciseness of material
- Suitability of material according to needs, interests and mental level of students
- Literary style
- Integration of illustrations with the material
- Mechanical aspect of the book

The following guiding principles of NCF 2005 should be kept in view while preparing the textbooks:

- Connecting knowledge to life outside the school,
- Ensuring that learning is shifted away from rote methods,
- Enriching the curriculum to provide for overall development of children rather than remain textbook centric,
- Making examinations more flexible and integrated into classroom life
- Nurturing an over-riding identity informed by caring concerns within the
- democratic polity of the country.

The textbook contains material that shows resonance of the values enshrined in the constitution of India. The material in the textbook should reflect sensitivity to gender, caste, peace, health and the needs of children with disabilities. The

content in the textbook should show infusion of environment related knowledge and work related attitude at all levels. The material of the textbook should link school knowledge with children's every day experience. The subject matter should have appropriateness of topics and themes for relevant stages of children's development and continuity from one level to the next. There should be inter-disciplinary and thematic linkages between topics listed for different school subjects which fall under discrete disciplinary areas.

2.1.5 Summary

Textbook facilitate the learner to understand different concepts, principles and theories of science in a simple way. It helps to encourage the students for classroom discussions. A textbook helps the teacher to plan his daily lesson, prepare assignments and organise activities to be performed in the class. A textbook is an instrument of instructional objectives. It provides logical and comprehensive material to students. Textbook helps in transmitting cultural values among students. It is a storehouse of basic information required for learning experiences. It can help the students to collect different ideas of the unit, acquaint them with vocabulary, help them learn lesson in their own way with their own speed. A science textbook enables a student to reinforce the learning to complete assignments at home to plan for individual study. It provides a basis on which the process of reading, analysing, interpretation and summarising can be mastered.

2.1.6 Keywords

Scientific concept, supplement, determinant, stimulates.

2.1.7 Suggested Questions

Q: Discuss importance of science textbook.

Q: Explain qualities of science textbook.

Q: Discuss characteristics of a textbook of science.

2.1.8 Suggested readings

Rajasekar, S. (2005) Methods of Teaching Physical Science. Neelkamal Publications, Hyderabad.

Kohli, V.K. (2005) How to Teach Science. Shri Krishna Publication, Ambala Cantt.

Web Sources:

<http://www.bdu.ac.in/cde/docs/ebooks/B-Ed/I/TEACHING%20OF%20SCIENCE.pdf>

<https://www.learningclassesonline.com/2020/10/pedagogy-of-science.html>

<https://ncert.nic.in/pdf/focus-group/science.pdf>

2.1.9 Self-check exercise

- The textbook is a _____ instrument. (learning)
- The textbook provides _____ of scientific concepts and different principles of science. (understanding)
- Textbooks provide _____ information to students. (additional)
- Textbooks encourage students to develop _____ skills and increase their concentration while _____. (self-study, self-learning)

LESSON No. 2.2

Learning Experiences: Concept and Edgar Dale's Cone of Learning Experiences

Structure

2.2.1 Objectives

2.2.2 Introduction

2.2.3 Meaning and concept of learning experiences

2.2.3.1 Definitions of learning experiences

2.2.3.2 Planning learning experiences

2.2.4 Edgar Dale Cone of Learning Experiences

2.2.4.1 Audio-visual experiences shown in the cone

2.2.4.2 Description of Cone

2.2.4.3 Use of the Cone of Experience

2.2.4.4 Merits of Edgar Dale Cone of Experience

2.2.4.5 Limitations of Edgar Dale Cone of Experience

2.2.5 Summary

2.2.6 Key Concepts

2.2.7 Suggested Questions

2.2.8 Suggested Readings and Web Sources

2.2.9 Self Check Exercise

2.2.1 Objectives

After going through this lesson students will be able to-

1. Understand the term learning experiences.
2. Define learning experiences.
3. Differentiate between learning and learning experiences.
4. Understand the cone of learning experiences given by Edgar Dale.
5. Describe the value of different stages of the cone of experience.

2.2.2 Introduction

We need to bring learning to people instead of people to learning (Elliot Masie). If someone asked you what you had learnt this year in your work, apart from in courses or training that is, you might find it is surprisingly difficult to answer. It is somewhat easier to identify learning if it is already labelled as such and is structured in terms of learning objectives like a course or an in-house training. Whereas 'things you've learnt as you go along' are not necessarily readily identifiable as learning and are not broken down into convenient categories such as: learning objectives, competences, exercises, tests etc. Furthermore a large proportion of what we learn is informal in nature.

2.2.3 Meaning and Concept of Learning Experiences

One word about 'learning experiences' before going any further. The word 'learning' is strongly bound to our experience of learning in educational institutions like schools, colleges, universities etc. Such learning is explicit and formal, at least in appearance. We know that everyone is supposed to learn

something in such situations. The learning we are talking about here is more about situations where we learn but we don't necessarily call it learning. The word 'experience' refers both to the contact with the world around us and the knowledge we derive from it. By definition then, learning experiences are those events and activities from which we learn by experience and can identify, to a certain extent, what we have learnt.

