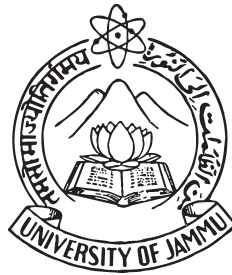


Directorate of Distance Education

UNIVERSITY OF JAMMU
JAMMU



SELF LEARNING MATERIAL

B.ED. SEMESTER - III

Paper : Teaching of Mathematics
Course No. 302

Unit - I to V
Lesson No. 1 to 15

Programme Co-ordinator
Prof. Darshana Sharma

Printed and Published on behalf of the Directorate of Distance Education, University of Jammu, Jammu by the Director, DDE University of Jammu.

<http://www.distanceeducationju.in>

TEACHING OF MATHEMATICS (COURSE NO. 302)

Course Contributors :

- **Dr. J. N. Baliya**
Department of Educational Studies,
Central University of Jammu, Jammu.
- **Dr. Namesh Kumar**
Principal, C. T. College of Education,
Jalandhar
- **Dr Leena Sharma**

Format Editing :

- **Prof. Darshana Sharma**
Directorate of Distance Education,
University of Jammu, Jammu.

Content Editing :

- **Dr. J. N. Baliya**
Department of Educational
Studies, Central University
of Jammu, Jammu.

© Directorate of Distance Education, University of Jammu, 2020

- * All rights reserved. No part of this work may be reproduced in any form, by mimeograph or any other means, without permission in writing from the DDE, University of Jammu.
 - * The script writer shall be responsible for the lesson / script submitted to the DDE and any plagiarism shall be his/her entire responsibility.
-

Printed by : Ajanta Art Press / 2020/ 100 Nos.

BACHELOR OF EDUCATION (B.Ed)

Semester –III

(For the examination to held in the year 2016, 2017, 2018, 2019 & 2020

Methodology of Teaching Subject-II

Course no. 302

Title: Teaching of Mathematics

Credits 4

Total Marks : 100

Maximum Marks Internal : 40

Maximum Marks External : 60

Duration of Exam : 3hrs

Objectives

To enable the pupil- teachers to:

- study and Understand the different teaching aids in the Teaching of Mathematics
- study and Understand the different techniques for the evaluation of the students of Mathematics
- study and Evaluate the Student's Performance in Mathematics through the use of the scientific tools.

UNIT I

Mathematics and Teaching Aids

Text book, Teacher Hand book, Assignment Book, Mathematics Magazine, Mathematics Laboratory, Audio-visual Aids, etc. Use of Computer in Mathematics Teaching as CAL and CAI, Preparation of Power Point Presentations for mathematics teaching. Evaluation of Text books of Mathematics prescribed by the J&K and CBSE Boards on the parameters of the Content and the level of Explanation for the specific class. The statistics- central tendency (Mean Median & Mode ;Bar Graph and Histogram, frequency polygon).The Use of Computer is to be made in tabulating the data and calculation through the spreadsheet on Computer.

UNIT II

Evaluation / Assessment Techniques

Diagnosis of Learning Difficulties and Remedial Measures; Backwardness in Mathematics- Enrichment Programmes for the Gifted; Different Types of Tests used for evaluation for the different groups in Mathematics;

Concept & use Continuous & Comprehensive Evaluation (CCE) in Mathematics, Construction of Objective Based Test Items in Mathematics on a particular topic studied and taught (sem I& II) is to be used for preparing the Objective Type and Essay type test on the real basis.

UNIT III

Construction and use of diagnostic test in mathematics – steps; preparation of diagnostic chart(error analysis table), identification of difficulties and remedial teaching Portfolio assessment and performance assessment in mathematics

Prepare an Achievement test of Mathematics with Blue print for different topic of Mathematics for any grade. Prepare any one self-made teaching aid for teaching of

Mathematics in secondary school.(for teaching Geometry and the Arithmetics on the innovative basis of the above said topics on 2D,3D Model, GeoBoard)

Prepare a collection of problems in your Mathematics club and published it in as a part of Mathematics Magazine which is to be developed on the Semester Basis.

UNIT IV

Lesson planning:

Meaning and importance of lesson plans at macro level, meaning and purpose of unit and monthly plans. Steps for preparing lesson plans for teaching mathematics using Herbartian and RCEM approaches. The topics of Triangle, Criteria for Similarity theorem of BPT) and Theorem of Pythagoras. Advantages and limitations of these approaches.HCF, LCM

Note for Paper Setters

The Question paper consists of 9 questions having Q no 1 as Compulsory having four parts spread over the entire Syllabus, with a weightage of 12 marks .The rest of Question paper is divided into four Units and the students are to attend four Questions from these units with the internal choice. The essay type Question carries 12 marks each. Unit IV having the sessional work/field work(section) could also be a part of the theory paper.

Internship/field work Unit IV having the components/activities of the internship are to be developed in the form of the Reflective Journal. All the activities under the internship are to be evaluated for credits and hence all the activities are to be showcased by the trainee and are to be fully recorded with the complete certification of its genuineness.

The Theory paper is to have 60 marks (external) . 40 Marks are for the In House activities

BOOKS RECOMMENDED:

- *Aiyanyas , N. Kuppaswami, (1982). **The Teaching of Mathematics in New Education**, Delhi; Universal Book and Stationary Co.*
- *Butler , C. H. and Wren, F. L., (1951). **Teaching of Secondary School Mathematics**:
New York; Mac Grow Hill*
- *Mangal, S. K. (1987). **Teaching of Mathematics**; Prakash Brothers Education Publishers Pvt. Ltd.*
- *NCERT, **A Textbook of Content-cum-Methodology of Teaching Mathematics**, New Delhi*
- *Sidhu, Kulbirsingh (1996). **Teaching of Mathematics**; (Fourth Ed.), Sterling Publishers Pvt.*
- *Aggarwal, S.M. (1999)**Teaching of Modern Mathematics**, Dhanpat Rai and Sons, New Delhi*

TEACHING OF MATHEMATICS

CONTENTS

Course No.	Unit No.	Lesson No.	Title of Lesson	Name of lesson writer	Page No.
302 Teaching of Mathema- tics	I	1	Text book, Teacher Hand Book, Assignment Book, Mathematics Magazine.	Dr. J. N. Baliya	
		2	Mathematics Laboratory, Audio-visual Aids, etc. Use of Computer in Mathematics Teaching as CAL and CAI, Preparation of Power Point Presentations for mathematics teaching.	Dr. J. N. Baliya	
		3	Evaluation of Text books of Mathematics prescribed by the J&K and CBSE Boards on the parameters of the Content and the level of Explanation for the specific class.	Dr. J. N. Baliya	
		4	The Statistics-Central Tendency (Mean, Median & Mode; Bar Graph and Histogram, frequency polygon). The Use of Computer to be made in tabulating the data and calculation through the spreadsheet on Computer.	Dr. J. N. Baliya	
	II	5	Diagnosis of Learning Difficulties and Remedial Measures.	Dr. Namesh Kumar	
		6	Backwardness in Mathematics-Enrichment Programmes for the Gifted.	Dr. Namesh Kumar	

TEACHING OF MATHEMATICS

CONTENTS

Course No.	Unit No.	Lesson No.	Title of Lesson	Name of lesson writer	Page No.
302 Teaching of Mathema- tics	II	7	Different Types of Tests used for evaluation for the different groups in Mathematics.	Dr. Namesh Kumar	
		8	Concept & use Continuous & Comprehensive Evaluation (CCE) in Mathematics.	Dr. Namesh Kumar	
		9	Construction of Objective Based Test Items in Mathematics on a particular topic studied and taught (sem I & II) is to be used for preparing the Objective Type and Essay type test on the real basis.	Dr. J. N. Baliya	
	III	10	Construction and use of diagnostic test in mathematics - Steps; preparation of diagnostic chart (error analysis table), identification of difficulties and remedial teaching.	Dr. Leena Sharma	
		11	Portfolio assessment and performance assessment in mathematics.	Dr. Leena Sharma	
		12	Prepare an Achievement test of Mathematics with Blue print for different topic of Mathematics for any grade.	Dr. Leena Sharma	

TEACHING OF MATHEMATICS

CONTENTS

Course No.	Unit No.	Lesson No.	Title of Lesson	Name of lesson writer	Page No.
302 Teaching of Mathema- tics	IV	13	Lesson planning: Meaning and importance of lesson plans at macro level, meaning and purpose of unit and monthly Plans.	Dr. J. N. Baliya	
		14	Steps for preparing lesson plans for teaching mathematics using Herbartian and RCEM approaches	Dr. J. N. Baliya	
		15	The topics of Triangle, Criteria for Similarity (theorem of BPT) and Theorem of Pythagoras. Advantages and limitations of these approaches. HCF, LCM.	Dr. J. N. Baliya	

**TEXT BOOK, TEACHER HAND BOOK ASSIGNMENT BOOK,
MATHEMATICS MAGAZINE**

Structure

- 1.1 Introduction
- 1.2 Objectives
- 1.3 Textbook
 - 1.3.1 Importance of Text-Books:
 - 1.3.2 Need for a Good Textbook in Mathematics
 - 1.3.3 A textbook is an important aid for learning mathematics
 - 1.3.4 Characteristics of Good Text-Books
 - 1.3.5 Qualities of A Good Mathematics Textbook
- 1.4 Teacher Hand Book
 - 1.4.1 Uses of Handbook
 - 1.4.2 Teacher Handbook
 - 1.4.3 Organization of the Teacher Handbook
 - 1.4.4 Uses for the Handbook

- 1.5 Assignment Book
 - 1.5.1 Types of Assignments in Assignment Book
 - 1.5.2 Importance and Purposes of Assignment
 - 1.5.3 Characteristics of a Good Assignment
 - 1.5.4 Role of the Assignment in Teaching
- 1.6 Mathematics Magazine
 - 1.6.1 Characteristics of Magazines
 - 1.6.2 Types of magazines
 - 1.6.3 Mathematics Magazine
- 1.7 Let Us Sum Up
- 1.8 Lesson End Exercise
- 1.9 Suggested Further Readings
- 1.10 Answers to Check Your Progress

1.1 INTRODUCTION

In this lesson, you will understand what is textbook and also elaborate the need of textbook in Mathematics which we will use in the teaching mathematics. Further, the teacher's handbook will be discussed in this lesson. You will also appreciate the key characteristics, types and concept of magazine in the perspectives of teaching of Mathematics. You will also go through the concept of assignment book, characteristics of good assignment and types of assignment.

1.2 OBJECTIVES

After going through this lesson, you shall be able to:

- explain the concept of textbook and need for good textbook in teaching mathematics.
- define the teacher handbook,
- list out the prerequisite points to be covered in teacher's handbook,
- describe the concept of assignment book and types of assignment to be used by teacher in the classroom teaching, and
- discuss about mathematics magazine

1.3 TEXT – BOOKS

Text-books are standardized collection of the subject-matter that has to be taught to the students. They facilitate the teaching of new concepts and skills and maintain the knowledge already acquired and help the correlation of the theoretical knowledge with the practical aspects of life

1.3.1 Importance of Text-Books:

1. Usefulness to the teacher:

- It provides suitable subject matter and guideline regarding the syllabus of the subject. So, the teacher neglects no portion of the syllabus and does not waste time on relevant details.
- The text books help the teacher planning his lessons, deciding his method of teaching and preparing suitable aids.
- It provides certain well illustrated examples about a topic.

- Text books are usually written by the well experienced teachers and subject experts. A teacher can make use of their services by making use of their Text-books.
- 2. Usefulness to the students:**
- They provide the students with well graded exercises for drill, revision and review.
 - Text books help in pre-preparation. At their home, students may get themselves prepared for studying the next day lesson.
 - Text-books help in doing self-learning, self-study and helping the students to acquire the habit of independent learning.
 - Text-books are also quite useful in case a student has to remain absent from class due to one (or) the other reason.
- 3. Usefulness to maintain the uniform standards:** Text-books play an important role of maintaining uniformity in standards. The text books are quite helpful to examiners in their Evaluation work because they come to know of the standards expected of a particular class.

1.3.2 Need for a Good Textbook in Mathematics

Though there are contradicting opinions regarding the use of textbooks for mathematics teaching and learning, the following points support the use of mathematics textbooks.

A mathematics textbook is very useful for a teacher in the following ways.

1. A textbook is written according to the syllabus and gives the outline of the course. Therefore, it helps the teacher to decide about the limits and depth of the content to be presented to the students while teaching.

2. A textbook provides insight to the teacher in planning the lesson, in selecting the problems to be worked out, the methods of teaching to be adopted and the teaching aids to be used.
3. The textbook is written by experienced teachers of mathematics. By using textbooks, a teacher of mathematics, especially a beginner, can avail the experience and expertise of the authors.
4. The logical and psychological sequence followed in a textbook helps the teacher in presenting the subject matter in an orderly and systematic sequence.
5. A good textbook presents a variety of worked out examples on each topic. This helps the teacher in getting acquainted with different types of problems and the methods to solve them. This gives him more self-confidence while teaching.
6. The well-graded exercises provided after every topic in the textbook help the teacher in assigning suitable homework and assignment to the students to suit their intellectual capacity.
7. A textbook saves a lot of time for the teacher as he need not spend time to prepare problems and the solutions as they are readily available in the textbooks.
8. A mathematics textbook provides the teacher with the basic information considered essential in attaining the objectives of mathematics education and this helps the teacher to plan appropriate learning experiences.

1.3.3 A textbook is an important aid for learning Mathematics- It is useful for the students in the following ways:

1. The textbook helps the pupils to relate, what they are learning, to life.
2. It helps to foster the right study attitude among the students since the textbook presents definite and concrete details in a scientific and intensive manner which could arouse the students' interest and curiosity.

3. The textbook provides important source of materials for reviewing and recapitulating the lessons taught in the class.
4. It places within the reach of the pupil the theoretical development, worked out with much thought and a wide view of the bearings of the subject. This helps in meaningful learning.
5. The textbook helps in pre-preparation of the lesson and gets the students acquainted with lessons to be taught.
6. It provides adequate materials for drill and practice and thus helps in fixing the mathematical principles and formulae in the minds of the students.
7. It saves time and labor of the students as they need not copy the illustrative problems, exercise problems and homework problems.
8. It encourages self-study and independent work among the students.
9. It supplements classroom learning and helps in the realization of the objectives of mathematics education.
10. Textbooks help in clearing the doubts and misunderstanding relating to mathematical concepts, formulae and principles. It also helps in correcting the mistakes that occur while copying the formulae and problems from the blackboard.
11. The textbook helps in the extensive study of the subject as it presents different problems and various approaches to problem-solving.
12. New learning activities such as individual projects, laboratory experiments and demonstrations suggested in the textbook can be carried out by the students. It permits each student to read and carry out the activity at his own rate of comprehension.

1.3.4 Characteristics of Good Text-Book. Following are the characteristics of a good text book in Mathematics :

1. It presents the subject-matter strictly in accordance with the latest-syllabus.
2. It is written by experienced teachers of Mathematics.
3. It should contain well graded problems for revision and upgradation of knowledge.
4. The day-to-day needs of the students and their physical and social environment should find due place in the text book.
5. It should be according to the aims and objectives of teaching Mathematics in that particular class.
6. The new development in the field of Mathematics should find the proper place in the text-book of Mathematics.
7. The psychological as well as logical order should be followed in the organization of the subject matter of the text-book.
8. All the definitions, concepts and principles given in the text book should be as clear and definite as possible.
9. It should make use of the national and international standard terminology in terms of symbols, formulae and definitions.
10. The principle “from simple to complex” should be followed in the arrangement of the topics of the text-book.
11. It should meet the abilities, experience and interest of the students for which it has been written. It should cater to the needs of all types of students – slow, average and fast learners.

1.3.5 Qualities of A Good Mathematics Textbook-The quality of a good textbook in mathematics can be broadly classified under the following heads.

1. Physical features.
2. Author.
3. Content.
4. Organisation and presentation.
5. Language
6. Exercise and Illustrations.
7. General

1. Physical features:

- The paper used in the textbook should be of superior quality with the consideration of over all weight.
- It should have quality printing and the binding of the book should be strong and durable.
- The printing should be bold and easily readable.
- It should have an appealing and attractive cover page with interesting mathematical design on it.

2. Author- The textbook should be written by qualified, experienced and competent teachers of mathematics or a committee of experts constituted by the state government or the agencies associated with teaching of Mathematics.

3. Content:

- The textbook should be written according to prescribed syllabus and every aspect of the syllabus should be adequately covered.

- It should be in accordance with the aims and objective of teaching mathematics in that particular class.
- The content presented in the textbook should be accurate and up-to-date. It should include the recent developments in the mathematics relating to the content dealt with.
- The contents of the textbook should have a direct, practical and social utility value of the students at that level.
- Oral mathematics should find its due place in the textbook with due exercise and practical tasks related with oral aspects.
- The answers given at the end of each section should be correct and explanatory.
- It should satisfy the demands of examination and latest innovative techniques.

4. Organisation and Presentation:

- It should provide for individual differences. It should meet the needs of students of varying abilities, interests and attitudes.
- There should be sufficient provision for revision, practice and review for the readers of the text book.
- The textbook should relate the classroom learning to the real-life needs and the physical and social environments of the learners of that level.
- The subject matter in the textbook should be carefully organized with reference to the logical as well as psychological considerations which make teaching effective.
- The content should be organized in the increasing order of difficulty. Principle of vertical correlation should be followed to relate the present knowledge with the past and future in order to increase the lucidity.

- The presentation of the content should foster right attitude towards self-study and self-reliance among pupils by suggesting project work, field work and laboratory work.
- It should facilitate the use of analytic, synthetic, inductive deductive, problem solving and heuristic approaches to teaching.
- The textbook should stimulate the initiative and originality of the students.
- It should offer suggestions to improve study habits.

5. Language-

- The language used in the textbook should be simple and easily understandable and within the grasp of the pupils.
- The style and vocabulary used should be suitable to the age group of students for whom the book is written.
- The terms and symbols used must be those which are popular and internationally accepted.
- All terms, and concepts and principles used in the text should be clearly and accurately stated and defined.

6. Exercise and Illustrations:

- The presentation of the subject matter must be attractive and interesting with appropriate illustrations in terms of pictures, diagrams and figures.
- The diagrams used in the textbook should be easily recognizable and geometric constructions should be in proportion with the measurements prescribed by the problem.
- The illustrations should be accurate, clear and appropriate.
- It should provide adequate opportunities to motivate the students to solve problems by Presenting adequate number of worked out problems and problems constructed from daily life. Situations requiring

the student to apply mathematical principles and formulae for their solution.

- The text should contain some difficult problems or exercises to challenge the mathematically Gifted students.
- There should be well graded exercises give at the end of every topic to satisfy the needs of all Calibers.

7. General:

- The textbook should be of latest edition with necessary modifications.
- The book should be of moderately priced and readily available in the market.

Check Your Progress -1

Note: (a) Answer the questions given below:

(b) Compare your answers with those given at the end of the lesson:

1. The instructional material which forms a strong bond between the teacher and the taught i
 - a. Textbook
 - b. Teacher's guide
 - c. Work books
 - d. None of the above.
2. A textbook must be
 - a. Attention catchy
 - b. Very light
 - c. Loaded with information
 - d. Bulky enough.
3. Write any two qualities of textbook of mathematics.

1.4 HANDBOOKS: CONCEPT

A handbook is a type of reference work or other collection of instructions, which is intended to provide ready reference. It is regarded as a book giving information such as facts on a particular subject or instructions for operating a machine.

The term 'Handbook' has its origin in German word "Handbuch" meaning "a small book or a treatise giving useful facts". It is usually considered a reference book which is handy to use, handy to carry, and so on. A handbook is defined as a comprehensive and detailed work on a particular topic for practitioners, structured for quick reference. It is called as a handbook because it is usually convenient to be held in the hands of the users. It is, therefore, a ready reference book, the relevant portions of which are consulted at the time of need. It is the best 'working tool' for a technologist and usually contains factual information, data, tables, formulae, etc. It may deal with any topic, and generally is a compendium of information in a particular field or about a particular technique. Designed to be easily consulted, it provides quick answers in certain areas and is designed and developed to meet what is called "everyday approach". For example, the MLA Handbook for Writers of Research Papers is a reference for how to cite works in MLA style, among other things. The term handbook is commonly used interchangeably with a manual because, according to William Katz, it is difficult to distinguish between the average handbook and the average manual. A handbook, therefore, is much the same as a manual.

So, Katz further stated that a handbook "is a collection of a miscellaneous group of facts centered on one theme or subject area". He observed that a handbook presupposes that readers know the field well and turn to it to refresh memory.

Louis Shores defines a handbook as "A reference book of miscellaneous facts and figures on one or many subjects assembled for ready use, in response to popular interest or to a specific need for concise, handy information".

Harrods's Librarians Glossary and Reference Book defines a handbook as "a treatise on a subject; nowadays it has often a simple but all-embracing treatment,

containing concise information, and being small enough to be held in the hand; but strictly a book written primarily for practitioners and serving for constant references”.

A large number of organizations, centers, and other institutions have been preparing handbooks since a long time. The term handbook is, therefore, used for documents that are produced within an organization. Professional organizations usually prepare a variety of handbooks ranging from short duplicated set of regulations to glossy multi-colored reports. These are produced for different type of users such as technical personnel, industrial workers, office staff, and so on. On the other hand, some handbooks are prepared for general information, such as history of an organization; and there are other handbooks that are meant only for the benefit of the employees of the organization, for example, they provide a set of rules, and so on. All the available handbooks may not be providing facts of popular interest. Many of the handbooks are limited in scope, and focus on a specific area of interest. Such subject handbooks consist of articles based on research reports in a particular field. This presupposes that the users have a basic knowledge of the subject.

1.4.1 Uses of Handbook

As single-volume ready reference sources, handbooks have the following uses:

- a) They provide facts of popular interest for public at large.
- b) They provide depth of information in a narrow subject field.
- c) They contain articles for subject specialists.
- d) They also serve as ‘how-to-do-it’ type guides, whereby one can learn things by oneself.
- e) They also provide rules for government servants.
- f) They are also useful for historical and literary information

1.4.2 Teacher Handbook

The *Handbook* for teacher, simply put, is about supporting quality teachers. The handbook for teachers consists of information required by them with respect to their learners and to their career improvement and advancement. The handbooks also contain details for teachers with respect to the expectations the board has from them. The handbook can also be considered as a source of information to the teachers regarding procedures, policies, roles, responsibilities, awards, and resources which are related to their professional life.

1.4.3 Organization of the Teacher Handbook

The *Handbook* provides tools that can be selected by teachers, peer coaches, principals, supervisors, and others to focus on improving teacher performance and mainly includes the following key theme:

- Prerequisites of effective teachers
- The teacher as a person,
- Classroom management and organization,
- Organizing for instruction,
- Implementing instruction, and
- Monitoring student progress and potential.

1.4.4 Uses for the *Handbook*

The *Handbook for Effective Teachers* aims to improve the quality of teacher performance and the resulting learning opportunities for students. In this effort, the handbook can be a valuable resource for:

- *teachers* who desire to enhance their own performance through reflection and application of tools for improving performance;

- *teacher leaders* who are engaged in mentoring and collaborative schoolwide improvement;
- *instructional coaches* who are actively supporting the critical work of teachers
- *school administrators* who supervise and evaluate teachers;
- *staff development specialists* who plan and deliver training focused on improving and sustaining quality instruction;
- *human resource specialists* who are responsible for selecting and retaining high-quality teacher applicants;
- *teacher and administrator educators* who can employ the book’s research and application strategies in their teacher training and instructional leadership programs, respectively; and
- *policymakers* and their staffs who are responsible for developing tools and strategies for state or district teacher development and evaluation processes.

Check Your Progress-2

Note: (a) Answer the questions given below:

(b) Compare your answers with those given at the end of the lesson:

1. Write down the two uses of teacher’s handbook.

2. Which of the following theme doesn’t include in the teacher’s handbook?

- a) Classroom management and organization,
- b) Organizing for instruction,
- c) Implementing instruction, and
- d) None of the above

3. The main aim of teacher’s handbook is to improve the quality of teacher performance and good learning outcome. T/F

1.6 ASSIGNMENT BOOK

Assignment is an integral part of teaching-learning process as it is a prime tool for monitoring the progress and shaping learning. The main aim of Assignment is to collect information of learner's achievement and progress and provide direction for ongoing teaching and learning process. Assignment is the means, which deduces what learners know and what they do not. It suggests teachers, learners, parents, and policymakers something about what learners have learned and what more should be done in order to improve performances. Assignment book is a kind of book for teachers as well as for students.

The term ASSIGNMENT is quite familiar to the teacher as well as the pupil. It usually refers to any exercise given by the teacher to the pupil as part of the lesson, or any follow up work suggested for study is called an assignment. The principle aim of any education is to teach the pupil to work on his own responsibility. Thus, assignment book is nothing but acts as a guide for teacher to give the assignment to students as per the learning objective of the lesson.

1.5.1 Types of Assignment in Assignment Book

The teacher can assign four types of assignment.

- 1. Preparatory Assignments-** These are meant to prepare the pupils for the work which is to follow on the next day.
- 2. Study Assignments-** These can be of various types; Problem solving assignments, assignments for making charts, graphs, tables etc
- 3. Revisional Assignments-** These assignments are given for:
 - Providing drill on what was learnt
 - Checking retention and reproduction of the information related to a topic or unit studied

- Checking the understanding of the ideas of a topic taught
- Assignments need to be worked out in advance keeping in view the specific instructional objectives of the subject matter being tested

4. Remedial Assignments- These assignments are devised in the light of pupil's reactions to the three types of assignments mentioned above. The purpose of these assignments is to remove weak points and clear misunderstandings.

1.5.2 Importance and Purposes of Assignment

Assignments, properly planned and executed have great educational value. They enhance comprehension and pave the way for further learning, Assignments may serve the following purposes.

- Assignments serve pupil needs by facilitating learning effectively. Assignments make pupils active.
- Assignments can enable pupils to discover difficulties in learning and to be find out ways and means to overcome them.
- Assignments may stimulate interest arouse curiosity motivation is highly fruitful in the development of learning.
- To provide educationally gainful experiences and to illustrate them through examples assignments are very effective.
- To attain the different objectives of teaching the subjects variety of suitable assignments can be selected and given.
- To develop proper skills, desirable attitudes and interest assignments very helpful.

1.5.3 Characteristics of a Good Assignment- following are the characteristics of good assignment given by teacher:

- Assignments should be challenging, but not threatening.

- Assignments should be interesting and appealing.
- Assignments should naturally grow out of the lesson. The close connection between the lesson and the assignments should be quite clear to the pupils.
- Assignment should motivate pupils.
- Assignments should be goal oriented.
- Assignment should be designed and worked out cooperatively.
- Assignment must be specific and definite. They should be stated in simple and clear language.
- Assignment should have enough variety for motivating children, creating mental activity appropriate for the different objectives of teaching and for widening their perspectives.
- Providing and working out assignments should not be postponed to the last moment.

1.5.4 Role of the Assignment in Teaching

The assignments have to play important roles at all the three stages of lesson.

- A. At the beginning of the lesson assignments will serve the purpose of linking the acquired experiences of children with the new knowledge.
- B. During the development of the lesson the educative process can be furthered through suitable assignments.
- C. Assignments are usually employed at the end of the lesson. Acquired concepts are to be applied or problems are to be solved.

Check Your Progress-3

Note: (a) Answer the questions given below:

(b) Compare your answers with those given at the end of the lesson:

1. Write briefly the types of assignment used in teaching learning process.

2. The main purpose of assignment is to

- a) Facilitate Learning
- b) Reduce teacher burden
- c) Make student busy
- d) Label the student

1.6 WHAT IS A MAGAZINE ?

A magazine is a publication that is issued periodically. It generally contains essays, stories, poems, articles, fiction, recipes, images etc. Magazines are directed at general and special audience, often published on a weekly or monthly basis. The word “magazine” is derived from Arabic word “makhazin” or “storehouse,” which contains a collection of facts and fiction, all bundled together in one package. Gentlemen’s Magazine, founded in 1731 is considered as the world’s first magazine. Then we had The Economist, Collier’s, The Saturday Evening Post, National Geographic, Time, The New Yorker, Life, People etc. In the present age of the tablet and social media, the idea of a “magazine” is returning to its storehouse roots. Functionally, a magazine still represents the idea of a bunch of thematically-related content put together as one package. A magazine can also be considered as a cabinet of curiosities; i.e. a display case in which interesting, unusual and occasionally

‘eccentric’ objects are collected and displayed as a conversation piece or an expression of the writer’s wide-ranging interests or tastes. The readers are treated with a fascinating, mind-expanding and unique set of wonders they had never dreamt of.

1.6.1 Characteristics of Magazines

While popular magazines provide broad overviews of topics, scholarly journals provide in-depth analysis of topics and report the findings of research, and trade magazines report on industry trends, new products or techniques. A popular magazine which caters to the general public uses non-technical language. The contents of these magazines include interviews, general interest articles and various types of features. They usually cover a wide range of topics based on research, source comments and generalizations. Articles are usually written by a staff writer or a journalist; in some cases, interesting articles of freelancers are also encouraged. They generally contain many interesting and sometimes photographs to attract readers. In general, magazine articles are easy to read, fairly brief in length, and may include illustrations or photographs. Magazines don’t necessarily follow a specific format or structure in writing the articles. Its attractive appearance, eye-catching cover pictures and illustrations on quality paper make it more appealing to the reading public.

1.6.2 Types of magazines

Today, there are thousands of magazines worldwide. They inspire, inform, educate and entertain audiences across the globe. Nearly 600 years after the advent of the printing press, magazines continue to change the nature of things throughout the world. The major categories of magazines are briefly explained below:

- 1. General Interest Magazine.** This type of magazine is published for a wider audience to provide information, in a general manner and the focus is on many different subjects. The main purpose of a general interest magazine is to provide information for the general audience. No background knowledge or expertise is assumed. Articles usually provide a broad coverage of topics of current interest. They are written by journalists, freelance writers or staff

correspondents of the magazine. These periodicals may be quite attractive in appearance, with articles often heavily illustrated with photographs. The language of these publications is geared to any educated audience. Examples of general interest periodicals are: Time, Newsweek, Outlook, India Today and The Week etc.

- 2. Specific Interest Magazine** Special interest publications are magazines directed at specific groups of readers with common interests. Most special interest magazines cater to any specific interests or pursuits. For instance, there are magazines that cover sports, news, fashion, business, music, particular subject like science mathematics, economic and so on. While some attempt to cover all aspects of a broad subject, others are concerned only with a particular element of the general subject.

1.6.3 Mathematical Magazine- Mathematical Magazine is a special Interest publication which is generally produced for the readers who are interested in mathematics. Its intended audience may be teachers of collegiate mathematics, especially at the junior/senior level, and their students. It focuses explicitly on mathematics rather than pedagogy. Rather than articles in the these “theorem-proof” style of research journals, it seeks articles which provide a context for the mathematics they deliver, with examples, applications, illustrations, and historical background.

Check Your Progress-4

Note: (a) Answer the questions given below:

(b) Compare your answers with those given at the end of the lesson:

1. The meaning of word magazine is.....
2. Which one of the following depicts about the physical appearance of magazine ?
 - a) Attractive appearance

- b) Eye-catching cover pictures
 - c) Illustrations on quality paper
 - d) All of the above
3. Mathematics Magazine is a type of magazine.

1.7 LET US SUM UP

In this lesson you studied about ‘textbook’ as an instructional aid in teaching mathematics and highlighted the importance of ‘textbook as means of connection between student and teacher. Also, we discussed about a teacher handbook and uses of teacher handbook for the quality of teacher performance as well as for the quality of learning outcome in the process of teaching. The assignment book which is a device consisting of a series of assignment dealing with different types of assignment that is Preparatory Assignments, Study Assignments, Revisional assignment and Remedial Assignments. Along with this, we too discuss the type of mathematics magazine and what actually these magazines meant for.

1.8 LESSON END EXERCISES

- 1. What is a textbook? Explain its need of good textbook in teaching of mathematics.
- 2. Explain the need of a textbook.
- 3. List out the characteristic features of a good textbook.
- 4. Explain the concept of assignment and types of assignment with its purpose.
- 5. Describe in detail the types and characteristics of magazine.

1.9 SUGGESTED FURTHER READINGS

Sharma. R.C. (1988). *Modern Science Teaching*. New Delhi: Dhat Pal Rai Publishing Co. Pvt. Ltd.

Yadav. K. (2001). *Teaching of Life Sciences*. New Delhi: Anmol Publications Pvt. Ltd.

1.10 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress-1

1. a. Textbook
2. a. Attention catchy
3. Refer to section 1.3.5

Check Your Progress-2

1. Refer to section 1.4.4
2. d
3. True

Check Your Progress-3

1. Refer to section 1.6.1
2. a

Check Your Progress-4

1. Storehouse
2. D
3. Special Interest Type Magazine

**MATHEMATICS LABORATORY, AUDIO VISUAL AIDS, ETC.
USE OF COMPUTER IN MATHEMATICS TEACHING**

Structure

- 2.1 Introduction
- 2.2 Objectives
- 2.3 Mathematics Laboratory
 - 2.3.1 Importance of Mathematics Laboratory
 - 2.3.2 Equipment and maintenance of the Mathematics Laboratory
 - 2.3.3 Advantages of Mathematics Laboratory
- 2.4 Audio-Video Aids
 - 2.4.1 Definitions of Audio Visual Aids
 - 2.4.2 Purposes and Advantages of Audio Visual Aids
 - 2.4.3 Advantages of Audio Visual Aids
 - 2.4.4 Various Teaching Aids in Teaching Mathematics
 - 2.4.5 Place of Audio Visual Aids in Mathematics:
- 2.5 Use of Computer in Mathematics Teaching as CAI
 - 2.5.1 Definitions

- 2.5.2 Steps in Developing CAI
- 2.5.3 Learning Sequence of CAI
- 2.5.4 CAI Programmes (or) Mode of CAI
- 2.5.5 Advantages of CAI
- 2.5.6 Disadvantages of CAI
- 2.6 Computer Assisted Learning (CAL)
 - 2.6.1 Types of CAL
 - 2.6.2 Advantages of CAL
 - 2.6.3 Limitations of CAL
- 2.7 Preparation of Power Point Presentation for Mathematics Teaching
 - 2.7.1 Steps for Preparing PowerPoint in Microsoft office
 - 2.7.2 Advantages of Using Power Point in Teaching Mathematics
- 2.8 Let Us Sum Up
- 2.9 Lesson End Exercise
- 2.10 Suggested Further Readings
- 2.11 Answers to Check Your Progress

2.1 INTRODUCTION

As we know, the main aim of teaching of mathematics is the development of power of abstract thinking and reasoning.

In this lesson you will understand about ‘Audio Visual Aids’ which focuses its attention totally on the what Aids to be used and how these can be practically employed

in the subject mathematics. You will also appreciate the benefits and the key characteristics of the computer assisted learning and computer assisted instruction. You will also go through the steps related to the formation of PowerPoint presentation so that you will understand its importance in present day teaching-learning situations.

2.2 OBJECTIVES

After going through this lesson, you shall be able to:

- to describe about mathematics laboratory and material required for it,
 - explain the meaning of the term audio-visual aids,
 - classify the audio video aids, with examples,
 - differentiate the concept of computer assisted instruction and computer assisted learning, and
 - delineate the steps for making PowerPoint presentation in Microsoft Office.
-

2.3 MATHEMATICS LABORATORY

Mathematics teaching in today's school is textbook dominated, concerned primarily with the manipulation of symbols and all too often largely removed from the real world of the child. Endless repetition, meaningless memorization and general lack of interest are other few reasons that attribute negative attitudes towards mathematics.

Taking into consideration the national aspirations and expectations reflected in the recommendations of the National Curriculum Framework (NCF) developed by NCERT, had initiated a number of steps to make teaching and learning of mathematics at school stages activity based and experimentation oriented.

Mathematics laboratory is a place rich in manipulation materials to which children have ready access to handle them, perform mathematical experiments, play mathematical games, solve mathematical puzzles and become involved in other activities. The laboratory approach allows pupil to set up mathematical experiment

for the purpose of discovering some mathematical principles, patterns or process. These activities may be carried out by the teacher or the students to explore to learn, to stimulate interest and develop favorable attitudes towards mathematics. More involvement in the laboratory work helps in satisfying the creative and constructive urges of the students.

2.3.1 Importance of Mathematics Laboratory

In Mathematics laboratory all essential items (E.g. set-square, compass, models etc) concerning the learning activities in mathematics are kept. It also provides facilities for laboratory work. The main aim of teaching of mathematics is the development of power of abstract thinking and reasoning. For this we must start from concrete subjects, his learning is quicker and understanding is better. If mathematical facts are verified physically then they could be understood more easily and can be easily applied in new situations and also more practical work in mathematics makes the subject interesting to the student.

1. It helps in making clear and in understanding abstract concepts.
2. It saves teachers time by cutting short certain lengthy explanations.
3. It enables the students to apply mathematical facts and principles in an actual life.
4. The pupils develop love for the subject and arousing their interest in mathematics.
5. It is multi-sensory approach to learning.

2.3.2 Equipment and Maintenance of the Mathematics Laboratory- Following are the key equipment required for mathematics laboratory:

1. **Concrete Materials:** It should be provided with concrete materials connected with simple arithmetical topic such as beads, stick, pebbles, ball frames, number cards, balances, coins, weights, measuring tapes apparatus which is used in Montessori Method card-board, chart paper, graphs etc.

2. **Charts:** A number of Mathematical charts should be kept in the Mathematics laboratory. Charts can be used to explain certain points which otherwise would be difficult to explain the teacher encourage the students to prepare charts on different topics of percentage, fractions, average etc.
3. **Pictures and photographs:** The pictures and photographs of various Mathematicians are prominently displayed in the Mathematics room. It would be much useful if the contributions of these Mathematicians are also indicated on such charts.
4. **Models:** Various mathematical models such as these of triangles, squares, solids etc, are stored in a mathematics laboratory. These help in understanding abstract Mathematical proofs (or) principles or statements are available in the market.
5. **Equipment and Materials Concerning other Subjects:** Mathematical principles and procedures are used in other subjects and materials, equipment illustrating the application of Mathematics (E.g. barometer, hydrometer, pendulum) be also kept in mathematics laboratory.
6. **Proportional Dividers, slide rules, is calculating Machines etc:** These are quite useful in the study of similarity of geometrical figures and are kept in a mathematics laboratory, making use of these instruments we can magnify or reduce figures, graphs; maps etc. slide rules are quite useful in Mathematical calculations. Training in Mathematical calculations can be provided by using simple calculating machines. A simple calculating machine resembles a type writer. Its working is also very simple.
7. **Surveying Instruments:** Various instruments used in surveying kept in a mathematics laboratory because surveying is concerned with Mathematics.
 - Angle Mirror: Which is used for laying out right angles in the field?
 - Plane table: Which is used for elementary mapping and surveying?