2.2.3.1 Definitions of Learning Experiences:

Various educationists and experts of the field defined learning experiences in their own ways. Some of the definitions are given below:

1. Shane Gallagher defined **Learning Experiences** as 'every situation someone finds himself in as a learning experience'. Traditionally also this phrase is not used in relation to more formal learning interventions – i.e. classroom, but from a learner's perspective, both formally and informally, that's exactly what is happening: learners are experiencing something that, hopefully, results in a change in thinking, understanding, or behavior afterwards.
2. **Learning experience** refers to any interaction, course, program, or other experience in which learning takes place, whether it occurs in traditional academic settings (schools, classrooms) or nontraditional settings (outside-of-school locations, outdoor environments), or whether it includes traditional educational interactions (students learning from teachers and professors) or nontraditional interactions (students learning through games and interactive software applications).

Because students may learn in a wide variety of settings and ways, the term is often used as a more accurate, preferred, or inclusive alternative to terms such as *course*, for example, that have more limited or conventional connotations. *Learning experience* may also be used to underscore or reinforce the goal of an educational interaction—learning—rather than its location (school, classroom) or format (course, program), for example.

The growing use of the term *learning experience* by educators and others reflects larger pedagogical and technological shifts that have occurred in the design and delivery of education to students, and it most likely represents an attempt to update conceptions of how, when, and where learning does and can take place. For example, new technologies have dramatically multiplied and diversified the ways in which students can learn from and interact with educators, in addition to the level of independence they may have when learning. For example:

1. Students can email, chat, or have video conversations with teachers, and they can use online course-management systems to organize and exchange learning materials (e.g., the assignments given by teachers or the work turned in by students).
2. Students can use software programs, apps, and educational games to learn on their own time, at their own pace, and without instruction or supervision from teachers.
3. Students can also watch videos created by their teachers.
4. Students can conduct online research to learn more about a concept taught in a class, or use tablets to record scientific observations in a natural environment—among countless other possible options and scenarios.

While listening to a lecture, reading a book, or completing a homework assignment remain “learning experiences,” students are now learning in different ways than they have in the past and in a wider variety of outside-of-school settings, such as through internships, volunteer activities, or [dual-enrollment programs](#) etc.

Learning experiences are a way to think about what a learning intervention might be (i.e. – its design) in the context of desired end goals and outcomes. This can then inform our choices about how communication channels and modes, learning activities, and resources come together to best support the end goals and outcomes, and also how these channels and activities may evolve over time. Certainly in this context, a learning intervention is something that is

much more than what has traditionally been thought of as “content.”

Now in context of learning content, it can be a page from a textbook with which one “reads” and then “interacts” with in some way. This definition of learning content and learner interaction represents a very narrow and limited view of what a learning experience can be and usually limits the type of learning to that of recognizing or memorizing specific facts, procedures, and concepts exemplified in the deployment of web-based, self-directed individual learning experiences *commonly called e-learning.*

Learning content can be thought of much more broadly and inclusively. This could mean that learning content could actually include not only the “whats” but the “hows” of learning. For example, learning content in the context of learning experiences could contain a collection of specific content resources, content pointers, functional tools or tool pointers, activity descriptions, and assessments that, when brought together, embody a particular pedagogical model. In fact, the reverse could also be learning content – a pedagogical model describing the types of learning resources, tools, and activities needed to achieve learning outcomes. So you could think of learning content as collections of pedagogical models and collections of resources that participate in shaping an individual’s learning experience that are aligned with learning outcomes and positive actions that stem from the experience. Another facet of learning content is the artifacts produced during the learning experience. Besides the description above, learning content models should also be collaborative or cooperative with resources and activities supporting the learners working together to produce a learning artifact. A learning artifact could be anything based on an authentic learning activity or experience such as a model, computer code, diagram or even the ubiquitous PowerPoint presentation. As these artifacts are created and evaluated during the learning process, they then become learning resources that can be used iteratively for others in similar or more advanced experiences. These ideas allow us to merge knowledge management and single/double loop organizational learning into our concept of learning content.

2.2.3.2 Planning learning experiences

It is on the careful planning of learning experiences that learning of any subject or skill depends. Planning of learning experiences is connected with educational objectives which are being proposed by such experiences to be achieved. In reality, true learning is not concerned only with acquisition of certain traits or skills by the students, whereas, it is various kinds of positive changes brought about in the behavioural pattern of the students.

Changes of different kinds are being experienced by learners in any course of instruction, which take place in terms of established goals. An important cause of changes taking place in the behavioural pattern of students is the kind of interaction taking place in between the students and their immediate environment. In planning learning experiences, student's participation play an important role.

Thus, learning experiences are those activities which are being planned to attain some specific purposes of bringing about desirable kind of changes in behavioural pattern of the students.

Short In Text Questions

1. Define learning.
2. Define learning experiences.
3. Discuss the planning for learning experiences.

2.2.4 Edgar Dale Cone of Learning Experience

Edgar Dale was an American educationist who developed the Cone of Experience. He made several contributions to audio and visual instruction, including a methodology for analyzing the content of motion pictures.

Definition

All the experiences which can be utilized for classroom teaching are shown by Edgar Dale in pictorial device ‘pinnacle form’ which he called the ‘Cone of Experience’.

Dale's "Cone of Experience," which he intended to provide an intuitive model of the concreteness of various kinds of audio-visual media, has been widely misrepresented. Often referred to as the "Cone of Learning," it purports to inform that of how much people remember based on how they encounter information. However, Dale included no numbers and did not base his cone on scientific research, and he also warned readers not to take the cone too seriously. The numbers originated from 1967, when a Mobil oil company employee named D. G. Treichler published a non-scholarly article in an audio magazine titled Film and Audio-Visual Communications.

If we go up the pinnacle from its base, we will find that every aid has been arranged in the order of increasing abstractness or decreasing directness. In a simple language it can be said that the cone classifies the audio-visual aids according to their effectiveness in communication. Aid at the base of the cone as ‘most effective,- relative effect gradually decreases.

2.2.4.1 Audio – Visual Experiences Shown In The Cone

The experiences included in the cone are indicated as below:

1. Direct, Purposeful Experience- The experiences gained through the senses are direct and purposeful. It has been amply observed, “An ounce of experience is better than a ton of theory simply because it is only as an experience that any theory has vital and verifiable significance.”
2. Contrived Experience: when the real thing cannot be perceived directly, its simplification becomes necessary. Contrived experience is like a working model which is an editing of reality and differs from the original

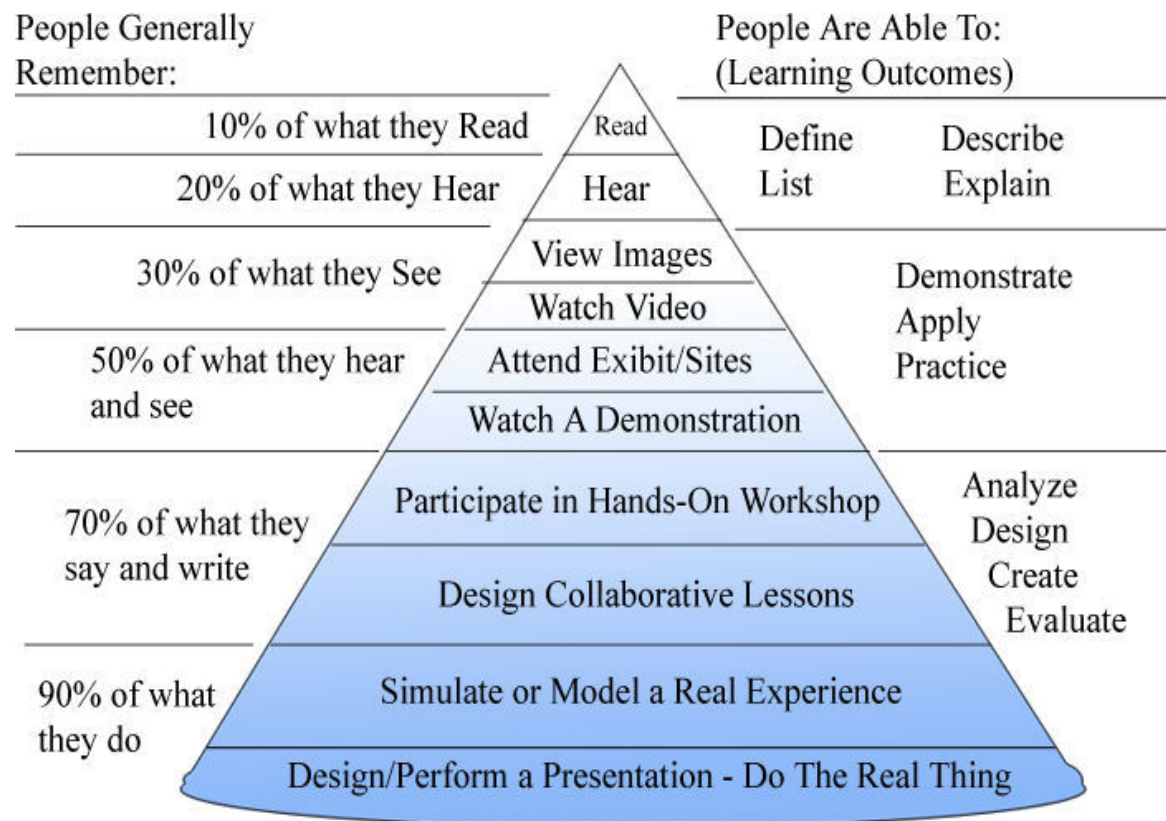
either in size or in complexity. The real object may be too small or too big, may be confused or concealed. In such a situation, imitation is preferred for better and easier understanding.