- Hypsometer and clinometers: These are simple devices to measure angles of elevation and depression. These can be used to measure heights and distances of objects indirectly.
 - Level: Which is an instrument used in finding differences in elevation.
 - Transit: Which is an angle measure and a leveling instrument
- 8. Projective Aids:** Various projective aids and projecting devices such as magic lantern, film-strip projector, epidiascope etc. should also be kept in Mathematics laboratory.

2.3.3 Advantages of Mathematics Laboratory

The needs and requirements of learning experiences are always flexible. A resourceful teacher should not always look to confine the practical experiences in the Mathematics to the four walls of a class room but broaden his/her student's horizons and one such means is by making use of a Mathematics laboratory

- Help in creating interest of the students.
- Help in making use of all the progressive methods of Mathematics.
- Help in the inculcation of scientific problem-solving methods.
- The theoretical concepts may be easily clarified through practical demonstration.
- It will help in training the students for the practical application of mathematical facts and principles in their life.
- It will help in satisfying the creative and constructive urges of the students.

Check Your Progress -1

Note: (a) Answer the questions given below:

(b) Compare your answers with those given at the end of the lesson:

1. What is mathematics laboratory ?

2. Name the key equipment required for establishing mathematics laboratory.

3. Use of Mathematics laboratory leads to support which approach in teaching mathematics.

2.4 AUDIO VISUAL AIDS

A fact that to keep teaching interesting and make it effective we have to make use of certain material aids. The use of these materials aids makes the teaching effective, simple and interesting. The use of sensory aids in teaching of Mathematics is of recent origin. The maths teacher we have been using text-books, writing materials Geometric instruments and the black-board since long as in used the equipment for mathematics classes. For many years resourceful teachers have been using models, instruments, drawings and other devices for stimulating interest and to facilitate learning of Mathematics. Since Mathematics is considered as a dry subject so to create interest in learning mathematics has been a constant problem for teacher. In mathematics teaching we require one or the other aid at every step.

2.4.1 Definitions of Audio Visual Aids

Some of the meaningful and purposeful definitions which are given by different authors are as under:

Burten: Audio-Visual aids are those sensory objects or images which initiate or stimulate and reinforce learning.

Kinder S. James: Audio-Visual aids are any device which can be used to make the learning experience more concrete more realistic, and more dynamic.

McKown and Roberts: Audio-Visual aids are supplementary devices by which the teacher, through the utilization of more than one sensory channel is able to clarify, establish, and correlate concepts, interpretations, and appreciations.

Meaning of Audio Visual Aids

The meaning which can be drawn from these definitions is that:

The Audio Visual Aids are sensory devices and provide sensory experience to the learner, i.e., the learner can see and hear simultaneously. At times the learner can also taste, smell, and touch, e.g., objects related to diet in nutrition class.

The sensory experience through Audio Visual Aids help teachers to clarify the spoken and written words and ideas, to establish and understand correlation of ideas (concepts)/facts, to do interpretations and thus help her to make teaching-learning more concrete, i.e., meaningful and vivid, effective and interesting.

2.4.2 Purposes of Audio Visual Aids

The Audio Visual Aids can serve two major purposes:

- 1) To supplement and enrich teacher's own teaching to make teaching-learning more concrete, i.e., meaningful, vivid, effective and interesting.
- 2) To serve an instructional role in itself, e.g., through motion picture film or television, information can be provided to students instead of teacher in the classroom.

2.4.3 Advantages of Audio Visual Aids

The Audio Visual Aids are being increasingly used in modern days in various educational programmes. It has been found that Audio Visual Aids when properly used in the teaching-learning situation can serve the following advantages:

- a. **Audio Visual aids help in effective perceptual and conceptual learning:** Audio Visual aids provide direct sensory experience by which one can see, hear, touch, taste, and smell and can acquire clear, accurate and vivid images and that results in concrete learning in the subject mathematics.
- b. **Audio Visual aids are helpful in capturing and sustaining attention of students:** Use of audio-visual aids result in clear perception and understanding of concepts through direct sensory experience of the abstract things like algebra, 3-dimensional geometry etc. in mathematics. This in turn captures and sustain students' attention in the class.
- c. **A.V. aids arouse interest and motivate students to learn:** Use of A.V. Aids in teaching-learning situations, e.g., use of 3D models and specimen to explain the structure and functions of figure and graphical representation would not only help in better understanding but it would generate interest and motivate students to learn. It would also attain sustained attention of students in the mathematics classroom.
- d. **A. V. aids help in more permanent learning:** More permanent learning is clue to motivation to learn and effective perceptual and conceptual learning through multi-sensory experience in the mathematics classroom.
- e. **A. V. aids provide opportunities for students' involvement in teaching learning situations:** There are many A.V. aids which can be handled and manipulated by students, e.g., students can touch, feel, and see a specimen, a model, a figure or picture of any graph. Properly selected A.V. aids can provide for purposeful self-activities and students participation in the learning of the subject mathematics.

- f. A.V. aids are helpful in new learning:** This is possible because A. V. aids can provide variety of experiences and stimuli to learner to fix up new learning.
- g. A. V. aids help in saving energy and time of both the teachers and students:** Energy and time of both teachers and students are saved because A.V. aids help clarify, understand, assimilate concepts, their relationships, interpretations etc. of different abstract concepts in teaching of mathematics.
- h. The A.V aids provide near reality experience:** Which stimulates self-activity on the part of students e.g. demonstration of trigonometry operations or video on 3dfigures.
- i. A.V. aids can meet individual demands:** There are variety of A.V. aids which can help in meeting the needs of different types of students. There are variety of A.V. aids which can help in meeting the needs of different types of students, e.g., audios can meet the demands of students who are ear oriented, some other students who can be helped by visual demonstration and while others can learn better by doing.
- j. A.V. aids are useful for education of masses:** As we all know that Indian classroom is of more strength thus, A.V. aids like radio, television is used for education of population at large, teleconference or counselling sessions for students in the mathematics classroom.

2.4.4 Various Teaching Aids in Teaching Mathematics:

For the sake of the convenience, all the audio-video aids are classified as under :

- 1) Audio Aids
- 2) Video or visual Aids
- 3) Audio-visual Aids

- 1) **Audio Aids: Importance and Types:** The audio materials are those which can be heard or learners' auditory sense are involved and then stimulated by materials. They include radio, tape recordings, sound distribution sets, microphones etc. which are called audio aids. In primary grades, particularly in language learning. It is very essential to strength or enrich communication skills along the -learners through various listening activities. Examples: radio, tape recorder, CD player, etc.

Radio has been playing a vital role in the field of education and Radio has established due credit in the field of education. Almost all the important centers of A.I.R. board cost programmes concerning ed/ either the regular classes on topics of mathematics are being held (or) the important discussions and speeches concerning principles and laws of mathematics, life history and contribution of mathematics, the application at mathematics in practical life are broad cast. Highly Experienced teachers, teacher educators, mathematicians and research persons take part in such programmes. The Radio as a means of communication takes their voices to the millions of students and teachers listening to their programmes.

Radio programmes are of two types. One type of radio programme is called education radio broadcasts— which provide scope for participation of teachers and students. They also supplement school activities. You along with your students may listen to the programme and take notes on them. As a follow-up activity: discuss the programme, the main events. the content: the dialogue, the characters, etc., with the students to evaluate and consolidate their learning. The second category of radio programmes are those where a general discussion on social issues. health and diseases. about the universe etc. is held. Those programmes which you consider useful for your students may be recorded and used to supplement your presentation inside the classroom.

Before you guide the learners to listen to any radio programmes, check whether -

- a) everybody has his / her own copy and pencil to take notes,
- b) learners know in general what to note down,
- c) you also have noted down a few points for a further discussion on the topic, and
- d) learners will be able to grasp the programme by listening to it once.

Tape recorder also we can use for the programmes on mathematics education. This is also used in rural areas. If the lessons are not understood for the students at a time, they record these programmes and they can listen any time. If the students miss the radio lesson for different timings, they will be able to listen in tape recorder by recording such programme.

Tape recorders run by battery are now easily available in the market. The tapes can be used again and again. The learners can tape their own singing or discussions and teachers can use this for evaluation of learners' speech. Sometimes children use some unnecessary words in the sentences. These errors can be removed with the help of the tape recorder. By using a tape recorder, you can devise a good number of programmes to develop your learner's listening skills.

Before you want to develop any programme by using the tape recorder, ensure that –

- i) the instrument(i.e., the tape recorder) is functioning properly,
- ii) the voice to be recorded is appealing and clear,
- iii) the person can pronounce well,

- iv) enough pause has been given between two recorded programmes for discussion,
- v) the tape recorder is also equipped with the battery system. If the electric current fails, it can run on the battery.

2) Video or visual Aids : Aids which require the involvement of learners' visual senses (senses related to "sight" or "seeing") are called visual aids. Visual aids are designed to influence the eyes of learners to enable them to understand what is being shown. In language learning, visual aids are helpful in developing language skills such as speaking and writing as they stimulate learners' sense of sight. Generally, visual aids are classified in the following two major categories:

Category 1: In this category we have aids where an electronic equipment or machine is not used. Real objects, The chalkboard, pictures, posters, charts, photographs, maps, graphs, objects, specimens, models, puppets, materials made from clay and textbook illustrations etc. are visual aids.

a) Real Objects

These are most useful and most effective means of providing direct experiences to the pupil Example to teach the area of four walls of a room we can make use of the four walls of class-room. Similarly, black-board can be used to teach the area of a rectangle.

b) Models

In order to clarify and explain the abstract things, some things concrete like models have to be presented to explain those abstract things. Models are the three-dimensional representations of the real objects. For E.g.

1. Models of geometrical solids such as cone, sphere cylinder etc. These models may be made out of card board (or) chart paper and may be used to teach topics such as area of a cone, are of a sphere, area of a cylinder etc.
2. The concept of angles can be explained easily if two strips are hinged at one end.
3. To prove that the sum of three angles of a triangle is 180 degree we can take a chart paper model of a triangle and fold it as under.
4. To find the area of a circle can be obtained by cutting a piece of cardboard. This is then cut into 8 equal parts are these parts are then assembled.

c) Charts

Charts are defined as a combination of graphic and pictorial media for the orderly and logical visualizing of relationship b/w important facts, ideas or concepts. “Edgar Dale defines a chart as a systematic arrangement of facts in a graphic (or) pictorial form, presenting for convenient reference comparisons of quantity, distribution, trends, and summaries. The charts serve the following purpose:

1. Showing relationship by means of facts, figures
2. Presenting matter or statistics symbolically, graphically
3. These are used for depicting certain important formula (or) results of mathematics.

Eg. 1

$$SI = \frac{P \times R \times T}{100}$$

Eg. 2 : Area of rectangle = length X breath.

1. Presenting abstract ideas in a visual from showing continuity in teaching – learning process and summarizing information presented.
2. Motivating and arousing students' interest.

d) Chalk – Board

Chalk-board is an integral part of the Mathematics classroom. The chalk-board should be well polished and smooth. It should be fit for writing with a chalk with the option of erasing. In some places the colour of black-board has now been made green. This has been done because the green colour is useful for eye sight. The chalk board is there to solve the Mathematical Problem and explain diagrams.

e) Flannel – Board

The flannel board consists of a piece of flannel, stretched tightly over a strong backing of plywood, pictures, cards and other similar material can be stuck on the flannel board if sand paper, felt paper (or) blotting paper are given to their back.

f) Bulletin Board

The bulletin board is used for displaying bulletins, announcements, and visual displays that are interesting to the students. Bulletin boards are usually made of wood with thick flannel cloth on them and a wooden frame running around it with a glass covering on the front side.

ADVANTAGES

1. To motivate, arouse curiosity and build enthusiasm in students.
2. To display work done by students.

3. To display graphic and pictorial material linked with the curriculum in an attractive manner.

Category 2: In this category we include those aids which are well-integrated with machines or electronic equipment. The overhead projector and the silent motion picture fall in this category.

a) Silent Motion pictures

Young learners enjoy learning through motion pictures. Silent motion pictures are those in which you can only see the pictures but you do not hear anything because there is no sound. You might have seen silent motion pictures related to the freedom struggle. You can try this by switching off the volume of your T.V. or video, where you can understand from the picture without hearing my statement, dialogue etc.

b) Overhead Projector

The overhead projector is used to show your hand-written work on a screen to be displayed before the learners. For overhead projectors there are transparency sheets on which you can write with the help of pens specially meant for writing on the transparency. OHP is a device that can project a chart, a diagram, a map, a table or for that matter anything written on a transparent sheet, onto a Screen (or) even a wall.

Advantages:

1. OHP's are usually light weight and easy to carry.
2. Teacher can always face the class.
3. Lots of time is saved as writing on black-board can be avoided.
4. There are very useful with large groups the visibility is more.

- c) **Film Strips:** - In a film strip, 15 to 20 slides concerning useful topics are photographed on a 35- or 16-mm films. These film strips are then projected on the screen through a projector. The teacher may demonstrate the pictures for any period of time irrespective of speed as the situation demands. These are light in weight and easy to transport and a large variety of information can be presented.

3) **Audio-Visual Aids: Importance and Types**

Audio-visual aids are those which require the involvement of learners' visual and audio senses (both "seeing" and "hearing").

Any programme developed to show something through my audio-visual aid calls upon learners' ability to learn through listening and viewing (seeing). Audio-visual educational programmes are so developed that these two learners' abilities are well integrated with the information or ideas contained in the lesson to be taught.

Nowadays, through television or video, written or printed documents can be shown to the viewers. It also takes care of the learners' reading skills.

At the elementary grade, you can use mainly two types of audio-visual aids. One of them is television and the other is video.

i) **Television**

Television is an exciting means of communication. Useful programmes are being telecast regularly for children. As a teacher you should utilize the T.V. programmes and make them the basis for discussion. You may give your learners home assignments also on these programmes. Television has the greater advantages as it not only conveys the voices but the picture and actual scene also, the students sitting far away from the T.V. stations may be benefited through the telecasting programmes almost in the same way as it is happening just before their eyes. In

television the programmes on mathematical speeches, Mathematics classes for competitive exam, History of mathematics and pictures about mathematicians, and also it has shown the places about related to mathematics. Eg: Bank, Post-office, share market etc.

The teacher of mathematics should try to take advantage of such learning opportunities by making himself and his students fully conversant with such programmes

You may ask them to write the name of the serial/programme, the names of the main characters and some descriptions about them. The resourcefulness of the teacher can enable him/her to utilize school T. V. programmes for classroom instruction effectively. Nowadays we have colour television which provides colour and almost real images.

ii) Video

Teaching with the help of video is called video-aided instruction. In video-aided instruction, learners' reactions are generally ascertained through a questionnaire. Nowadays: educational video cassettes are available with video libraries in the market. The Central Institute of Educational Technology NCERT, New Delhi, and the State Institute of Educational Technology (SIET) can also provide video cassettes for the teacher's use in the classroom.

Selecting appropriate aid Knowledge about the need and types of audio-visual aids will certainly help you to select the appropriate aid for a particular topic. How can you decide what type of aid you should use in a given situation?

Giving thought to the following questions will help you select the appropriate aid.

- i) What are you actually trying to convey'?
- ii) Which aid will best serve your purpose'? Using the Audio-Visual Articles
- iii) V Which aid is easily available'?
- iv) Can it be used in the classroom situation'?
- v) Can it be used in other situations like outside the classroom etc.?
- vi) Can you use the same aid again?

2.4.5 Place of AV Aids in Mathematics:

There are so many abstractions in Mathematics which cannot be easily followed by the students. To make such abstract or complex ideas less abstract, rather concrete, teacher takes helps of various teaching aids. Thus, teaching aids are aids to imagination of pupils. The importance of teaching aids in teaching mathematics in justifies on the following considerations.

- i) They help in clear understanding of the subject and clarifying the abstract ideas.
- ii) They appeal the senses of the pupils and so they satisfy their innate tendencies and interests.
- iii) They stimulate pupil participation. They are based on the maxim, "Learning by doing".
- iv) They make the teaching-learning process interesting.
- v) They help in saving time and energy because it takes a long time in clarifies an abstract idea verbally but the point can be made clear at once by using some appropriate teaching aid.

- vi) The needs of individual students are met. Some pupils learn by listening but a majority of them learn by doing.
- vii) They help in creating a lasting impression on the mind of the learner. Things are well retained in the mind since the sensory impression is more permanent.

Check Your Progress -2

Note: (a) Answer the questions given below:

(b) Compare your answers with those given at the end of the lesson:

1. Complete the following statements:

a) Aids that are used by a teacher for effective communication are called

b) Aids which stimulate the auditory sense of learners are called

c) Aids meant to influence the sight sense are called

d) Audio-visual aids influence both the ability to
and

2. What do you mean by audio-visual aids? Write our answer in two sentences.

3. Audio Aids are more effective than visual aids. (True/False)

2.5 COMPUTER ASSISTED INSTRUCTION IN MATHEMATICS (CAI) :

With the technological advancement, computers have become important aids for teaching mathematics. A teacher of mathematics can put to use computers for a variety of purposes such as tutorial sessions, drill and practice, simulation, gaming, mathematical modelling and problem-solving. The use of computers makes the learning interactive and interesting for the students. Other than these the teacher can use the CD's prepared by the experts to enhance the quality of teaching-learning process.

The most striking innovation in the field of Mathematics is the use of computers in the instructional process. CAI is a natural outgrowth of the application of the principles of programmed instruction in mathematics. The main objective of CAI is to provide the needed flexibility for idealizing the educational process. It meets the needs of a specific learner in a way in which it is almost impossible to do so in a face to face student. Teacher relationship a computer is such a device which can cater to the needs of the individual learners by storing a large amount of information about mathematics. It can process the information suiting to the needs of the individual learner. It can cater to a great variety of educational needs that range widely with respect of educational levels, subject matter, and style of instruction and level of learning from drill and practice to problem solving.

2.5.1 Definitions:

It is the use of computer to assist in the presentation of instructional materials to a student to monitor learning process (or) TO select additional instructional material in accordance with the needs of individual learners – International dictionary of education.

2.5.2 Steps in Developing CAI:

The steps in developing CAI are more (or) less the same as those of PLM and are listed below.