3. Dramatic Participation: In dramatics certain real events are presented through the play, the pageant(kind of community drama, usually based on the local history), pantomime (actors do not speak, make movements) tableau (picture line scene in which all the characteristics stand still, silently), and the puppets.
4. Demonstration: the teacher demonstrates or shows how things can be done. Examples: (i) air exerts pressure – show this with the help of an example. (ii) show how to pronounce a word (iii) how to draw a map.
5. Field trips: The teacher takes students to historical, industrial and business places.
6. Exhibits: playing objects and models are its examples.
7. Motion pictures: (i) Doordarshan programmes on various educational issues, (ii) NCERT's programmes, (iii) UGC's and IGNOU's several programmes, and (iv) documentary films etc.
8. Radio recordings and still pictures These provide audio experiences through tapes, discs and radio-sets and also provide visual experiences through slides.
9. Visual symbols: Charts, diagrams, maps, and cartoons are the examples.
10. Verbal symbols: These include the most abstract learning experiences. For example- verbal discourse, lecturing, reading and recitation etc.

2.2.4.2 Description of Cone of Experience

Dale's Cone of Experience is a model that incorporates several theories related to instructional design and learning processes. During the 1960s, Edgar Dale theorized that learners retain more information by what they "do" as opposed to what is "heard", "read" or "observed". His research led to the

development of the Cone of Experience. Today, this “learning by doing” has become known as “experiential learning” or “action learning”.



Dale's Cone of Experience

2.2.4.3 Use of the Cone of Experience

According to Dale's research, the least effective method at the top, involves learning from information presented through verbal symbols, i.e., listening to spoken words. The most effective methods at the bottom, involves direct, purposeful learning experiences, such as hands-on or field experience. Direct purposeful experiences represents reality or the closest things to real, everyday

life. The cone charts the average retention rate for various methods of teaching. The further you progress down the cone, the greater the learning and the more information is likely to be retained. It also suggests that when choosing an instructional method it is important to remember that involving students in the process strengthens knowledge retention.

It reveals that “action-learning” techniques result in up to 90% retention. People learn best when they use perceptual learning styles. Perceptual learning styles are sensory based. The more sensory channels possible in interacting with a resource, the better chance that many students can learn from it. According to Dale, instructors should design instructional activities that build upon more real-life experiences.

Dales’ cone of experience is a tool to help instructors make decisions about resources and activities. The instructor can ask the following:

1. Where will the student’s experience with this instructional resource fit on the cone? How far is it removed from real-life?
2. What kind of learning experience do you want to provide in the classroom?
3. How does this instructional resource augment the information supplied by the textbook?
4. What and how many senses can students use to learn this instructional material?
5. Does the instructional material enhance learning?

2.2.4.4 Merits of Edgar Dale Cone of Experience

1. It shows at a glance all learning experiences in an increasing order of their effectiveness.
2. It also makes teachers aware of different learning experiences and their relative values.
3. It is helpful to use deductive and inductive strategies.

4. It illustrates that different teaching aids have different effects.

2.2.4.5 Limitations of Edgar Dale Cone of Experience

1. It does not take into account the cognitive impact of different audio-visual aids.
2. It does not provide scope for classifying new learning experiences.
3. It is based on hypothesis. It should not be taken as a gospel truth.

Short In Text Questions

1. Throw light on the use of Edgar Dale of Cone Experience.
2. Discuss the merits of Edgar Dale of Cone Experience.
3. What are the limitations of Edgar Dale of Cone Experience.

2.2.5 Summary

In the present chapter we have discussed the concept of learning experiences and Edgar Dale Cone of Learning Experiences. Learning experience refers to any interaction, course, program, or other experience in which learning takes place, whether it occurs in traditional academic settings (schools, classrooms) or nontraditional settings (outside-of-school locations, outdoor environments), or whether it includes traditional educational interactions (students learning from teachers and professors) or nontraditional interactions (students learning through games and interactive software applications). Learning experiences are a way to think about what a learning intervention might be (i.e. – its design) in the context of desired end goals and outcomes. It is on the careful planning of learning experiences that learning of any subject or skill depends. Planning of learning experiences is connected with educational objectives which are being proposed by such experiences to be achieved. In reality, true learning is not concerned only with acquisition of certain traits or skills by the students, whereas, it is various kinds of positive changes brought about in the behavioural pattern of the students.

2.2.6 Key Concepts

1. Learning : modification of behavior through experience.
2. Learning Experience: refers to any interaction, course, program, or other experience in which learning takes place, whether it occurs in traditional academic settings or nontraditional settings or whether it includes traditional educational interactions or nontraditional interactions.

2.2.7 Suggested Questions

- Q1. Define learning. Differentiate between learning and learning experiences.
- Q 2. Explain the Edgar Dale Cone of Experience in detail along with its limitations.

2.2.8 Suggested Readings and Web Sources

1. V. K Kohli – How to teach Science
2. J.C. Aggarwal – Elementary Educational Technology
3. .Source: Adapted from E. Dale, Audiovisual Methods in Teaching, 1969, NY: Dryden Press.