- a) Planning
 - b) Preparation
 - c) Testing
- a) **Planning:** Planning a lesson for CAI involves making decisions about the following aspects.
- Nature of the target group for whom the instruction is planned: Their age, Previous level of achievement and Medium of Instruction.
 - Nature of the topic: Potential for paced, sequenced learning and Scope for using illustrations.
 - Length of the topic: Neither too long nor too short.
 - Nature of the programme: Use friendly, Opportunities for interactive learning, Visual/graphical presentation and Programming language.
- b) **Preparation:** Preparation of the lesson for CAI involves the steps, listed below.
- Stating the objectives.
 - Structuring and organizing the lesson.
 - Writing the program
 - Editing
- c) **Testing:** The programme is to be tried out and its effectiveness assessed with respect to the following.
- Program contents.
 - Content presentation and arrangement of structure.
 - Learner's motivation
 - Graphic presentation.
 - Essential elements of educational software

2.5.3 Learning Sequence of CAI: Following as the learning sequence of CAI:

- i. Orientation information:** The teacher outlines the topic and presents the objectives verbally.
- ii. Directions and procedure:** The directors embedded in the software are read and understood by the student.
- iii. Learning procedure:** The students familiarize themselves with the learning procedure.
- iv. Answering questions:** The students actively participate by answering questions and evaluate the realization of the objectives.
- v. Feedback:** The student's responses are confirmed and immediate feedback is given.
- vi. Remedial Instructions:** Remedial Instructions is provided whenever it is necessary with supplementary materials and references.
- vii. Choosing the next learning sequence:** Students choose the direction for the Next step to be taken i.e., to go to the next unit, or go back to the original unit (or) exit from the program.

2.5.4 CAI Programmes (or) Mode of CAI: There are several kinds of CAI programmes (or) modes. These are:

1. Simulation / Games
2. Tutorial.
3. Drill and practice.
4. Problem solving / Information Retrieval.
5. Demonstration and
6. Controlled learning.

- 1. Simulation/Games:** The thing that cannot be brought into a classroom (real (or) Imaginary) can be represented by simulations). It is considered to be one of the most powerful applications of educational computing.

2. **Tutorial:** Tutorial is used to teach basic concepts (or) Methods. The tutorial type utilizes written Explanations, descriptions, questions, problems and graphic illustrations for teaching concepts much like tutor.
 1. **Drill and Practice:** Drill and practice provide of practice in specific subject, solving mathematical problems and soon. Students participate and practice and receive feedback on their performance. Drill and practice play an important role in fixing the Mathematical concepts and rules and formulae in the minds of students.
 2. **Problem solving (or) Information Retrieval:** Computer provides a wide variety of problems and allows and students to focus on the synthesis of ideas and skills that lead to the solution of problems.
 3. **Demonstration:** Demonstration is considered to be the very important part in Mathematics teaching. There is so many demonstration software available through which can do demonstrations very easily.
 4. **Controlled learning:** It has of both drill and Practice with in it. The teacher may specify the topics in advance and also introduce the fundamental concepts in mathematics. Then, the students practice fundamental skills of their own.
- 2.5.5 Advantages of CAI:** The benefit advantages of CAI can be enumerated as under:
1. CAI enhances quality of education and saves instructional time.
 2. It is interactive and involves the student actively in the learning process.
 3. Learning is student-based and self-paced.
 4. Learning is more private and reinforcements are immediate.
 5. CAI is best suited for remedial teaching.
 6. CAI saves time for creative work.
 7. CAI is particularly helpful for slow learners.

8. The graphics facility is a powerful aid in enhancing intuition, especially in giving insight into mathematical formulae.

2.5.6 Disadvantages of CAI

1. There is lack of personal communication if the entire course is taught through CAI.
2. It is difficult to get suitable software for our Indian requirements.
3. Cost may be an important factor of consideration for the Indian schools as computer can be an expensive.
4. Long hours of CAI could result in fatigue.

Check Your Progress -3

Note: (a) Answer the question given below:

(b) Compare your answers with those given at the end of the lesson:

1. Write briefly the steps of Computer Assisted Instruction (CAI).

2. During this kind of method, shared information is applied and repeated.

- a) Simulation
- b) Drill and practice
- c) Games
- d) Multimedia presentations

3. Computer technology is a valuable teaching tool that can already replace the role of the teacher. (T/F)

2.6 COMPUTER ASSISTED LEARNING (CAL)

There are still good reasons to use CAL rather than internet-based technologies. CAL is run either straight from a CD or floppy disk drive or over a local network so the constrain of the internet- slow download times for multimedia

Tell me and I forget. Show me and I might remember. But involve me and I will understand.

CAL is to convey a vast amount of information in a very short period of time. It is powerful method of reinforcing concepts and topics.

“Computer assisted learning is a systematic control of instruction by computer is characterized by testing, diagnostic learning, presentation and through record keeping.”

“It is defined as one kind of learning environment in which though the use of computer technology, a learner receives, reacts to, and interacts with instructional material prepared by an instruction specialist.

“A teaching process that uses a computer in the presentation of instructional materials, often in a way that requires the students to interact with it called computer assisted learning. -Mosby’s medical dictionary

“Reduce the detrimental effects of having too much content to cover in too little time and yet provide unique educational gains through computer.” -Petty

“Interactive technique in which a computer is used to present instructional material, monitor learning, and select additional instructional material in accordance with individual learner needs.” “Computer-assisted learning (CAL) is an approach to teaching and learning in which computer technology is used as an aid to the presentation, reinforcement and assessment of material to be learned, usually including a substantial interactive element.”

“Computer Aided Learning (CAL) or Computer Assisted learning can be defined as learning or teaching subjects like mathematics, Science, Geography, and etc., through computers with subject wise learning packages/materials.

“Computer assisted learning can be defined as “learning through the new Information and Communication Technologies, as computer networks and multimedia”.

2.6.1 Types of CAL

1. Interactive video
2. Multimedia
3. Visual reality
4. Internet based

2.6.2 Advantages of CAL: Following are the advantages of CAL:

- Some so-called hard subjects, like English, Mathematics and Science will be joyful through computer.
- Better teaching learning material
- helps to reduce drop out, repetition rate. & Enhance in the achievement levels etc.,
- not only help to memorize the tough topics at ease but also it will act as a virtual laboratory experiment.
- Reduce required instruction time.
- Performing as well, compared to other more traditional education techniques.
- Provides freedom for repetition.
- It allows the learner to proceed at his own pace and offers safe practice environment and Provides private learning environment.

- It involves any student actively in the learning process.
- Reinforcement of learning in such situations is immediate and systematized.
- Frees faculty members or training coordinators to devote more time to the personal, human considerations of their students.
- CAL is very useful in remedial education.
- Interactive Access is easy and flexible.
- Supplement traditional classroom or lecture materials
- Gives prompt feedback
- More accurate monitoring of learner progress

2.6.3 Limitations of CAL

- Costly as it requires technological hardware.
- Lack of computers or resources
- Must be internally or self-motivated
- Hardware or software problems / internet connectivity
- Must be familiar computer hardware and software
- Time commitment required to prepare
- Resistance of learners and teachers
- Individual differences in learning styles

Check Your Progress -4

Note: (a) Answer the question given below:

(b) Compare your answers with those given at the end of the lesson:

1. Define Computer Assisted Learning (CAL).

2. Describe five advantages of Computer Assisted Learning (CAL) while using in TL Process

2.7 PREPARATION OF POWER POINT PRESENTATION FOR MATHEMATICS TEACHING

PowerPoint is a presentation program developed by Microsoft. It is included in the standard Office suite along with Microsoft Word and Excel. The software allows users to create anything from basic slide shows to complex presentations.

PowerPoint is often used to create business presentations, but can also be used for educational or informal purposes. The presentations are comprised of slides, which may contain text, images, and other media, such as audio clips and movies. Sound effects and animated transitions can also be included to add extra appeal to the presentation. However, overusing sound effects and transitions will probably do more to annoy your audience than draw their attention.

When presenting a PowerPoint presentation, the presenter may choose to have the slides change at preset intervals or may decide to control the flow manually. This can be done using the mouse, keyboard, or a remote control. The flow of the


presentation can be further customized by having slides load completely or one bullet at a time. For example, if the presenter has several bullet points on a page, he might have individual points appear when he clicks the mouse. This allows more interactivity with the audience and brings greater focus to each point.


2.7.1 Steps for Preparing PowerPoint in Microsoft office:

By following the below mentioned steps one can prepare the PowerPoint but it won't be covered in these limited directions. What follows will only give you a jumping off point. Experimenting with the transitions, animations, and other features will only make you more comfortable with the program. Please be encouraged to do so.

- **Start by opening a “Blank presentation” in PowerPoint.** When you first open PowerPoint, you will have the options of using the AutoContent wizard, a Template, or a Blank presentation. At some point you should experiment with the first two options, but for now, simply select “Blank presentation,” then click on the “OK” button.
- **Select the “Title Slide” option.** We will be coming back to this window later to select other styles of slides from the palette. Since we are just beginning, click on the option in the top left corner. You will notice that the name for that particular slide layout appears in the box in the bottom right corner. **Click “OK.”**
- **Type in your title and subtitle.** Simply click in the box and start typing. If you don't have a subtitle, you can leave it blank.
- **Select a background for the entire presentation.** Under the “Format” menu select “Background.” Click on the bar under the sample slide, and select “Fill Effects.” Play with the Gradients, Textures, and Patterns which can be accessed by clicking on the tabs at the top of that window. Once you have selected a background you like, click on

“OK.” Then click the “Apply to All” button. This will put the same background on all of your slides. (Consistency is important!)

- **Add new slides.** Under the Insert menu, select “New Slide” or click on the  icon on the button bar across the top of the screen. (Getting to know these buttons can save lots of time in using any program.) Once again you see the “New Slide” palette. You may try any of these slide templates. In fact, why not take a few minutes to click on each one to see what they are. Remember that the name of each template will show up at the bottom left corner of the window. If you use any of the slides with clip art, you will be prompted to click on an area in the slide to select the clip art that you want placed there. **Create all of the slides you want in your presentation before going on to the next step.**
- **Set the transitions for your slides.** You will first want to select a slide. The best way to do this is from the slide sorter view.

To get there, click on the  icon in the bottom left corner of the screen. This will allow you to see all of your slides at once. Click once on the first slide to select it. (Double-clicking on a slide will open that slide.)

2.7.2 Advantages of Using Power Point in Teaching Mathematics:

1. With the help of power point mathematics can be taught effectively.
2. Power point allows us to animations, time settings, sounds, diagrams etc.
3. Which attract the student and all sense organs will be effect.
4. Power point is the presentation software used to create slides, handouts and speaker notes.
5. Power point helps the user to prepare, update and order slide-based presentation material quickly.

6. Organizing and re-organizing information effectively. So that students see the structure of a classroom teaching in Mathematics.
7. Providing more time for listening and comprehending so that class time is used effectively.
8. Providing enhanced legibility and read ability.
9. Illustrating concepts with pictures and other multimedia.
10. Merging text, graphics, sound, multimedia, offering control and visual dynamics.
11. Allowing the teacher easily to modify/enhance slides and lecture notes.
12. Allowing the teacher to face the students.
13. Presenting out lines of information in a sequential manner.

Check Your Progress -5

Note: (a) Answer the question given below:

(b) Compare your answers with those given at the end of the lesson:

1. What is Power Point Presentation?

2. PPT helps in making the mathematics classroom more

3. Microsoft PowerPoint Presentation is a

- a) Database Programme
- b) Spreadsheet Programme
- c) Presentation Programme
- d) Word Processing Programme

2.8 LET US SUM UP

Mathematics teaching in today's school is textbook dominated, concerned primarily with the manipulation of symbols and all too often largely removed from the real world of the child. In this unit, we have discussed the meaning and various types of audio-visual aids which can be used in teaching mathematics so that there is proper mathematical skill to be developed among the learners. The need for using such aids has also been discussed. Audio-visual aids help in communication, retention and providing more information in less time. We have also discussed the importance of audio aids, visual aids and audio-visual aids separately. In spite of this, computer assisted instruction and learning has also been discussed. A teacher of mathematics can put to use computers for a variety of purposes such as tutorial sessions, drill and practice, simulation, gaming, mathematical modelling and problem-solving. The use of computers makes the learning interactive and interesting for the students. Other than these the teacher can use the CD's prepared by the experts to enhance the quality of teaching-learning process.

2.9 LESSON END EXERCISE

1. What are audio-visual aids'?
2. What is the need to use audio-visual aids'?
3. What is the difference between audio and visual aids'?
4. 'List the various steps which is used in formation of PPT.
5. Describe briefly the mode of CAI.
6. What are the advantages of mathematics laboratory in teaching mathematics ?

2.10 SUGGESTED FURTHER READINGS

Dahama, O.P., & Bhatnagar, O.P. (2007). *Education and Communication for Development*.

New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.

Leagans, J.P. (1961). *Extension Teaching Methods. In Extension Education in Community Development, Directorate of Extension, Ministry of Food and Agriculture, New Delhi: Government of India.*

Reddy, Y.N. (1998). *Audio Visual Aids in Teaching Training and Extension.* Hyderabad: Haritha Publishing House.

2.11 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress-1

1. Mathematics laboratory is a place rich in manipulation materials to which children have ready access to handle them, perform mathematical experiments, play mathematical games, solve mathematical puzzles and become involved in other activities.
2. Concrete Materials, Charts, Pictures and photographs, Models, Equipment and Materials Concerning other Subjects, Proportional Dividers, slide rules, is calculating Machines etc, Surveying Instruments, Projective Aids
3. Multi-sensory learning approach.

Check Your Progress-2

1.
 - a. Audio Visual Aids
 - b. Audio Aids
 - c. Visual Aids
 - d. Listen and See
2. Audio-visual aids are those which require the involvement of the learners' visual and audio senses (both "seeing" and "hearing").
3. False

Check Your Progress -3

1. The steps in developing CAI are more (or) less the same as those of PLM and are listed below.
 - a) Planning
 - b) Preparation, and
 - c) Testing
2. b. Drill and Practice
3. False

Check Your Progress-4

1. It is defined as one kind of learning environment in which through the use of computer technology, a learner receives, reacts to, and interacts with instructional material prepared by an instruction specialist.
2. Following are the advantages of the CAL:
 - a) CAL is very useful in remedial education.
 - b) Interactive Access is easy and flexible.
 - c) Supplement traditional classroom or lecture materials
 - d) Gives prompt feedback
 - e) More accurate monitoring of learner progress

Check Your Progress-5

1. The presentations are comprised of slides, which may contain text, images, and other media, such as audio clips and movies.
2. Effective
3. C.

EVALUATION OF TEXT BOOK OF MATHEMATICS

Structure

- 3.1 Introduction
- 3.2 Objectives
- 3.3 Meaning of Textbook Evaluation
- 3.5 Need of Textbook Evaluation
- 3.6 Qualities of a Good Textbook
- 3.6 Criteria for Textbook Evaluation
- 3.7 Evaluation Of Mathematics Textbook Of Class VII Prescribed By JKBOSE
And CBSE
- 3.8 Let Us Sum Up
- 3.9 Lesson End Exercise
- 3.10 Suggested Further Readings
- 3.11 Answers to Check Your Progress

3.1 INTRODUCTION

Mathematics remains a key subject in school education and textbooks are an important part of school education. Textbooks provide a framework for what is taught and how it is taught. Textbooks also impart a sequence that is followed in a particular subject. Given the sequential nature of mathematics, the mathematics textbook becomes a vital component for mathematics achievement. The National Policy on Education stresses on learning mathematics as a compulsory subject up to class X. It is also imperative to see to what extent the school mathematics textbook reflects the changes in the mathematics curriculum that have taken place. A textbook should stimulate problem-solving ability among students. The textbook should present real learning situations which are challenging and interesting for the students.

3.2 OBJECTIVES

After going through this lesson, you shall be able to:

- describe the meaning of textbook evaluation,
- identify the need of textbook evaluation,
- describe the qualities of a good textbook, and
- explain the criteria for evaluation of textbooks.

3.3 MEANING OF TEXTBOOK EVALUATION

The term “evaluation” generally applies to the process of making a value judgment. According to **Hutchinson and Waters (1987)**, “Evaluation is the matter of judging the fitness of a something for a particular purpose”. Textbook evaluation means determining the efficacy, value, etc. of textbooks with respect to stated objectives, standards or criteria. “Textbook evaluation is basically a straightforward, analytical matching process: matching needs to available solutions.” (**Hutchinson and Waters 1987:97**)

The selection of the best suitable book for a particular context demands careful investigation. In the selection of a textbook, it is important to conduct an evaluation to ensure that whether it is suitable or not. In addition to being a learning instrument, textbooks are also used as supporting teaching instruments. Textbook has to play a vital role in our education system. The aims of education cannot be achieved if we provide poor quality of text books to our students.

3.4 NEED OF TEXTBOOK EVALUATION

Then main purpose of evaluating the textbook is selection, improvement and research. Evaluation of textbooks takes into account the objectivity of different aspects of textbook, needs of the learner, requirement of the subjects, interpretativeness of the criteria and effectiveness in teaching learning situation.

Textbooks are part and parcel of curriculum implementation process. In fact textual material plays vital role in achieving the objectives of the curriculum. Effective learning occurs only when there is combination of good teachers, motivated students and appropriate, well graded textbooks. Textbook evaluation provides the opportunity for the teachers, supervisors, administrators and material developers to make judgment about the textbooks and how to choose them for the learners.

According to Sheldon (1988), we need to evaluate textbooks for two reasons. First, the evaluation will help the teacher or program developer in making decisions on selecting the appropriate textbook. Furthermore, evaluation will familiarize the teacher with its content and consequently assist educators in identifying the particular strengths and weaknesses in textbook already use. The evaluation of textbook therefore deserves serious consideration since an inappropriate choice may waste funds and time and has a demotivating effect on students and possibly teachers.

Check Your Progress-1

Notes: a) Write your answers in the space given below:

b) Compare your answers given at the end of the lesson.

1) What do you mean by textbook evaluation ?

2) Why is textbook evaluation needed ?

3.5 QUALITIES OF A GOOD TEXTBOOK OF MATHEMATICS

The text book of Mathematics should have following qualities which may be described as below :

A Subject matter:

- 1. Its usefulness:** The subject matter of the textbook should have a direct, practical and social utility value.
- 2. Proper organization:** Content in a good textbook is organized according to psychological consideration. There is sufficient provision for revision, practice and review.
- 3. Coverage of the prescribed syllabus:** It should be written according to the prescribed syllabus and every aspect of the syllabus should be adequately covered.

4. **Accordance with standard of students:** It should be child centered. It should have written in accordance with the aims and objectives of teaching the subject in that particular class/standard.

5. **Logical and psychological sequence of presentation:** A good textbook should satisfy the individual differences in the students and should meet the varying abilities, interests and attitudes. The subject matter should be arranged from simple to complex and concrete to abstract.

6. **Up-to-date content:** It should include the recent changes and developments in the field of mathematics relating to the content dealt with.

B. Language and style:

1. **Simple and clear language:** The language in a good textbook is simple and easily understandable and within the grasp of the pupils.

2. **Simple language of question:** The questions should be written in lucid, simple, precise and scientific language.

3. **Number and type of questions:** It should provide an adequate number of worked out problems and problems that reflect daily life situations requiring the students to apply mathematical principles and formulae for their solution. The questions should develop thinking and reasoning power of the pupils.

4. **Use of well-defined and authorized technical words:** The terms and symbols should be used which are popular and internationally accepted.

5. **Free from errors and mistakes:** Questions should be clear and appropriate. The answers given at the end should be correct.

C. Appearance and Cost :

1. **Impressive get up:** It should have appealing and attractive cover page.

2. **Good and mistake less printing:** The printing should be bold and mistake less.