Web sources:

1. <https://sites.google.com/a/adlnet.gov/future-learning-experience-project/project-updates/whatisalearningexperience>

8 .9 Self Check Exercise**MATCH THE COLUMNS****COLUMN –I**

1. Interaction course programme in which learning takes place
2. Modification of behavior
3. When real things need simplification

COLUMN- II

1. Verbal symbols
2. Exhibits
3. Learning experiences

4. Playing objects and models

4. Learning

5. Lecturing/ Reading can't perceived

5. Contrived experiences

Directly

Ans: (1)-3, (2)- 4, (3)-5, (4)- 2 , (5) -1

**Teaching Aids: Importance, Uses and classification of
Teaching Aids, Integrated ICT in Science Teaching**

Structure

2.3.0 Objectives

2.3.1 Introduction

2.3.2 Guidelines for the use of Audio-visual aids.

2.3.3 Kinds of teaching aids

2.3.3.1 Visual aids

2.3.3.2 Chalk boards

2.3.3.3 Photographs, Picture, Charts, Models

2.3.3.4 Flannel Graph/ Flannel Board

2.3.3.5 Bulletin Board

2.3.3.6 Aural aids

2.3.3.7 Science Broadcast on the Radio

2.3.3.8 Tape recording

2.3.3.9 Audio-visual aids

2.3.3.10 Visual/optical aids

2.3.3.11 Epidiascope

2.3.3.12 Glass-slide projector (Magic lantern)

2.3.3.13 Filmstrip Projector

2.3.3.14 Film Projector

2.3.4 Advantages of Motion Pictures

2.3.5 Using films for instructions

2.3.6 Television

2.3.7 Computer

2.3.8 Activity Aids

2.3.9 Memory aids

2.3.10 Science Library

2.3.11 Integrating ICT with Science Education

2.3.12 Summary

2.3.13 Suggested Questions

2.3.14 Reference.

2.3.0 Objectives

After going through this lesson students will be able to-

1. Understand and define teaching aids
2. Explain the importance and uses of teaching aids in teaching-learning process
3. Classify various teaching aids in various categories.
4. Understand the importance of integrating ICT with science teaching.

2.3.1 Introduction :

This term 'audio-visual' is made up two words. Audio=to hear, and visual=to see. Ideally audio-visual aids are those instructional materials in which sight and sound are combined which is usually found in T.V. and Motion Pictures. Practically most of the materials used are visual materials like photographs, charts, apparatus, specimens, filmstrips, for which sound is provided by the teacher in the form of explanation, comments and/or demonstration.

According to an old Chinese saying, "A picture is worth a thousand words". "Seeing is believing" is another saying. One can explain the size, shape and colour of Giraffe or Zebra and the child may fully understand the concept quickly and instantly. The words "nucleus" becomes much more meaningful if the students has seen a diagram cells and have studied them under microscope.

Human beings derive their experience mainly from these sources :

1. Direct sensory experience.
2. Pictures or some other forms of representation of objects, phenomena and relationships.
3. Oral or printed words or symbols.

Of these three possibilities, the third is of little value. Sensory experience is provided to serve as a basis for interpreting the oral and written words. A child comes to the school with few useful concepts. It is the duty of the teacher to help the student to form many useful concepts through wide and varied experiences.

Audio-Visual aid are of great help for the teacher in creating interest and making the concepts clear to the students. But they are not substitute for teaching. Following are the advantages of using audio-visual materials for teaching :

1. They create interest and make learning quicker, easier and effective.
2. They help the pupils to get first hand experience by observing concept objects, living specimens, demonstrations, handling the apparatus and performing experiments.
3. They help to bring a change of activity and atmosphere in the routine of the class.

4. They help the students to visualize, motivate, develop meaningful associations and attain insight.
5. They help the pupils to develop scientific attitudes and impart training in scientific method.
6. Large number of students can be taught at a time through projections by magic lantern, epidiacope, film and television.
7. They save time and learning is more solid and durable.
8. It reduces verbatism or the meaningless use of the words and phrases and contributes towards the clearness of perception and accuracy in learning.
9. It extends first hand experience when the students see a demonstration, handle the apparatus or prepare a chart or model themselves.
10. It helps in bringing vivid reality into the classroom.

2.3.2 Guidelines for the Use of Audio-Visual Aids

1. Use of audio-visual aids in the classroom should not be equated with entertainment. They should be used to make teaching-learning process more interesting and meaningful and to stimulate pupils to greater activity any thinking.
2. Effective use of audio-visual aids requires that they should be planned and be a part of a well integrated programme of many types of experiences and activities of the class.
3. The audio-visual aids used should be according to the intellectual level of the pupils and closely related to their previous experience.
4. Teaching aids should be realistic and accurate. If models are used they should be a good substitute for reality. Whenever possible a model should be working model.
5. Proper planning is most essential for their use. Students should be prepared well in advance. The teacher should know how and where these aids can fit into the entire scheme of teaching.
6. Audio-visual aids should be periodically evaluated in regard to their use, function, effect and learning-outcomes.

2.3.3 Kinds of teaching aids :

Teaching aids can be classified as follows:

1. Visual Aids
2. Audio Aids
3. Audio-Visual Aids
4. Activity Aids

5. Memory Aids

2.3.3.1 Visual Aids:

As the name indicates these teaching aids are related to the sense of sight. They can be understood and appreciated by looking and observation. The important visual aids are the following:

1. Chalk board.
2. Charts, pictures, photographs, graphs and model.
3. Slides, filmstrips, film and other projection materials.
4. Flannel graphs-Flannel Board.
5. Bulleting Board.
6. Computers.

2.3.3.2 Chalk-board

Chalk board, commonly as black board is widely used. The board need not to be black. Green board with yellow chalks to write are very common in the United States of America. The written work is pleasant to see and does not strain the eyes. Effectiveness of the chalk board can be increased if the following points are kept in mind:

- (A) Size of the letters written on the black board should be such that it is easily read by the students and the lines must be straight.
- (B) For better organisation of black board work, it should be divided into two parts one for the summary and the other for sketches.
- (C) Coloured chalks should be used for drawings, sketches and headlines.

2.3.3.3 Photographs, Pictures, Charts and Models :

One of the basic requirements for the above mentioned teaching-aids is that they should be of fairly big size, so that even the back-benchers can see them.

Printed Charts may be purchased but most of them must be prepared by the teacher and the students. Simple charts like part of a plant, flower, etc. can easily be drawn by the students using bright colours in which labeling should be clear and in black capital letters. Commercially prepared charts are useful where internal structures and cross-section are to be shown-such as internal structures of roots and stems. These charts usually are a good supplement to teaching and a compliment for the practical work.

Models are very important for biology teaching, but they are expensive. Like charts, some of the models like human respiration, osmosis, and transpiration etc. can be made in the laboratory by the teachers and the students.

2.3.3.4 Flannel Graph / Flannel Board:

Also known as felt board. These boards are made by fixing flannel or felt on

cardboard. It is one of the most effective devices to show and explain parts of a plant, flower, digestive and other systems. It is very simple to make and costs very little. But at the same time it is not used as much as it should be. Pictures and diagrams may be cut out of coloured blotting paper in pieces. These parts are put on the board and gently pressed. Parts of a diagram may be arranged to make a whole on the board, or the parts may be removed from the whole to show the parts. Examples may be parts of a plants flower, organs of a system.

2.3.3.5 Bulletin Board:

1. It should be of the size of a black board.
2. It is used for the display of newspaper clipping, diagrams, sketches, pictures, articles and cartoons.
3. Material displayed should be large enough and must have suitable heading.
4. Over crowding of the material on the bulletin board should be avoided.
5. The material on the bulletin board should be changed frequently.
6. Bulletin board with small holes at suitable distances can be used to display small objects and specimens.

2.3.3.6 Aural Aids

As the name signifies it involves the sense of hearing. These aids are given below :

1. Science broadcast on the radio.
2. Tape recording of science lectures.
3. Science lesson on television.

2.3.3.7 Science Broadcast on the Radio

Radio-teaching has been very effectively used in some countries, particularly in Australia. Programmes for school students are regular of All India Radio (AIR). In addition AIR broadcast programmes of scientific interest in English, Urdu and Hindi Languages. It is possible with the cooperation and collaboration of AIR and Ministry of Education to have regular broadcast (Radio Teaching) for the schools to fit the school time table. Such a programme will have science teaching as a top priority. School in the rural areas will benefit most from it. Tape recording of these radio lessons may be made available for the use of the school when they need it.

2.3.3.8 Tape Recording :

Interesting, exciting, illuminating lessons by "Master" teachers may be recorded on tape. Master teacher have an "Art of making complex and difficult topics simple so that they are easily understood by the pupils.

Tape recording of such lessons should be available to the school to be used

when needed.

2.3.3.9 Audio-Visual Aids :

These teaching aids involve the sense of seeing and hearing and include materials projected on the screen. Projections are visual only while others are audio-visual.

2.3.3.10 Visual / Optical Aids :

These teaching aids are projected on the wall or screen. Material projected may be transparent, translucent or opaque. Some of the useful projectors are mentioned below :

2.3.3.11 Epidiascope :

This machine is very versatile. It can project opaque object such as pictures, charts, maps, diagrams, photographs or small objects like insects, feathers, coins etc. As it projects opaque objects, it may be called EPISCOPE.

Transparent material like 2" × 2" photographic slides and 4" × 4" glass slides can be projected. When used to project transparent materials it may be known as DIASCOPE. Because this machine serves both the purpose it is named EPIDIASCOPE.

2.3.3.12 Glass-slide Projector (Magic Lantern) :

It is a simple machine to project glass slides on a wall or screen. It cannot project any other transparent or opaque material. Thus its utility is limited. If a school can afford it should buy an epidiascope.

9.3.13 Filmstrip Projector :

Filmstrip is a series of still pictures arranged in a definite order. It is a strip of Cellulose acetate film 16 mm or 35 mm wide and 2' -5' in length. Filmstrip can be purchased from science equipment dealers. They are available on loan from Central Film Library, Department of Teaching Aids, NCERT, Indraprastha Estate, Ring Road, New Delhi. Filmstrip projector is an improvement upon magic Lantern.

1. It is easy to operate.
2. It is not very costly.
3. Usually it has an attachment for 2" × 2" slides.
4. Teacher can proceed according to his/her convenience. He can stop whenever he needs to or reverse frames (individual pictures) for

further clarification and /or revision.