3. **The type of print according to age group of students:** The print of the textbook should be easily readable by the students. It should be bulky and thick and within the grasp of students.
 4. **Clear printing of figures and graphs:** there should be clear figures and graphs wherever needed.
 5. **Use of good paper:** The paper used in the textbook should be of superior quality. The binding should be strong and durable.
- D. Author and publication:**
1. **Qualification:** A qualified, competent and experienced teacher should write it. A certain minimum academic and professional qualifications may be prescribed for the authors.
 2. **Expert of the subject & specialization:** It should be written by committee of experts constituted by the government.
 3. **Reputation the publisher:** It should be published by a reputed author with an experience of publication.
 4. **Year of publication:** Year of publication of book should be well specified on the book.

Check Your Progress-2

Notes: a) Write your answers in the space given below:

b) Compare your answers given at the end of the lesson.

1) What are the major quality aspects of a textbook ?

3.6 CRITERIA FOR TEXTBOOK EVALUATION

Generally the tools that are used in evaluation of a textbook are report card, scoring card, scoring sheets, profile, observation schedule, analysis sheets, evaluation perform, questionnaire, checklist and rating scale.

Evaluation of textbook is a cooperative endeavor. It can neither be left to the opinion of experts nor can it be left to the decision taken on the basis of the liking or disliking of teachers or taught. The panel of experts through the process of try out, pooling the opinions of teachers, supervisors and pupils can evaluate it. Following points are taken into consideration while evaluating a textbook.

It has been observed that the procedures followed by State Education Department for evaluation of textbook have a number of defects. Firstly the same review form; scorecard is used for all grades which leads to defective assessment because the objectives, choice of content etc. differ from grade to grade. Secondly due to lack of specialization in these form cards only vague opinion can be expressed such as style is defective or printing is proper etc. it is not possible to indicate on those form cards certain qualitative aspects of textbooks. Lastly, arbitrary weightage is given to various aspects of textbooks evaluation e.g. conformity to syllabus may be assigned 5 marks, while emphasis on organization, language etc. may be assigned 10 marks. The type of weightage is subjective and not reliable.

Below is given one evaluation scale for evaluating the textbooks in mathematics. This scale contains 47 statements distributed over eight aspects of the textbook. Textbook is evaluated on the basis of five points i.e. 5- excellent, 4- satisfactory, 3- average, 2- below, 1-poor.

Aspects	Statements	Grades
1.	Physical Aspects	
1.	The size of the textbook is quite, adequate to the level of the pupils.	5 4 3 2 1
2.	The type of the syllabus is adequate to the age level of the pupils.	5 4 3 2 1
3.	The textbook is revised from time to time.	5 4 3 2 1
4.	The book is published by authentic publishers.	5 4 3 2 1
5.	The binding of book is durable.	5 4 3 2 1
6.	The paper used is durable, attractive and facilitates reading.	5 4 3 2 1
7.	Proportionate margin is left for students to note the important points.	5 4 3 2 1
2.	General Nature	
8.	Experience and qualifications of the author are up to the mark.	5 4 3 2 1
9.	The objectives are clearly defined in preparing the book.	5 4 3 2 1
10.	The table of content is presented attractively and comprehensively.	5 4 3 2 1
11.	A list of illustration is given in the book.	5 4 3 2 1
12.	Answers are accurate and correct.	5 4 3 2 1
3.	The Nature of Content	
13.	The material presented is up-to-date.	5 4 3 2 1
14.	The material presented is accurate.	5 4 3 2 1

15. Style of writing is simple and within the level of understanding of pupils. 5 4 3 2 1

16. The material given in the book confirm to the prescribed syllabus. 5 4 3 2 1

4. Organization

17. The chapters are divided chronologically. 5 4 3 2 1

18. All the topics of syllabus are given adequate and proportionate weightage. 5 4 3 2 1

19. Content is correlated with other branches of mathematics and with other subjects. 5 4 3 2 1

20. The textbook provides for individual differences in terms of interests, needs and abilities. 5 4 3 2 1

21. Hints of difficult questions for teachers are given. 5 4 3 2 1

22. The generalization are supported by facts. 5 4 3 2 1

23. There is provision within the textbook for drill and review. 5 4 3 2 1

5. Illustrations

24. The space devoted to illustrations is in proportion to the demand of the grade level. 5 4 3 2 1

25. There is use of visual aids, charts, graphs, diagrams, pictures to give the meaning. 5 4 3 2 1

26. The depiction of illustration is clear, accurate. 5 4 3 2 1

6. Reference

- | | | | | | | |
|-----|---|---|---|---|---|---|
| 28. | References for pupils and teachers are given. | 5 | 4 | 3 | 2 | 1 |
| 29. | A bibliography is given at the end. | 5 | 4 | 3 | 2 | 1 |

7. Style

- | | | | | | | |
|-----|---|---|---|---|---|---|
| 30. | The expression is clear, logical, simple. | 5 | 4 | 3 | 2 | 1 |
| 31. | Symbols used in the book are internationally accepted. | 5 | 4 | 3 | 2 | 1 |
| 32. | Graded exercises for weak, average and gifted students are presented. | 5 | 4 | 3 | 2 | 1 |
| 33. | Not too much examples are given | 5 | 4 | 3 | 2 | 1 |
| 34. | The vocabulary norms are satisfactory | 5 | 4 | 3 | 2 | 1 |
| 35. | Practical application is emphasized | 5 | 4 | 3 | 2 | 1 |
| 36. | Problems are related to real life situations | 5 | 4 | 3 | 2 | 1 |

8. Instructional Aids

- | | | | | | | |
|-----|--|---|---|---|---|---|
| 37. | A list of individual and group activities is given | 5 | 4 | 3 | 2 | 1 |
| 38. | Directions for further study are given | 5 | 4 | 3 | 2 | 1 |
| 39. | Exercises contribute to problem solving and other skills | 5 | 4 | 3 | 2 | 1 |
| 40. | Suggestions for using instructional aids are given | 5 | 4 | 3 | 2 | 1 |
| 41. | Exercises serve the need and interest of the pupils. | 5 | 4 | 3 | 2 | 1 |

9. General

- | | | | | | | |
|-----|---|---|---|---|---|---|
| 43. | On the whole textbook is accepted and appreciated by the reviewer | 5 | 4 | 3 | 2 | 1 |
|-----|---|---|---|---|---|---|

- | | | |
|-----|--|-----------|
| 44. | The book is written with progressive out look | 5 4 3 2 1 |
| 45. | The price is reasonable | 5 4 3 2 1 |
| 46. | It helps in achieving the aims and objectives of teaching mathematics | 5 4 3 2 1 |
| 47. | There is provision for the use of inductive, analytic, laboratory, heuristic and project methods | 5 4 3 2 1 |

3.7 EVALUATION OF MATHEMATICS TEXTBOOK OF CLASS VII PRESCRIBED BY JKBOSE AND CBSE

Both textbooks are attractively presented and are student friendly. They are a part of a series which is in keeping with the continuing and developing nature of mathematics. The covers are colourful with the name and series number printed clearly. Text are interposed with diagrams, sketches and pictures which improve the readability of text. Both books deviate from the traditional type of mathematics textbook which consisted of text only. In the NCERT book guide lines for the teachers is given at the beginning of the book, while they are presented in the last page with additional notes for the teachers interposed within the lesson themselves at various places.

There is a conventional content page in both books but the presentation of the topics, is dissimilar. The NCERT book is divided into chapters, there is a brief review and revision of the topic, then the topics are presented with a considerable number of solved and practice exercises. However in the JKBOSE book the contents are presented as a sequence of chapters with a brief review and revision of the previous topic. These lessons are repeated gradually developing in depth and difficulty. Answers to exercises are provided in both the books. In terms of topics covered there is not much variance in books. As an example it is seen that rational numbers fractions, decimals, exponents and powers and their operations, being common to both in the chapters on numbers. Group activities with the numbers before formal exercises are a common feature in both books. The ideas introduced in initial chapters are used later

on for understanding new concepts. Student exercises for each topic introduced are given for drill and practice.

Both books lay emphasis on underlying mathematical ideas in addition to knowing just the procedure by the inclusion of word problems in exercises. But the NCERT book is more rigorous and comprehensive in its approach. Each new concept is introduced with a number of solved examples and definition. Also there are a considerable number of practice exercises for the student. Again the same concept is also introduced in more than one way. More stress is laid on activity based learning and group activity.

Thus it is seen that though there are topics which are common to both books there are also certain dissimilar topics. However keeping in mind the continuing nature of mathematics, it is to be understood that a single textbook for a particular class does not impart all the concepts of school geometry. The mathematics textbooks are published as a series and the student has to consult the entire series of books for an in-depth understanding of the subject.

3.8 LET US SUM UP

It has widely been accepted that textbook are essential component of teaching learning process. Evaluation of textbooks, therefore, is of utmost importance so that its pedagogical contribution to the teaching learning process can be assured. Good textbooks can play a central role in improving mathematics education for all students. The quality of mathematics textbooks should be judged mainly on their effectiveness in helping students to achieve important mathematics learning goals for which there is a broad national consensus. An in-depth analysis of much more than a textbook's content coverage would be required to evaluate whether there is potential for students' actually learning the desired subject matter. Evaluation of textbook is a cooperative endeavor. It can neither be left to the opinion of experts nor can it be left to the decision taken on the basis of the liking or disliking of teachers or taught. The panel of experts through the process of try out, pooling the opinions of teachers, supervisors and pupils can evaluate it.

3.9 LESSON END EXERCISE

- 1) Describe in detail the qualities of a good textbook.
 - 2) Explain the criteria for evaluating a mathematics textbook.
-

3.10 SUGGESTED FURTHER READINGS

Cunningsworth, A. (1995). *Choosing your Coursebook*. Oxford: McMillan Heineman.

Dendrinis, B. (1992). *The EFL Textbook and Ideology*. Greece: N.C. Grivas Publications Educater, D. (2002). *Textbook Selection for the ESL Classroom*. Retrieved from <http://www.cal.org/resources/digest/0210>.

Faunce, R.C., & Johnson (1952). *Students Activities in Secondary School*. New York: Ronald Press.

Gakhar, S. C., & Baliya, J.N.(2004). *Teaching of Mathematics*. Panipat: N.M. Publication.

Litaz, D. (2001). *Textbook Evaluation and ELT Management*. Retrieved from http://www.asian-efl-journal.com/Litz_thesis.pdf.

Russel, J. (2004). *Teaching of Mathematics*. New Delhi: Campus Book International.

Schon, D. A. (1996). *Educating the Reflective Practitioner: Toward a new design for teaching and learning in the professions*. San Francisco: Jossey Bass, Inc.

Sharma, N. (2015). *Professional Development of Teacher*. New Delhi: New Delhi Publishers.

Vartanian, P. (1962). *Criteria and Techniques for Textbook Evaluation, The Social Studies*.

53:4, 123-127, DOI: 10.1081/00220973.1941.11018465.

3.11 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress-1

- 1) Textbook evaluation means determining the efficacy, value, etc. of textbooks with respect to stated objectives, standards or criteria. “Textbook evaluation is basically a straightforward, analytical matching process: matching needs to available solutions.” (Hutchinson and Waters 1987 :97)
- 2) Then main purpose of evaluating the textbook is selection, improvement and research. Evaluation of textbooks takes into account the objectivity of different aspects of textbook, needs of the learner, requirement of the subjects, interpretativeness of the criteria and effectiveness in teaching learning situation.

Check Your Progress-2

- 3) I Subject matter II Language and style
 III Form of price IV Author and publication

Structure

- 4.1 Introduction
- 4.2 Objectives
- 4.3 The Statistics- Central Tendency
 - 4.3.1 Definition of Statistics
 - 4.3.2 Types of Statistics
- 4.4 The Arithmetic Mean
 - 4.4.1 Calculation of Mean from Ungrouped Data
 - 4.4.2 Calculation of Mean from Grouped Data by
- 4.5 Median and
- 4.6 Mode
- 4.7 Graphical Presentation of Data (Bar Graph, Histogram and Frequency Polygon)
- 4.8 Let Us Sum Up
- 4.9 Lesson End Exercise

4.10 Suggested Further Readings

4.11 Answers to Check Your Progress

4.1 INTRODUCTION

In this unit we shall discuss the various aspects of descriptive statistics, particularly how to organize and describe the data. The word statistics has different meaning to different persons. Knowledge of statistics is applicable in day to day life in different ways. In daily life it means general calculation of items, in railway statistics means the number of trains operating, number of passenger's freight etc. and so on. Thus, statistics is used by people to take decision about the problems on the basis of different type of quantitative and qualitative information available to them. However, in behavioral sciences, the word 'statistics' means something different from the common concern of it. Prime function of statistic is to draw statistical inference about population on the basis of available quantitative information. Overall, statistical methods deal with reduction of data to convenient descriptive terms and drawing some inferences from them. This unit focuses on the above aspects of statistics.

You will also go through the examples to solve central measure tendency that mean, median and mode so that you will learn procedure or methods of calculating these measures of central tendency.

4.2 OBJECTIVES

After going through this lesson, you shall be able to:

- define the term statistics,
- calculate mean for ungrouped data and ungrouped data,
- work out the median for grouped and ungrouped data,
- find out the mode for grouped and ungrouped data
- make the graphical representation of the data through bar graph, histogram and frequency polygon.

4.3 THE STATISTICS

The word statistics has been derived from Latin word 'status' or Italian 'Statista' meaning statesman. Professor Gott Fried Achenwall used it in the 18th century. During early period, these words were used for political state of the region. The word 'Statista' was used to keep the records of census or data related to wealth of a state. Gradually, its meaning and usage extended and there onwards its nature also changed.

4.3.1 Definition of Statistics

Statistics deals with classification, tabulation and analysis of numerical facts. Different statistician defined this aspect of statistics in different ways.

For example. A. L. Bowley gave several definitions of Statistics:

“Statistics may be called the science of counting”. This definition emphasizes enumeration aspect only.

In another definition he describes it as “Statistics may rightly be called the science of average”.

At another place Statistics is defined as, “Statistics is the science of measurement of social organism regarded as a whole in all its manifestations”.

All three definitions given by Bowely seem to be inadequate because these do not include all aspects of statistics.

According to Selligman “Statistics is the science which deals with the methods of collecting, classifying, presenting, comparing and interpreting numerical data collected to throw some light on any sphere of enquiry”.

Croxtton and Cowden defined “statistics as the collection, presentation, analysis, and interpretation of numerical data”.

4.3.2 Types of Statistics

After knowing the concept and definition of statistics, let us know the various types of statistics. Though various bases have been adopted to classify statistics, following are the two major ways of classifying statistics: (i) On the basis of function and (ii) On the basis of distribution.

I. On the Basis of Functions

As statistics has some particular procedures to deal with its subject matter or data, three types of statistics have been described.

- A. **Descriptive Statistics:** The branch which deals with descriptions of obtained data is known as descriptive statistics. On the basis of these descriptions a particular group of population is defined for corresponding characteristics. The descriptive statistics include classification, tabulation measures of central tendency and variability. These measures enable the researchers to know about the tendency of data or the scores, which further enhance the ease in description of the phenomena.
- B. **Correlational Statistics:** The obtained data are disclosed for their inter Introduction to Statistics correlations in this type of statistics. It includes various types of techniques to compute the correlations among data. Correlational statistics also provide description about sample or population for their further analyses to explore the significance of their differences.
- C. **Inferential Statistics:** Inferential statistics deals with the drawing of conclusions about large group of individuals (population) on the basis of observations of few participants from them or about the events which are yet to occur on the basis of past events. It provide tools to compute the probabilities of future behavior of the subjects.

II. On the Basis of Distribution of Data

Parametric and nonparametric statistics are the two classifications on the basis of distribution of data.

- a) **Parametric Statistics** is defined to have an assumption of normal distribution for its population under study. “Parametric statistics refers to those statistical techniques that have been developed on the assumption that the data are of a certain type. In particular the measure should be an interval scale and the scores should be drawn from a normal distribution”.

There are certain basic assumptions of parametric statistics. The very first characteristic of parametric statistics is that it moves after confirming its population’s property of normal distribution. The normal distribution of a population shows its symmetrical spread over the continuum of -3 SD to $+3$ SD and keeping unimodal shape as its mean, median, and mode coincide. If the samples are from various populations then it is assumed to have same variance ratio among them. The samples are independent in their selection. The chances of occurrence of any event or item out of the total population are equal and any item can be selected in the sample. This reflects the randomized nature of sample which also happens to be a good tool to avoid any experimenter bias.

In view of the above assumptions, parametric statistics seem to be more reliable and authentic as compared to the nonparametric statistics. These statistics are more powerful to establish the statistical significance of effects and differences among variables. It is more appropriate and reliable to use parametric statistics in case of large samples as it consists of more accuracy of results. The data to be analyzed under parametric statistics are usually from interval scale.

However, along with many advantages, some disadvantages have also been noted for the parametric statistics. It is bound to follow the rigid assumption of normal distribution and further it narrows the scope of

its usage. In case of small sample, normal distribution cannot be attained and thus parametric statistics cannot be used. Further, computation in parametric statistics is lengthy and complex because of large samples and numerical calculations. T-test, F-test, r-test, are some of the major parametric statistics used for data analysis.

- b) Nonparametric statistics** are those statistics which are not based on the assumption of normal distribution of population. Therefore, these are also known as distribution free statistics. They are not bound to be used with interval scale data or normally distributed data. The data with non-continuity are to be tackled with these statistics. In the samples where it is difficult to maintain the assumption of normal distribution, nonparametric statistics are used for analysis. The samples with small number of items are treated with nonparametric statistics because of the absence of normal distribution. It can be used even for nominal data along with the ordinal data. Some of the usual nonparametric statistics include chi-square, Spearman's rank difference method of correlation, Kendall's rank difference method, Mann-Whitney U test, etc.

Check Your Progress -1

Note: (a) Answer the question given below:

(b) Compare your answers with those given at the end of the lesson:

1. State true/false for the following statements
 - a. Parametric statistics is known as distribution free statistics. (T/ F)
 - b. Nonparametric tests assume normality of distribution (T/F)
 - c. T test is an example of parametric test (T/F)
 - d. Parametric tests are bound to be used interval scale. (T/F)
 - e. Descriptive statistics describes the tendency or variance of the scores in a distribution. T/F

Symbols Used in Calculations of Measures of Central Tendency

Let us get familiar with symbols which we will use in Calculating measures of Central tendency. Some of the symbols that you should know are given below:

Σ = Sum of (Add are the score)

N = The total number of observations

X = Raw scores of $X_1 \dots X_n$

M = Mean of the sample

Σx = the sum of X

4.4 THE ARITHMETIC MEAN

4.4.1 Calculation of Mean from Ungrouped Data

Example An academic achievement test was administered on 10 students and they obtained following (hypothetical) scores. 18,17,14,14,17, 15, 16, 19, 12 & 18

{The formula for calculating mean for ungrouped data is } $M = \Sigma X / N$

Sum of $X_1 + X_2 + X_3 + \dots + X_{10}$

$M = \Sigma X / N$

N = Total number of students.

Calculation: The mean will be

$18+17+14+14+17+15+16+19+12+18 = 160$

$M = \Sigma X / N = 160 / 10 = 16$

Mean = 16

Steps involved in computing means for ungrouped data are given below:

- 1) Add up all the scores of all the students.
- 2) Divide this sum by the number of students whose scores have been added.

4.4.2 Calculation of Mean from Grouped Data by

- a) Long Method:** When we have large data, it would take a long time adding up all the scores of all the students. Let us say there are 100 students whose scores are given, and to physically or manually add these scores is rather difficult. So, we group them into smaller divisions and then try to find the Mean for this. The manner in which we group the data is as given below.

Take the lowest score and the highest score.

Decide how many categories of the data you want.

Let us say you want to have 5 groups in all and the data (marks) ranges from 130 to 190 for a total of 100 students.

Now work out the difference between the lowest and the highest score which is = 60.

You need 5 categories, that means we need $60 / 5 = 12$ values in each category.

Now we group the data into a frequency distribution, as follows,

Categories of marks	No. of students(f)	Mid-point (X)	fX
130-141	25	36	900
142-153	20	48	960
154-165	30	60	1800
166-177	10	72	720
178-189	15	84	1260
Total	100		$\Sigma fX = 5640$

In the above the marks of 1000 students have been grouped into 5 categories. In each category the class interval (the difference between low and high scores is 12). In this you can also have 30-40, 40-50, 50-60, 60-70, 70-80 and 80-90. You have to see how many students fall in each category, that is the frequency for each category.

Calculation of Mean by long method:

$$\text{Mean} = \Sigma fX / N$$

Mid-point for each class interval = X

N=The total number of observations =100

ΣfX =Sum of the midpoints weighted by their frequencies. = 5640

Let us now calculate the Mean

$$\text{Mean} = \Sigma fX / N = 5640 / 100 = 56.4$$

Thus, the Mean marks obtained by this group of students = 56.4

b) Short Method

In the table given above, the Mean was calculated by long method. But sometimes we have to handle large numbers or midpoints whose values are in points, then further calculations become tedious, and hence the short method has been devised for calculating the Mean.

Remember that the short method does not apply to the calculation of the median or mode.

The most important point to remember in calculating the means by short method is that we assume a mean at the outset. There is no set rule for assuming a mean. The best plan is to take the midpoint of an interval somewhere near the center of the distribution or midpoint of that interval which contains the largest frequency.

The following formula is used to calculate means by short method or assumed means method.

AM = Assumed Mean

$X' = (X - AM)$ the difference between the assumed mean and the actual scores of each category. $\Sigma fx'$ = the difference obtained weighted with the frequency of that category or interval.

i = class interval

$$M = AM + \frac{\Sigma fx'}{N} \times i.$$

N = the no. of cases that is the total number of subjects.

The use of this formula can be easily understood through the following illustration:

Table: Calculation of Mean by short method with Assumed Mean

Class Interval	Mid-Point (X)	F	x'	Fx'
195-199	197	2	5	10
190-194	192	1	4	4
185-189	187	5	3	15
180-184	182	4	2	8
175-179	177	9	1	9
170-174	172	10	0	0
165-169	167	5	-1	-5
160-164	162	3	-2	-6
155-159	157	5	-3	-15
150-154	152	3	-4	-12
145-149	147	2	-5	-10
140-144	142	1	-6	-6
		N = 50		$\Sigma Fx' = -8$

In the above table the class interval 170-174 has the highest frequency of 10 and so we can assume the mean to be 172.

From 172 we go up by one point each, then we get 1,2,3,4,5.

As we go down by one point each from 172, we get -1, -2, -3, -4, -5, -6.

Thus, we have f the frequency and x the difference in the scores by 1-point difference towards up and down the AM.

Now to calculate $\sum fx'$ = we have 10, 4, 15, 8, 9, 0 all these are positive as they are taken up from the AM. Sum of these $fx' = 46$.

The other set we have of fx is the minus scores as we go down the AM and these are -5,-6,-15,-12,-10,-6, Sum of these $fx = -54$

The $\sum fx = -54 + 46 = -8$.

Now the correction has to be inserted as we took above and below mean 0,1,2,3, etc., which in the real sense would have been the actual difference. We had taken the difference without the class interval of 5 and so we have to add the correction here so that we know how much distance from the assumed Mean is the actual mean.

For this correction we take the $\sum fx'$ and multiply by class interval of 5 and divide by the total number 50

$$\sum fx' \times i = -8 \times 5 = -40 / 50 = -0.8.$$

$$\text{Actual Mean} = \text{AM} + \text{correction} = 172 - 0.8 = 171.2$$

Steps

Find out mid-point of each class interval (X)

Assume one value as mean in table the largest f is on intervals 170-174, Which also happens to be almost in the center of the distribution, 172 is taken as AM.

Find out the difference between mid-point and assumed mean and divide it by class interval x) eg. $177-172 = 5 / 5 = 1$

Multiply each x by f respective frequencies (fx').

Find the algebraic sum of the plus and minus fx' divide this sum by N . sometime $\sum fx'$ will be positive and sometimes negative.

Multiply this value by class interval. This gives the correction to be applied to the Assumed Mean

The assumed Mean + correction = the Actual Mean

Check Your Progress -2

Note: (a) Answer the questions given below:

(b) Compare your answer with those given at the end of the lesson:

1. An aptitude test was administered on 10 students, they obtained following scores on the test, find out the mean aptitude score.

72, 78, 88, 92, 96, 70, 78, 76, 81, 79

4.5 THE MEDIAN

a) **Computation of Median for Ungrouped Data** For ungrouped data two situations are there in the calculation of the median.

- When N is odd, and
- When N is even.

Where, **N is odd** median can be calculated by formula

$Mdn = (n+1)/2$ th item

Example: Suppose we have the following scores, 18, 19, 15, 16, 19, 20, 12

First, we will arrange the above scores in ascending order 12, 15, 16, 18, 19, 19, 20

Here $N=7$ ($N+1)/2$ th = 4 the 4th item i.e. 18 is the median. The score 18 lies in the middle of the series. Three scores lie above and three scores lie below 18.

When **the N is even** numbers of scores,

When N is even the medians can be calculated by following formula

The value of $(N/2)$ the item the value of $(N/2) + 1$ the item $Mdn = 2$

Example: 14,15,16,28,35,47,50,58,

The score of the $(N/2)$ th i.e. 4th is 28

The score of the $(N/2) + 1$ th 5th is 35

The median is $(28+35) / 2 = 63 / 2 = 31.5$

$Mdn = 31.5$

b) Calculation of the Median for Grouped Data

The formula for calculating the median when the data are grouped in class interval is

$$Mdn = L + \left\{ \frac{(N/2) - F}{f_m} \right\} \times i$$

Where, L = exact lower limit of the class intervals within which the Mdn lies.

$N/2$ = One half the total number of scores

F = Sum of the scores on all intervals below L

f_m = Frequency within the interval upon which the median falls.

i = length of the interval

The use of the formula can be illustrated by following example.

Example: Calculation of Median from Grouped data

Class interval	F	Cumulative frequency
195-199	5	55
190-194	4	50
185-189	5	46
180-184	5	41
175-179	7	36
170-174	10	29 Md Class
165-169	5	19
160-164	4	14
155-159	4	10
150-154	3	6
145-149	2	3
140-144	1	1

Let us apply the formula to derive median

$$\text{Md} = L + \frac{\left(\frac{N}{2} - F\right) \times i}{f_m}$$

Where L=169.5,

$N/2 = 55/2 = 27.5$

F = cum. Freq = 19

$f_m = 10$

$i=10$

$$\begin{aligned} \text{Mdn} &= 169.5 + \left(\frac{27.5 - 19}{10} \right) \times 10 \\ &= 169.5 + \frac{8.5}{10} \times 10 \end{aligned}$$

$$\text{The Median} = 169.5 + 8.5 = 178.0$$

Steps

To locate the median, we take 50% i.e. $N/2$ of our scored and count into the distribution until the 50% point is reached. In the above example there should 27.5 scores above and 27.5 scores below the median. Start adding the frequencies (+) from below we discover that 27.5 lies in the class interval 170-174. If we add the frequencies from above to below then again 27.5 lies on the class intervals 170-174.

Find the lower limit of the class interval on which Mdn falls. The lower limit of class interval 170-174 is 169.5

To find out F begin adding the frequencies from the below and count off the scores in order up to interval which contain median. The sum of these scores is F.

Compute $N/2 - F$. Divide this quantity by the frequency on the interval which contain the median (fm) and multiply it by the size of the class interval (i).

Add the amount obtained by the above calculations to the exact lower limit (L) of the intervals which contains the Mdn.

Check Your Progress -3

Note: (a) Answers the question given below:

(b) Compare your answers with those given at the end of the lesson:

1. Compute the median for the following data

a) 13,14,20,5,18,37,18

b) 75,85,88,61,68,53

4.6 THE MODE

a) Computation of Mode for Ungrouped Data

Mode can easily be computed by looking at the data. In ungrouped data mode is that single score which occurs most frequently.

Example

If we have to find out the value of the mode from the following scores.

25,25,29,29,29,30,32,36

Here the scores 29 is repeated maximum number of times therefore 29 is the “crude” mode.

b) Calculation of Mode for Grouped Data

When data is available in the form of frequency distribution then, we differentiate between crude mode and “true” mode.

Crude mode is the point of greatest concentration in the distribution. For example, in the frequency distribution given in table above. The class interval 170-174 contain the largest frequency and 172 is the midpoint therefore 172 is the „crude; mode.

The ‘true’ mode can be obtained by the following formula

$$\text{Mode} = 3 \text{ Mdn} - 2 \text{ Mean}$$

Md = Median and M= Mean

Therefore, if the mean is 170.80 and median is 171.00 the mode will be

$$\text{Mode} = 171 \times 3 - 170.80 \times 2 = 174.40$$

Check Your Progress -4

Note: (a) Answer the questions given below:

(b) Compare your answers with those given at the end of the lesson:

1. Find the mean, median and mode for the following scores.

a) 22,21,24,18,19,23,12,20

b) 9,8,13,10,11,10,12,10,14

4.7 GRAPHICAL PRESENTATION OF DATA

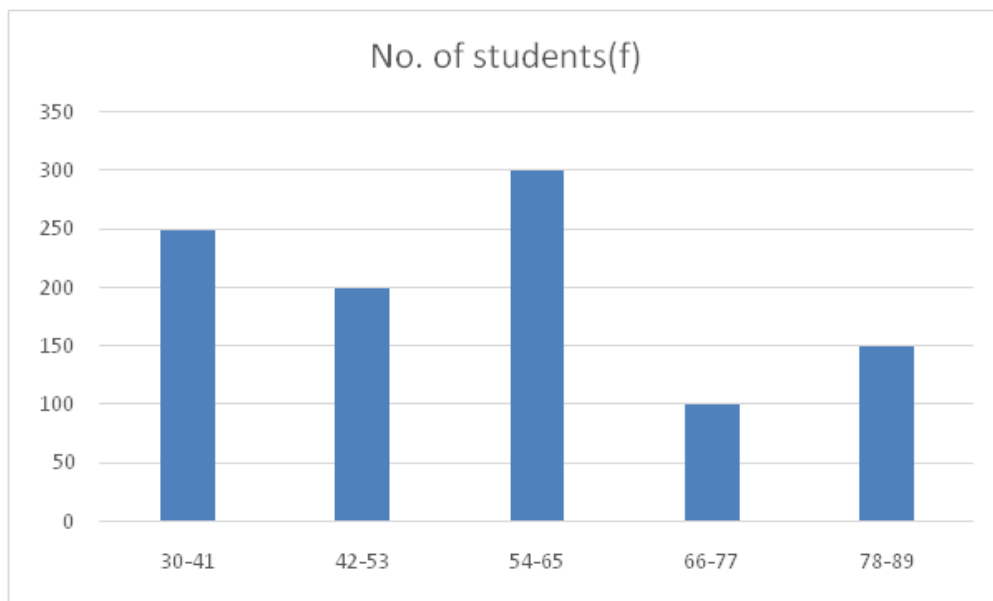
The purpose of preparing a frequency distribution is to provide a systematic way of “looking at” and understanding data. To extend this understanding, the information contained in a frequency distribution often is displayed in a graphic and/or diagrammatic form.

Bar graphs are the pictorial representation of data (generally grouped), in the form of vertical or horizontal rectangular bars, where the length of bars is proportional to the measure of data. They are also known as bar charts. Bar graphs are one of the means of data handling, in statistics.

In graphical presentation, a bar graph is created on two mutually perpendicular lines called the X and Y–axes on which appropriate scales are indicated. The horizontal line is called the abscissa and vertical the ordinate. Like different kinds of frequency distributions there are many kinds of graph too, which enhance the scientific understanding of the reader. The commonly used among these are bar graphs, line graphs, pie, pictographs, etc.

For example: In a School, the categories of marks of each student is given in the following table. Represent it through a bar graph.

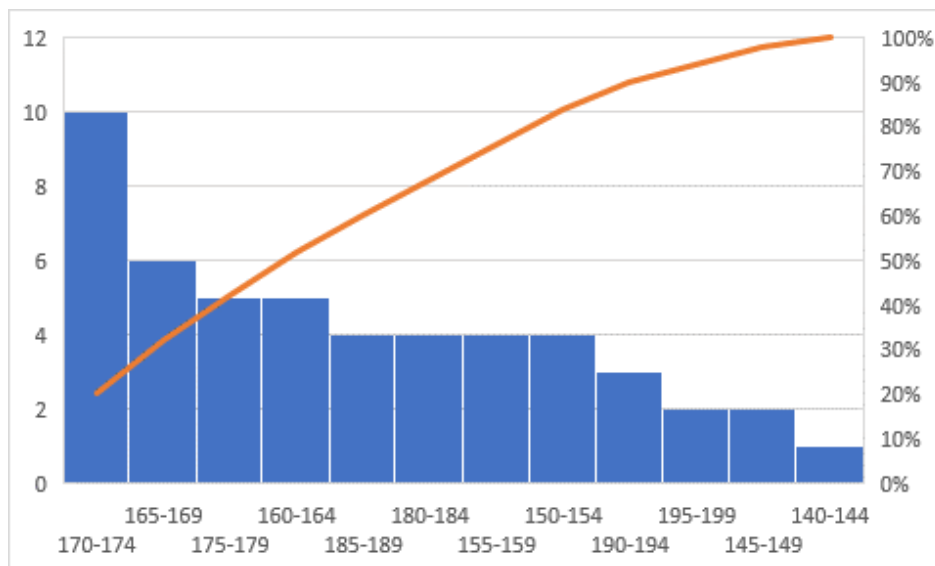
Categories of marks	No. of students(f)
30-41	250
42-53	200
54-65	300
66-77	100
78-89	150



Histogram: It is one of the most popular method for presenting continuous frequency distribution in a form of graph. The histogram consists of series of rectangles, with its width equal to the class interval of the variable on horizontal axis and the corresponding frequency on the vertical axis as its heights.

In this distribution, frequency distribution with equal class interval, classes with intervals are plotted on the X-axis and their corresponding frequencies are plotted

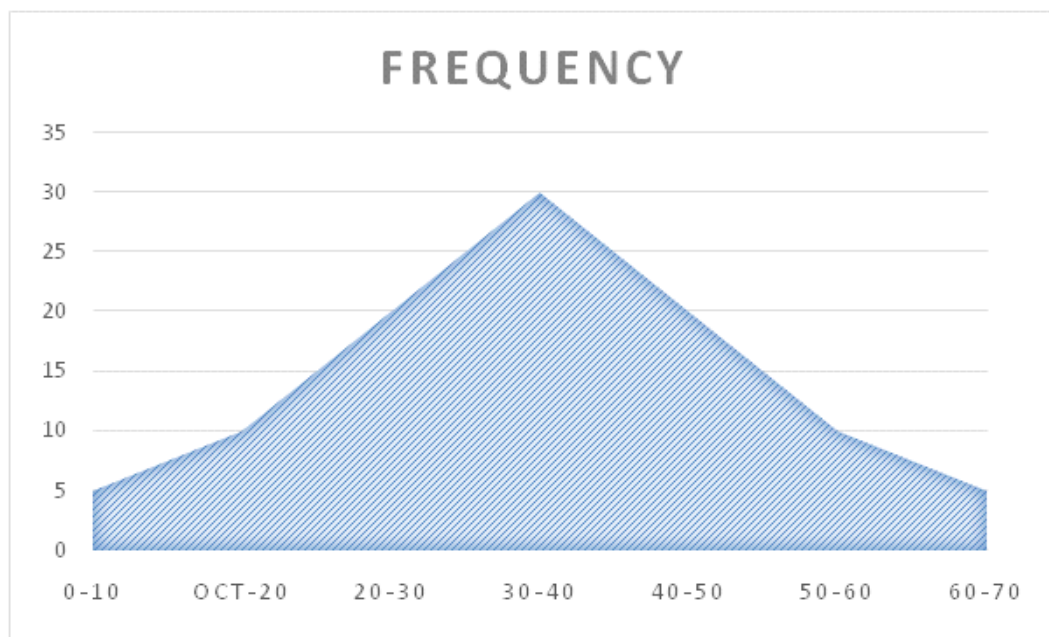
on the Y-axis in terms of rectangles with heights equal to frequency distribution. Following is a histogram of the above mention data:



Frequency Polygon: A frequency polygon is a graphical form of representation of data. It is used to depict the shape of the data and to depict trends. It is usually drawn with the help of a histogram but can be drawn without it as well. Mark the class intervals for each class on the horizontal axis and plot the frequency on the vertical axis. Now, plot the frequency as given to you against the mid-point of the given class interval and not the upper or lower limit of any class. The height always depicts the frequency. Join all the plotted points using a line segment.

But this graph is not closed as two ends of this graph is open. In order to make a closed graph we extend the left end line segments to the mid-points of the class preceding to the first class and right end line segment to the mid-point of the class succeeding the last class. In the graph of frequency polygon, the left end line segment is extended to 0 as we do not expect the measurement or observation to be negative.

Class	Frequency
0-10	5
10-20	10
20-30	20
30-40	30
40-50	20
50-60	10
60-70	05



4.8 LET US SUM UP

In this lesson we learn about the term statistics and its classification. we also came to know about three important measures of central tendency, that is the mean, mode and the median, their concepts and definitions. We then took up the mean, and learnt about the calculation of the mean from both grouped and ungrouped data. This

was followed by defining the median and learning to calculate the median from ungrouped and grouped data. We also learnt how to calculate median when there are gaps. We then took up in the next section the mode and learnt about its definition and then learnt how to calculate the mode. From these we also came to know when to use these three measures of central tendency, when to use the mean, median and the mode and what would be more appropriate etc. Then we worked out all the formulas and gave them together in this unit so that it is easy to remember. We also worked with graphical presentation of the data.

4.9 LESSON END EXERCISE

1. What do you mean by statistics? Define its various types with the help of examples of daily life.
2. Compute the mean, median and mode for the following frequency distribution:

Class Interval (Scores)	F
70-71	2
68-69	2
66-67	3
64-65	4
62-63	6
60-61	7
58-59	5
56-57	1
54-55	2
52-53	3
50-51	1

4.10 SUGGESTED FURTHER READINGS

Garrett, E.H. (1969). *Statistics in Psychology and Education*. New York: Greenwood Press.

Guilford, J.P. (1956). *Fundamental Statistics in Psychology and Education*. New York: McGraw-hill book company.

Pagano, R. (2004). *Understanding Statistics in the Behavioural Sciences (7th edition)*. Pacific Grove, C.A: Brooks/Cole Publishing Co.