2.3.3.14 Film Projector :

Film projector is more complicated than the one mentioned above and it needs maintenance like cleaning and oiling. Science teacher can learn to operate it with a few hours training. But it is costly. Many schools can not effort to buy this.

Film can be effectively used for the following purposes :

1. Supplementing classroom instructions.

2. Showing applications and uses of science in a general way.
3. Teaching particular skills. Skills may range from simple ones as typing scout knots to complex and complicated as brain or open-heart surgery.
4. A combination of education, information and recreation.

2.3.4 Advantage of Motion Pictures :

Edgar Dale in his book an Audio-visual aids had outlined the advantage of using films for instruction. According to him motion pictures can :

1. Compel attention when the room is dark.
2. Help clarify the time factor in any operation or series of event e.g. A bud changing into a flower takes several hours, it can be shown within minutes by slow motion. Flight of birds which is too quick to observe can be shown in detail by slow motion.
3. Bring the past and the distant to the classroom.
4. Enlarge or reduce the actual size of objects.
5. Present a process that can not be seen by the human eye even by microscope and telescope.
6. Can show an event which is either very difficult or dangerous to experience e.g. atomic fission, devastation caused by the atomic at Hiroshima.
7. Reach a mass audience at low / average cost per person.
8. Offer a satisfying aesthetic experience.
9. Give an understanding of relationships of things, ideas and events.

2.3.5 Using Films for instructions :

Effective use of films can only be made if proper and adequate preparation is made by the teacher and the students before their use.

Preparation :

A complete back ground of the contents of the film should be given to the students. Students should study the topic before hand and should be ready to watch for specific ideas, thought and events to be noted in the film. The teacher who must have already seen the film can help the students. The teacher should arrange for seating arrangement, darkening of the room, projector and the film.

Screening the Film

The students should be made to realize that the films are being shown for educational purposes and not for recreation. Thus classroom atmosphere should be maintained throughout the duration of the film.

Follow-up

Immediately after the film, the teacher should invite questions, comments and / or

explanations. Students should be asked to write a summary based on their reading and observation of the film.

Source of Films :

Film for science teaching can be borrowed free of charge from the following source :

- (i) Central Film Library, Department of Teaching Aids, NCERT, Indraprastha Estate, Ring Road, New Delhi,
- (ii) State Plan Publicity Office.
- (iii) Expansion Services of a College / Department of Education.
- (iv) United States Information Services, 24, Kasturba Gandhi Marg, New Delhi-1.
- (v) Other Foreign Embassies.

2.3.6 Television :

For the purpose of instruction, television combines the advantages of teaching through radio and films. Television-Teaching has not yet become popular in India. In the developed countries there are special channels reserved for Educational Television (ETV). Telecasts are timed and graded for specific subjects for school and colleges. In our country ETV is in infancy stage. T.V. is a useful and economical medium but the cost of TV set yet too high for an average school. In the years to come ETV will be utilized and popularized just like teaching by films TV teaching also involves three steps :

- (a) Preparation
- (b) T.V. Session
- (c) Follow-up

2.3.7 Computer

Computer has come on the center stage in school education. Computer literary projects have provided a new dimensions in teaching. Computer assisted instruction is one of the major innovations in teaching-learning process. It helps in better understanding of science concepts through use of different types of learning packages matched with individual capacity of learners. Moreover. Artificial intelligence, simulation and gaming through computer have made learning of science a joyful activity. The vast potential of computer use in education is still to explored in Indian schools to make it an intergral part of teaching-learning process, especially in teaching of Biology.

2.3.8 Activity Aids :

Such aids which grow and develop out of the activities of the students and

teachers are known as Activity Aids, e.g. field trips.

Excursion / Field Trip / Educational Tour :

These activities can be successfully utilized for enrichment supplementation, and correlation of classroom instruction if, selected wisely. Some of the community resources, appropriate for science teaching are :

1. Telephone Exchange, Radio Station and Power Plant.
2. Museum, Zoological Park and Botanical Garden.
3. Chemical and Industrial Plant.
4. Poultry, Dairy, Agriculture.
5. Weather Bureau.
6. Exhibition, Science Fair.

Visits to these places should be arranged in advance to fit-in and correlate with appropriate topic. The purpose should be to achieve specific educational aims and not mere sight seeing and / or recreations. Needless to say that selection of places to be visited will depend upon availability of these resources in or near the community and the finance available.

Planning an Excursion :

The entire planning and conduct should be done by students under the guidance of the teacher. It should be both enjoyable experience and a serious work, at the same time. Each pupil should feel that he / she has a responsibility and should carry it out. Following are the three essentials:

- (i) Preparing a guide sheet.
- (ii) Conducting the tour.
- (iii) Follow-up.

Guide sheet is detailed outline of the plan and may include :

- A. Apparatus and materials to be taken, such as graph paper, thermometers, lenses, binoculars, insect nets etc.
- B. Responsibilities of individuals on various committees for observation, data collection, recording, photographing etc.
- C. Particular devices, processes, departments to be observed.