<http://egyankosh.ac.in/bitstream/123456789/23457/1/Unit-2.pdf><http://egyankosh.ac.in/bitstream/123456789/64522/2/Unit-7.pdf>

4.11 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress-1

1. a. F
- b. F
- c. T
- d. T
- e. T

Check Your Progress-2

1. 81

Check Your Progress-3

1. a. 18
- b. 71.5

Check Your Progress-4

1. a) Mean-19.87 Mdn 20.5 Mode 18.61
- b) Mean 10.8 Mdn 10 Mode- 10.0

**DIAGNOSIS OF LEARNING DIFFICULTIES AND
REMEDIAL MEASURES**

Structure

- 5.1 Introduction
- 5.2 Objectives
- 5.3 Diagnosis of Learning Difficulties in Mathematics
 - 5.3.1 Types and Functions of Diagnostic Test
 - 5.3.2 Methods of Diagnosis
 - 5.3.3 Important Steps of Diagnosis
- 5.4 Different Types of Mathematics Learning Problems
- 5.5 Remedial Measures and Suggestions
- 5.6 Let Us Sum Up
- 5.7 Lesson End Exercise
- 5.8 Suggested Further Readings
- 5.9 Answer to Check Your Progress

5.1 INTRODUCTION

The good news is that there is variety of supports and strategies that can help school students grow the math skills they need. Students who have problems in learning mathematics or fail to meet grade-level standards are usually identified between third and fifth grade, much later than those recognized for reading problems, and are referred for special education services or other remedial programs. Parents and teachers do believe that arithmetic learning problems are not very common, or perhaps not very serious. However, school-age students have significant math deficits and among students classified as learning disabled, arithmetic difficulties are as pervasive as reading problems. This does not mean that all reading disabilities are accompanied by arithmetic learning problems, but it does mean that math deficits are widespread and in need of equivalent attention and concern. Evidence from learning disabled adults belies the social myth that it is okay to be rotten at math. The effects of math failure throughout years of schooling, coupled with math illiteracy in adult life, can seriously handicap both daily living and vocational prospects. In today's world, mathematical knowledge, reasoning, and skills are no less important than other social abilities.

5.2 OBJECTIVES

After going through this lesson, you shall be able to:

- diagnose learning difficulties in mathematics;
- classify types of mathematics learning problems, and
- suggest measures for varied learning problems.

5.3 DIAGNOSIS OF LEARNING DIFFICULTIES IN MATHEMATICS

Just as a doctor diagnoses a patient to find the nature, type and extent of his problem before prescribing medicine, a teacher of Mathematics applies diagnostic test to diagnose the difficulties and weakness of the students. Through this test, weakness and difficulties of students in the instructional material consisting of one or more type of mathematics are diagnosed. In diagnostic test, both background and

performance of the students is required. Diagnostic tests are qualitative not the quantitative. Diagnostic test can easily be understood with the following example. A bottle contains juice. Two questions can be arisen. How much juice is there in bottle and why is it full or empty? Question about the quantity of juice comes in achievement test while about quality, why the bottle is empty or full comes in diagnostic test. Hence, from the following example, an easy understanding can be made that diagnostic test are qualitative not quantitative. It undertakes to provide a picture of strengths and weaknesses of pupils in learning.

5.3.1 Types and Functions of Diagnostic Test

Diagnostic tests are mainly classified into two classes :

1. Education Diagnostic Test
2. Physical Diagnostic Test

Educational diagnostic test is related to study matter of education. These tests diagnose disorder of material according to level of class.

On the other hand, Physical or Clinical Diagnostic Tests are related to hearing, vision and other things that cause hindrance in the course of a child's learning.

Functions of Diagnostic Test

It has following functions

- 1. Classification**
 - Attitude
 - vocational Level
 - Intellectual Level
- 2. Assessment of specific Abilities with regard to**
 - Level of Abnormality

- Level of Depression and Anxiety
- Level of Adjustment

3. Remediation

- Special Education of Handicapped
- Remedial Teaching for Learning weakness
- Counseling for Mental Ailment
- Clinical Treatment for Physical Ailments

5.3.2 Methods of Diagnosis

Following methods are useful for diagnostics approaches.

1. Testing method

- It involves several types-testing procedures Known as
- Educational Testing Method
- Psychological Testing Method
- Clinical Testing Method

2. Observation Method

It is subjective method and applied only for children for prognosis and diagnosis.

3. Diagnostic Test in School Subjects

Different subjects in different schools are according to level of classes. Student faces several difficulties especially in arithmetic. To remove the doubts and difficulties of the students, different tests are designed as given below.

Diagnostic Mathematical Skill Test

This test is used to diagnose the following types of errors committed by the student during mathematical operations as Addition, Subtraction, Multiplication and Division.

- Carry over in addition
- Borrowing in addition
- Placement of decimal error
 - Borrowing and reducing one from next
 - Nothing wrong number
 - Tables are not remembered in divisions
 - Tables are not remembered in multiplication

5.3.3 Important Steps of Diagnosis

There are five main steps of diagnosis in Mathematics.

1. First of all we try to know about the students who are facing this problem. For it, we use different methods about which we have read above.
2. We try to know about the area or type of questions where the child does mistakes.
3. After finding the nature of mistakes in step 2 we try to know the reasons of their mistakes.
4. After knowing the reason is step 3, we think about its solution. There is not any certain rule to prove it. It depends on the nature of the problem.
5. After solving the problem, the process is not yet completed. Afterwards teacher should do so that these problems may not occur in Future.

Check Your Progress-1

Note: (a) Answer the questions given below.

(b) Compare your answers with those given at the end of this lesson.

1. Diagnostic tests are mainly classified into..... classes.
2. Educational Diagnostic Test is related to the study matter of
3.is subjective method and applied only for children for prognosis and diagnosis.
4. There aremain steps of diagnosis.

5.4 DIFFERENT TYPES OF MATHEMATICAL LEARNING PROBLEMS

There is also evidence that children manifest different types of disabilities in mathematics.

1) Mastering basic number facts

Many learning disabled students have persistent trouble “memorizing” basic number facts in all four operations, despite adequate understanding and great effort expended trying to do so. Instead of readily knowing that $5+7=12$, or that $4 \times 6=24$, these students continue laboriously over years to count fingers, pencil marks or scribbled circles and seem unable to develop efficient memory strategies on their own.

2) Arithmetic weakness/math talent

Some learning disabled students have an excellent grasp of math concepts, but are inconsistent in calculating. They are reliably unreliable at paying attention to the operational sign, at borrowing or carrying appropriately, and at sequencing the steps in complex operations. These same students also may experience difficulty mastering basic number facts. Because there is much

more to mathematics than right-answer reliable calculating, it is important to access the broad scope of math abilities and not judge intelligence or understanding by observing only weak lower level skills.

3) The written symbol system and concrete materials

Many younger students who have difficulty with elementary math actually bring to school a strong foundation of informal math understanding. They encounter trouble in connecting this knowledge base to the more formal procedures, language, and symbolic notation system of school math. Teachers often compound difficulties at this stage of learning by asking students to match pictured groups with number sentences before they have had sufficient experience relating varieties of physical representations with the various ways we string together math symbols, and the different ways we refer to these things in words.

4) Language problems

Most students with mild disabilities have primary or secondary language problems. The disorder may involve form, content, or function of the language. Even if a student does not have an identified language disorder, he or she may exhibit language deficiencies related to his or her disability.

5) Cognitive factors

Most students with mild to moderate disabilities have cognitive factors that impede learning. These may be perceptual, memory, attention, or reasoning factors. Perception involves taking in information from the environment and processing that information for storage or use.

6) Metacognitive factors

Metacognition is an awareness of the skills, strategies, and resources that are needed to perform a task and the ability to use self-regulatory mechanisms, including adjustments, to complete the task. Such cases don't monitor their

own use of strategies and have difficulty with generalization across time and setting.

6) Motor factors

Motor problems with written work are most evident in younger students but even adolescents with no physical disabilities can struggle with number and symbol formation. Motor skills, like perceptual ones, involve more than one process.

7) Social and emotional factors

Sometimes overlooked in the academic realm, social and emotional factors can cause as many learning problems as cognitive ones. The range of these factors is as diverse as the students served.

8) Habits of learning

“Habits of learning” refers to how individuals view and participate in learning, their self-discipline and self-motivation, goal setting, engagement in learning activities, and acceptance of challenges. Habits that could interfere with math learning include avoidance, learned helplessness, impulsivity, little curiosity, poor assignment completion, disinterest, and working for the “right answer” rather than understanding.

9) Previous experiences

A student’s prior knowledge and previous experiences with mathematics are the best predictors of future success. Many of these experiences have been influenced by the factors described above. However, previous instructional experiences also can have a significant impact on achievement.

Check Your Progress-2

Note: (a) Answer the questions given below.

(b) Compare your answers with those given at the end of this lesson.

1. Some learning disabled students have an excellent grasp of math concepts, but are inconsistent in.....
2.is an awareness of the skills, strategies, and resources that are needed to perform a task.
3. Most students with mild to moderate disabilities havefactors that impede learning.

5.5 REMEDIAL MEASURES AND SUGGESTIONS

Some of the following math strategies and suggestions may help students who are experiencing problems with mathematics. Identify strategies that will help our students and teacher about using some of the strategies in school.

1. Maintain consistency and communication across school and home settings

Parents, tutors, and classroom teachers should coordinate and use the same instructional approach.

2. Teach basic concepts using concrete objects

For example, let student explore number concepts by counting the legs of a chair to find the number four or by subtracting crayons from a box. The progression from understanding concrete materials, pictorial representations, and abstract number representations may take some student longer than others.

3. Provide specialized materials

To help student organize their calculations, have them use graph paper to keep numbers in columns. Encourage the use of scrap paper to keep work neat, highlighters to underline key words and numbers, and manipulative such as base-ten blocks or fraction bars.

4. Make our expectations explicit

Tell student the procedures would like them to use when solving a problem, model each procedure for them, and then have them tell what they are expected to do. Some students benefit by having a math notebook filled with examples of completed problems to which they can refer if they become overwhelmed or confused.

5. Provide time for checking work

Emphasizing that completing math assignments is a process, encourage students to become comfortable reviewing their work, making changes, or asking questions when they are unsure of their answers.

6. Give opportunities to connect mathematical concepts to familiar situations

When introducing measurement concepts, have children estimate their measurements before measuring classmates' and family members' heights or weighing their book bags' when empty and when full.

7. Help student apply math concepts to new situations

How to use percentages to understand the price of a pair of shoes on sale at the mall or the amount of their allowance they spend on snacks.

8. Provide access to programs or tutors that can help a student improve his or her math skills

Tutors can assist student with weak math sub-skills, such as multiplication and division. Provide tutors during summer months or after school to boost performance and ensure that the student retains his or her skills.

9. Help student keep track of problematic areas

When doing math homework, students may benefit from having their most common errors listed on flashcards. They can then refer to the cards while completing their assignments.

10. Play math games

To encourage automaticity with math facts, students may benefit from playing math games (i.e. dice, playing cards) and listening to commercially available audiotapes that provide a fun way of learning math facts.

11. Use of technology

Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning. Far from being just electronic downtime, the internet offers educators a huge range of research-based practices, interactive websites, resources, and lesson plans. A computer is a patient teacher and it is interesting to observe some students who will stay with a game well beyond the time they might usually stay with a pen and paper exercise.

12. Creative teaching

Take the help of tools to inculcate creativity. Use playful games or forms of visual exercises that will attract young minds and capture their interest. This is a time tested method to identify every young child's creative abilities and encourage their creativity. Bring creativity into all your subjects, like

mathematics, science and history. Think of ways and means to develop their creative ideas.

13. Audio & Video tools

Include audio visual materials to supplement textbooks during your sessions. These can be models, filmstrips, movies, pictures, graphics or other mind mapping and brain mapping tools. Such tools will help their imagination to develop and grow. These methods will not only develop their ability to listen but will also help them to understand the things better.

14. Real-world Learning

Infusing real-world experiences into your teaching will make teaching moments fresh, lively and enrich classroom teaching and learning. Relating and demonstrating by creating real life situations will make the material easy to understand and learn. It will boost their interest and get the child excited and involved.

15. Brainstorm

Conduct brainstorming sessions in your classrooms. These sessions helps to get the creative juices flowing. When we have multiple brains focusing on one single idea, we surely get numerous ideas and will also involve everyone in the discussion. These sessions will be a great platform for children to voice their thoughts. Set some rules before you start. You conduct simple brainstorming or group brainstorming or paired brainstorming.

16. Classes outside the classroom

Some lessons are best learnt when taught outside of the classroom or school. Organize field trips that are relevant to the lessons or just simply take students outside of the classroom. Students will find fresh and excited. Without making much effort, they will learn what you teach them.

17. Storyboard teaching

Storyboarding is a great way to teach any subject which requires step by step memorization and visualization of highly conceptual ideas.

Teachers can use a storyboard to recreate a famous event. Such visually stimulating activities will ensure that even difficult ideas are easily put before the students easily. You can also encourage the use of storyboards as a form of communication.

18. Stimulating classroom environment

A classroom environment that is well decorated, fun, and involvement will help stimulate a child's mind and will help to think and learn better.

19. Welcome new ideas

An open minded attitude can help you to innovate and create new teaching methods. Though you might claim to be open-minded but its human nature to resist change of any type. Assess yourself and ensure that you will try out new ideas in the classroom.

20. Think about new hobby

Sometimes, a hectic schedule may affect your engagement in teaching. If it happens, it's natural that you can take a break for a couple of hours and involve in some other activity that you are interested in. This will rejuvenate you and you can do your work with more passion and interest.

21. Work together as a team

If everyone knows that the end result of the collaborative effort is always positive. Think about spending some quality time with your colleagues. Ask them to share their views and ideas on improving teaching methods; you will see that many of them will come up with interesting strategies.

So, collaborate and introduce innovative and creative teaching methods.

22. Puzzles

Learning becomes fun when puzzles and games are part of teaching and education. Children may not require conscious efforts when lessons are introduced to them through games and puzzles. Puzzles and games help children to think creatively and face challenges in enjoyable manner.

23. Start school clubs

Think about starting an after-school club. Being a teacher and educator you may not get ample time to work on interesting topics that you are passionate about. You can share your ideas and views and learn from others when you have school clubs and groups.

24. Refer to books on creativity

To be a creative teacher you need to do some action research on creative ideas and techniques. There is a lot of creativity. Choose some of the best and start learning. It will help for your professional development as well.

25. Love what you do

You can give your best only when you love what you do. When you are not in stress you will be more creative and innovative. Loving your work will keep you relaxed and will give you room to experiment with new ideas.

Check Your Progress-3

Note: (a) Answer the questions given below.

(b) Compare your answers with those given at the end of this lesson.

1. Conductsessions in your classrooms. These sessions helps to get the creative juices flowing.
2. Some lessons are best learnt when taught of the classroom or school.
3. To encourage automaticity with math facts, students may benefit from playinggames.
4.and games help children to think creatively and face challenges in enjoyable manner.

5.6 LET US SUM UP

This relative neglect might lead parents and teachers to believe that arithmetic learning problems are not very common, or perhaps not very serious. However, school-age students have significant math deficits and among students classified as learning disabled, arithmetic difficulties are as pervasive as reading problems. This does not mean that all reading disabilities are accompanied by arithmetic learning problems, but it does mean that math deficits are widespread and in need of equivalent attention and concern. Evidence from learning disabled adults belies the social myth that it is okay to be rotten at math. The effects of math failure throughout years of schooling, coupled with math illiteracy in adult life, can seriously handicap both daily living and vocational prospects. In today's world, mathematical knowledge, reasoning, and skills are no less important than other social abilities.

5.7 LESSON END EXERCISE

1. How we can diagnose learning difficulties in Mathematics?
2. What are different types of Diagnostic Tests?
3. Explain the methods of Diagnosis.
4. Explain important steps of Diagnosis.
5. What are different types of Mathematics Learning Problems

5.8 SUGGESTED FURTHER READINGS

<https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/dyscalculia/understanding-dyscalculia><http://www.ldonline.org/article/5896/>

Gurganus, S.P. (2007). *Excerpt from math instruction for students with learning problems*. New York: Routledge.

<http://www.pbs.org/parents/education/learning-disabilities/types/mathematics/math-strategies/>

5.9 ANSWERS TO CHECK YOUR PROGRESS

Answers to Check Your Progress-1

1. Two 2. Education 3. Observation Method 4. Five.

Answers to Check Your Progress-2

1. Calculating 2. Metacognition 3. Cognitive.

Answers to Check Your Progress-3

1. Brainstorming 2. Outside 3. Math 4. Puzzles.

**BACKWARDNESS IN MATHEMATICS-ENRICHMENT
PROGRAMME FOR THE GIFTED**

Structure

- 6.1 Introduction
- 6.2 Objectives
- 6.3 Backwardness in Mathematics
 - 6.3.1 Characteristics of Backwardness
 - 6.3.2 Identification of Backward Students
 - 6.3.3 Causes and Remedies of Backwardness
- 6.4 Gifted students in Mathematics
 - 6.4.1 Identification of Gifted Students in Mathematics
- 6.5 Enrichment Programme for Gifted Students
- 6.6 Let Us Sum Up
- 6.7 Lesson End Exercise
- 6.8 Suggested Further Readings
- 6.9 Answers to Check Your Progress

6.1 INTRODUCTION

When a student is found to lag behind than other students in his class we call that particular child as backward. Backward or slow learners have limited cognitive capacity. They fail to cope with learning situations and to reason abstractly. Rational thinking becomes practically impossible. They have the capacity to succeed in rote-learning. These children show interested in learning where relationships are clearly demonstrated. With regard to retentive memories they require more practice and revision in comparison with normal children. All students can be inspired from lesson plans, work in small groups, and use technology in daily assignments. Although every kind of student gains from challenges in the classroom. It is very important to push your gifted students a little further. Make certain that they are actively using their gifts. If they don't learn how to tackle challenges early on in life, they might never effectively do so.

6.2 OBJECTIVES

After going through this lesson, you shall be able to:

- explain the process of identification of backwardness in mathematics,
- describe causes and remedies of backwardness,
- discuss the characteristics of gifted students in mathematics, and
- delinents enrichment programme for mathematically gifted students.

6.3 BACKWARDNESS IN MATHEMATICS

In the functioning of school and teaching learning process every teacher encounters the problems of backwardness or slow learners especially of mathematics in reality. Such children don't desire any benefit through generalized instruction. Facial expressions, indifference and incapacity to respond to simple questions are sure indications of retarded learning.

Slow learners generally do not respond to the lessons meant for that class and are incapable of achieving even to level below that of a year. The general I.Q of a child is between 85 and 155. According to the studies, the I.Q of a slow learner is below 85. Burton Hall identifies a slow learner as a low achiever to the generally accepted educational levels.