Physical details are :

- (a) Itinerary and route to be followed.
- (b) Transportation.
- (c) Refreshments and meals.
- (d) Dress/uniform suited to the weather.
- (e) First-aid and emergency provisions.

Approval of school authorities and permission of the parents is a pre-requisite for any excursion.

Follow-up

The value of an excursion can be increased by a planned follow-up a few suggestions are given below :

- (i) Discussion on the experiences of the excursion with students, questions, reactions, suggestions for future trip.
- (ii) Preparation of models, charts, scrap-books, albums.
- (iii) Written papers, sketches, drawings/paintings.
- (iv) Test(s) - - objective or short answer based on the knowledge gained as a result of the trip.

2.3.9 Memory Aids:

It is an effort to simplify important principles and facts so that the students can remember them easily. Some common, sometime nonsense words are formed by linking each better with the fact to be memorized,

Example are :

The word CLOUD spells out common properties of a gas combustion (whether it supports combustion or not).

L	itmus	(Action on Litmus)
O	dour	
U		(hue or color)
D	ensity	(compared with Air)
S	olubility	(in water)

The seven colours of spectrum of light can be remembered by the word VIBGYOR which is a meaningless word.

V	iolet
I	ndigo
B	lue
G	reen
Y	ellow
O	range
R	ed

2.3.10 Science Library

The concept of science library in our schools has not grown due to poor reading habits of students and teachers, bookish nature of curriculum transaction, inadequate grants for purchase of books and journals and above all lack of independent study and project work, essay writing, participation in debates and discussion and competition in science talent schemes etc, alongwith their not being part of evaluation system. There is enough scope to improve the functioning of library, services to be rendered by library and modifications in teaching-learning process which can motivate students and teachers to make use of library in science teaching. The main objectives of a science library are :

- (i) to provide means developing good reading habits.
- (ii) To provide reference material and journals for content enrichment.
- (iii) To provide wide range of reading materials on recreational activities and conduct of different curricular activities in a school.
- (iv) To provide guidance to prepare projects for competition in talent search scheme, children science related vocations in later life.
- (v) To provide support to science teachers for their professional growth.

The science library should be equipped with text books, reference books, journals, encyclopedia and a good collection of audio-visual/ teaching aids for their effective use in science teaching. With the patronage of head of school science teacher should seek help from main libraries to provide a wide range of reading material to students, for their mental and social development.

2.3.11 Integrating ICT with Science Education.

Information and Communication Technologies refer to technologies that provide access to information through telecommunications. It also includes internet, wireless networks, cell phones and other communication mediums. The application of ICT needs to be understood in the changing scenario of education. There are certain factors which compel to come out with certain innovations and alternatives to meet the growing needs and emerging challenges of modern knowledge.

ICT is applied to the science teaching in the following context.

1. Covering large no. of population for imparting education.
2. Enhancing quality in education with the application of multiple technologies.
3. Self-learning with the assistance of aids like computers, mobiles and other electronic gadgets.
4. Group learning thought projects and team work etc.
5. Cooperative learning while pooling the human resource for enhancing quality of learning.
6. Team teaching for adding variety and expertise in teaching of science.
7. Interactive teaching and learning for creating new knowledge and enhancing quality of learning along with fun and recreation.
8. Develops powers of comprehensions, expression, speed, decision making, scientific attitude and scientific aptitude etc.
9. Develop self- confidence and reliance through participation and actually performing practically.
10. Helps students to collect data for their research projects
11. It helps in developing understanding and application of the concepts.

In nutshell we can say that use of ICT in science education is appropriate to classify into (i) tool application (ii) ICT use in learning.

- (i) Tool application- In this category ICT is treated as a set of available software enabling students to accomplish their tasks in an effective way. Data bases, powerpoint presentations, spread sheets, graphic tools and modelling environment can be used as tools in science education.

(ii) ICT in learning- In this category one of the examples is CAI computer assisted learning. It is an interaction between a student and a computer system designed to help student learning. The second example is computer assisted inquiry. It is used as an aid in collecting information and data from various sources to support scientific reasoning. e.g. Internet or a microcomputer-based laboratory (MBC), e-mail, news groups, chat room etc. are used for educational purposes. (iii) The third one is distance learning approaches- for example a news group can be used for facilitating students homeworks. The whole course can be managed through a learning management system.

2.3.12 Summary

In this chapter you have studied about teaching aids. Teaching aids are of very much importance for a teacher teaching science. To make various concepts of science clear to the students these are of utmost importance, these help and support a teacher in explaining and helps students in understanding the concepts.

Teaching aids are of various kinds, like visual aids, Audio aids, Audio-visual, activity and memory aids. In spite of these aids science library is also an important source of information which students should explore. In this era of computer information and communication technologies should be integrated with science education so as to make students equipped with the latest knowledge and information, which helps them to adjust in this computer age.

2.3.13 Suggested Questions

1. How you will plan an excursion and what are its advantages in the field of science education ?
2. How the use of television and computer can help the cause of science education ?

2.3.14 References

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