6.3.1 Characteristics of Backwardness

1. Slow learners have limited cognitive capacity. They fail to cope with learning situations and to reason abstractly. Rational thinking becomes practically impossible.
2. One of the pertinent characteristics of slow learners is poor memory. It occurs due to lack of concentration, it is impossible to say how much a child can learn and retain although he is motivated externally and internally. Experimental evidences reveal that very often the dull children can recall facts about their local cricket team as well as its players.
3. Classroom situations include distraction and lack of concentration of slow learners. This typical behaviour is also associated with poor motivation. Again different studies also report that when the learning material are presented through concrete situations, the slow learners concentration and attention do not differ significantly from that of a normal child.
4. Inability to express his ideas through language is another significant characteristic of a slow learner. A slow learner also lacks imagination and foresight. He faces difficulty to foresee consequences in the future.
5. Some dull children are very poor in scholastic achievements in the school. Their performance is not satisfactory. But some children who come from sophisticated homes show good performance, because they get help and encouragement from home. This is only possible at the primary stage of education. But at the secondary stage, the frustrations and failures come from different sources. The children develop an attitude of resentment towards the

authorities and create problems. This kind of attitude may lead to anti-social behaviour in the future.

6.3.2 Identification of Backward Students

- Intelligent Quotient is below 90.
- Have little Drive.
- Have short span of attention.
- Have weak association memory.
- Poor reader.
- Have difficulty with abstractions.
- Not logical in thinking.
- Lack of imaginations.
- Unable to detect his own errors.
- Have little power to transfer training.
- Have no creative in his thinking.

Check Your Progress-1

Note: (a) Answer the questions given below.

(b) Compare your answers with those given at the end of this lesson.

1. Slow learners have limitedcapacity.
2. One of the pertinent characteristics of slow learners is memory.
3. Intelligent Quotient of Backward students is below.....
4. Slow learners have short span of

6.3.3 Causes and Remedies of Backwardness

1. Physical causes

Backwardness may be due to some physical causes such as poor eyesight, hearing defect or any other physical ailment which do not allow the child to concentrate on studies. Remedy of all these causes' lies with the physician or doctor but some sort of physical exercise may also help the child.

2. Lack of interest in the subject

Interest is the basic factor in teach mathematics subject some of the students have little or sometimes no interest for learning mathematics. In some cases the students are forced to learn mathematics due to over enthusiasm and ambitions of the parents such students generally develop a sort of disinterest, apathy or sometimes hatred towards the subjects and in the long run turn into so called backward in the subject.

Therefore it is essential that the children should be given proper opportunities for the essential motivation to learn mathematics. All efforts should be made to make the subject interesting and meaningful by correlating it with their natural interests and basic needs.

3. Mental Disability

The mental disability may be inborn or caused by environmental factors. The child may have low I.Q, mental conflict, inferiority complex, feeling of insecurity, anxiety, tension, fear, nervousness, maladjustment etc. Many of these mental disorders can be successfully tackled by a competent teacher with a conscious effort. Attitude of affection, sympathy and kindness can go a long way in this regard.

4. Lack of Mathematical ability

Certain abilities like abstract reasoning, numerical ability, spatial ability, arithmetic reasoning, and computational ability are prerequisites for success

in mathematics. Slow learners may lack proficiency in one or more of these abilities. The teacher will have to test proficiency of slow learners on these abilities and necessary training programmes should be implemented to improve the skills and abilities.

5. Inappropriate Learning Experiences

The inappropriate learning experiences provided in the mathematics class could lead to confusion resulting in misconception of the basic mathematical concepts. The teachers should plan the learning experiences which are simple and relevant for the slow learners to achieve the objectives and get the concepts clear and clarified. Remedial teaching has to be done in such cases where the slow learners need them. Remedial teaching has to be planned in such a way that learning experiences provided would be different and would meet the special needs of the slow learners.

6. Irregular Study Habits

Mathematics is a subject of logical sequence. Higher order concepts depend upon low order concepts. Rules and formulae are statements of relationship among these concepts. Therefore a student with irregular study habits will find it hard to understand and apply the mathematical laws and principles. The teacher should help such students to plan their study time properly and make them more regular and systematic. Drill and review also could help them in improving their performance.

7. Teacher's Indifference

Many a time the mathematics teachers become impatient and show indifference to the slow learners who are slow in grasping mathematical ideas and concepts. Moreover slow learners may not be able to perform the mathematical tasks at the same rate as their counterparts in the class. This could result in frustration among the slow learners leading to low achievement.

A Teacher could take more interest in the slow learners and understand their levels of learning. This will definitely boost up the self-confidence of the slow learners.

8. Ineffective method of Teaching

The group of methods of teaching is not very effective for the slow learners because their rate of learning, levels of achievement and level of understanding are not the same as the other students in the class. The teacher has to give special attention to the needs of the slow learners. In the case of slow learners, methods of individualized instruction like Programmed Instruction, Computer Aided Instruction (CAI) and use of learning packages and modules could yield better result and facilitate effective learning. The teacher should also give individual attention to the slow learners in clarifying their doubts, in stimulating and in directing their thinking. This will enthuse in them a sense of well-being, trust and confidence in the teacher.

9. Practice and Drill

The slow learners need more concrete experiences for effective learning and more drill and practice for longer retention. The teacher has to provide them with such opportunities which would result in meaningful learning.

10. Lack of facilities at Home:

When the child does not have adequate time and facilities for learning at home, it may lead to backwardness. The teacher can help such students by arranging supervised study, where the child can learn under the supervision of the teacher. In this connection the teacher can seek the help of the gifted children.

11. Family Background and Home Environment:

The uncongenial atmosphere at home, the negative attitude of the parents towards the subject, the pressure of the parents and so on could adversely influence the students' performance in mathematics. A teacher could deal with

such children with patience and sympathy. The teacher has to change the attitude of the parents and students by interacting with them in a more meaningful manner.

12. Irregular School Attendance:

The irregularity in attendance causes a serious problem for mathematics learning as it creates a wide gap in the student's understanding of mathematical concepts. Mathematics being a sequential subject, the understanding of a concept depends upon an earlier concept. Once the link is lost, the learning becomes more complex and difficult. The teacher has to look into the causes of irregularity in attendance and help the students in the best possible ways.

13. Lack of Individual attention:

Proper learning in mathematics needs individual attention. Individual differences are bound to exist. The need is to pay proper individual attention of the proper time the teacher should take care that each of the student in his class understandings the basic concepts clearly. He should be helped in solving the problems independently. His homework should be regularly supervised and the difficulties, if any, should be individually solved.

14. Lack of proper educational guidance:

Sort of affair needs careful educational guidance to the students in the choice of subjects and courses. In this way children should be help in making right educational choices through the properly arranged guidance services at the school and community so that no child may develop into a backward child in learning mathematics on account of the lack of educational guidance.

Check Your Progress-2

Note: (a) Answer the questions given below.

(b) Compare your answers with those given at the end of this lesson.

1. The mental disability may beor caused by environmental factors.
2. When the child does not have adequate time and facilities for learning at home, it may lead to
3. Certain abilities like abstract reasoning, numerical ability, spatial ability, arithmetic reasoning, and computational ability are prerequisites for success in

6.4 GIFTED STUDENTS IN MATHEMATICS

A person showing consistent extraordinary achievement in a productive field is a genius/Gifted.

A Student is considered as mathematically gifted student, if he shows consistent remarkable interest and achievement in mathematics.

Characteristics of the mathematically gifted student

General Characteristics:

- Has excellent memory, good vocabulary, broad attention span, and high reading ability.
- Makes associations readily and retains them indefinitely.
- Recognises similarities and differences quickly.
- Has a relatively mature sense of values.
- Pursues interest with tremendous energy and drive.
- Uses his/her spare time productively.

Special Characteristics:

- Frequently impatient with drill and details that he thinks are not important.
- May be reading mathematics books years ahead of his age.
- Recognises patterns readily and enjoys speculating on generalisation.
- Prefers to think on higher levels of abstraction.
- Classifies particular cases as special cases of more general situations with relative ease.
- Follows a long chain of reasoning, frequently anticipating and contributing.
- Frequently asks profound questions.

6.5.1 Identification of Gifted Students in Mathematics

- Gifted student picks up things rapidly and easily.
- Gifted student is quick in grasping, relationships, making generalizations and drawing conclusions.
- Puts intelligent questions in class.
- Able to solve those problems which are of a higher standard.
- Shows originality in solving problems.
- Possesses a good power of imagination, thinking and reasoning.
- Likes to work at abstract levels and does not like simple practical work.
- His achievements are remarkable in various achievement tests.

- His assignment work is of good standard.
- Always alert and actively participates in teaching learning process.

Check Your Progress-3

Note: (a) Answer the questions given below.

(b) Compare your answers with those given at the end of this lesson.

1. A Student is considered as mathematically gifted student, if he shows consistent remarkable..... andin mathematics.
2. Gifted students prefers to think onlevels of abstraction.
3. Gifted students have assignment work is ofstandard.
4. Gifted studentsparticipates in teaching learning process.

6.5 ENRICHMENT PROGRAMMES FOR MATHEMATICALLY GIFTED STUDENTS

1. An enriched syllabus to provide for extensive and intensive study.
2. They should be encouraged to enrich their knowledge by the study of supplementary readers, reference books and general literature from the library.
3. They should be allowed to do their independent study in the library.
4. For teaching such gifted children the teacher should use heuristic, analytic, problem solving, project or discussion method.
5. They should be told the history of the development of various topics and about the contributions of renowned mathematics.
6. Gifted students are encouraged to actively participate in various activities of Mathematics club.

7. Gifted students be encouraged to apply mathematical facts for solving their day to day problems and should be told about the practical, cultural and disciplinary values of the subject.
8. Gifted students be asked to organize seminars, exhibitions etc. concerning Mathematics.
9. They should be asked to work on some useful projects either independently or collectively.
10. They should be told that there is enough scope for research work in mathematics.
11. The work of such gifted students should be duly appreciated by the teacher.
12. Special coaching is arranged for such students.
13. Spark Interests by offering projects that lean toward their passions and fascinations. Then, allow them to choose their own topics. This encourages creativity and originality.
14. Group Gifted Students together.
15. Connect to the Real-World to keep your gifted students interested with the outside world.
16. Set goals in order to achieve them. The best way to look at a challenge is to see it as an achievable goal.
17. Teach gifted students that everything isn't black or white. After all, creative thinking encourages creative solutions.
18. Use Technology to teach them extensively.

In a subject like Mathematics providing individual attention assumes a greater role because of the intricate skill involved and the vigorous mental and disciplinary qualities in build in the very nature of the subject. The identification of the mathematically

gifted is as important as nurturing their mental abilities and skills to acquire a high level mathematical thinking and reasoning. The unique characteristics exhibited by the gifted students will help the teacher in identifying them. However, the teacher has to carefully follow their academic and other performance consistently for a long time before he identifies them as gifted.

These important approaches are not only beneficial for gifted students. These methods can be applied to any classroom. All students can be inspired from lesson plans, work in small groups, and use technology in daily assignments. Although every kind of student gains from challenges in the classroom, it is very important to push your gifted students a little further. Make certain they are actively using their gifts. If they don't learn how to tackle challenges early on in life, they might never effectively do so.

Check Your Progress-4

Note: (a) Answer the questions given below.

(b) Compare your answers with those given at the end of this lesson.

1. For teachingchildren the teacher should use heuristic, analytic, problem solving, project or discussion method.
2.students be asked to organize seminars, exhibitions etc. concerning Mathematics.
3. Connect to theworld to keep your gifted students interested with the outside world.
4. The best way to look at a challenge is to see it as angoal.

6.6 LET US SUM UP

Slow learners have limited cognitive capacity. They fail to cope with learning situations and to reason abstractly. Rational thinking becomes practically impossible.

They have the capacity to succeed in rote-learning. These children show interest in learning where relationships are clearly demonstrated. With regard to retentive memories they require more practice and revision in comparison with normal children.

In a subject like Mathematics providing individual attention assumes a greater role because of the intricate skill involved and the vigorous mental and disciplinary qualities in build in the very nature of the subject. The identification of the mathematically gifted is as important as nurturing their mental abilities and skills to acquire a high level mathematical thinking and reasoning. The unique characteristics exhibited by the gifted students will help the teacher in identifying them. However, the teacher has to carefully follow their academic and other performance consistently for a long time before he identifies them as gifted.

6.7 LESSON END EXERCISE

1. What are characteristics of Backwardness in Mathematics?
2. How we can identify backward students in Mathematics?
3. What are causes and remedies of Backwardness in Mathematics?
4. How we can identify gifted students in Mathematics?
5. Enlist various enrichment programme for Gifted students.

6.8 SUGGESTED FURTHER READINGS

<https://www.education.udel.edu/wp-content/uploads/2013/01/GiftedStudents.pdf>

<http://www.ascd.org/publications/newsletters/education-update/apr16/vol58/num04/Six-Strategies-for-Challenging-Gifted-Learners.aspx>

<https://www.weareteachers.com/teaching-gifted-students/>
<https://www.scholastic.com/teachers/articles/teaching-content/challenge-your-top-students/>

6.9 ANSWERS TO CHECK YOUR PROGRESS

Answers to Check Your Progress-1

1. Cognitive 2. Poor 3. 90 4. Attention.

Answers to Check Your Progress-2

1. Inborn 2. Backwardness 3. Mathematics.

Answers to Check Your Progress-3

1. Interest, Achievement 2. Higher 3. Good 4. Actively.

Answers to Check Your Progress-4

1. Gifted 2. Gifted 3. Real 4. Achievable

**DIFFERENT TYPES OF TESTS USED FOR EVALUATION FOR
THE DIFFERENT GROUPS IN MATHEMATICS**

Structure

- 7.1 Introduction
- 7.2 Objectives
- 7.3 Purpose of Evaluation
- 7.4 Difference Between Evaluation and Examination
- 7.5 Different Types of Test Items for Evaluation for Different Groups in Mathematics
 - 7.5.1 Essay Type Test Items
 - 7.5.2 Objective Type Tests
 - 7.5.3 Short Answer Type Tests
- 7.6 Let Us Sum Up
- 7.7 Lesson End Exercise
- 7.8 Suggested Further Readings
- 7.9 Answers to Check Your Progress

7.1 INTRODUCTION

Evaluation plays an enormous role in teaching-learning process. It helps teachers and learner to improve teaching and learning. Evaluation is a continuous process and periodic exercise. It helps in forming the values of judgment, educational status, or achievement of student. Evaluation is one form or the other is inevitable in teaching-learning, as in all fields of activity of education judgments need to be made. In learning, it contributes to formulation of objectives, designing of learning experiences and assessment of learner performance, besides this, it is very useful to bring improvement in teaching and curriculum. It provides accountability to the society, parents and to the education system. Evaluation is very important requirement for the education system. It fulfills various purposes in systems of education like quality control in education, selection/entrance to a higher grade or tertiary level. It also helps one to take decisions about success in specific future activities and provides guidance to further studies and occupation. Some of the educationists view evaluation virtually synonymous with that learning appraisal and examinations etc., but evaluation has an expanded role. It plays an effective role in questioning or challenging the objectives. Different type of tools of evaluation are used for tests/examinations by the teachers/ educators to test the knowledge of the learners such as, essay type tests, objective type tests and short answer type tests etc.

7.2 OBJECTIVES

After going through this lesson, you shall be able to :

- explain the purpose of evaluation
- bring out difference between evaluation and examination
- describe different type of test items for evaluation in mathematics

7.3 PURPOSE OF EVALUATION

Evaluation, examination and tests can be conducted for a variety of purposes depending upon its purpose. In an educational setting, the purpose of evaluation is to

assess the outcomes in education in accordance with the goals of education. The basic goals of evaluation, examination and tests can be elaborated as follows:

1. **Achievement of the students:** The students who come to the school come with an objective of developing their skills, knowledge and their personalities. The evaluations are conducting with a view to ascertain whether after joining the school, the students have any acceleration in the development of their skills, knowledge or personalities. In other words, evaluation tells up to what extent the learner has learned.
2. **Personality Development:** Personality includes the development of inner abilities as well as manners in which the person presents him. It relates to the development of concepts, the thinking process, the alertness, the analytical abilities, the thoughtfulness, the behaviour, etc. Evaluation tells us weather the students' personality has developed in the desired direction or not. If so, to what extent and with what inputs provided by the school.
3. **Efficiency of teachers and School:** as discussed earlier, evaluations also show the teacher effectiveness and efficiency which ultimately leads to institutional performance. If a majority of students is found to be not performing well, it can be presumed that the teachers have to change their teaching strategies and instructional methods. Institution would also review its overall planning and implementation of the curriculum to improve their performance.
4. **Diagnostic Purpose:** Evaluations assist in understanding the specific problems of a particular individual case, so that these specific problems could be handled by teacher or by the institution as a whole.
5. **Incentives:** In case the evaluation shows that performance of the institution is good, it works as incentive and motivation for students as well as for the staff.
6. **Prognosis:** Evaluations are directly related to prognosis. On the basis of what is happening in the present, the future of the institution can be visualized. This

kind of forecasting helps the institutions in taking remedial measures wherever needed.

7. **Uniformity of Standard:** If the evaluation of different institutions is conducted by an external authority, the performance of the institution could be compared because the institutions are evaluated against certain pre-defined criteria and norms. With the help of evaluation, groups and teams can be constituted according to their achievements and abilities and these different types of groups can be taught adopting varying strategies suitable for the students of each group.
8. **Educational and vocational guidance:** At certain level, students have to opt for certain subjects, as they may like to go to higher studies in technical or professional fields or to some vocational courses. Evaluation helps in determining the capabilities of individuals opting for such subjects.
9. **Selection in Competitive examination:** Those who perform well in competitive examinations are recruited to various posts. Scholarships are also provided to those students who perform well in the examinations. Evaluations help in identifying such students.
10. **Evaluation and Management:** Evaluation helps in improving managerial functions. According to the results of students, the management can think of a more logical distribution of functional and human resources, various activities can be re-planned for better achievements.
- 11 **Evaluation and Decisions:** Evaluation is also related to decision-making. They help in reviewing the promotional policies, recruitments, retaining of teachers, in-service, training, etc.

7.4 DIFFERENCE BETWEEN EXAMINATION AND EVALUATION

Generally, examination and evaluation are used as synonyms and mutually interchangeable. But the fact is that they carry different functional meaning that they

cannot be replaced by another. The difference between evaluation and examination is as follows.

Examination	Evaluation
<ol style="list-style-type: none"> 1. It is a narrow concept. 2. It only aims to determine the achievement of child in particular subject in a specific period e.g. annual, half yearly, monthly etc. 3. It gives quantitative data or information. 4. It is used for classification and promotion of children only. 5. It is less reliable and valid than evaluation 6. It is mainly oral, written and practical i.e. quantitative techniques. 7. Examination confines to the memorization of knowledge only. 8. It is informative 9. It can examine cognitive domain only. <p>It does not improve curriculum, methods etc.</p>	<ol style="list-style-type: none"> 1. It is a wider and comprehensive concept. 2. It is a continuous process and aims to determine the achievement of children in overall activities. 3. It gives quantitative as well as qualitative or information. 4. It is used for classification, diagnosis, prediction and guidance to the children. 5. It is more reliable and valid. 6. It involves the use of various tools and techniques of evaluation i.e. both quantitative and qualitative techniques. 7. It does not confine to memorization. 8. It is formative and summative. 9. It can evaluate all the three domains. <p>It improves curriculum, method etc.</p>

Check Your Progress-1

Note: (a) Answer the questions given below.

(b) Compare your answer with those given at the end of this lesson.

1. _____ gives quantitative as well as qualitative information.
2. _____ is formative and summative.
3. _____ does not improve curriculum, methods etc.
4. _____ is mainly oral, written and practical i.e. quantitative techniques.

7.5 DIFFERENT TYPES OF TEST ITEMS FOR EVALUATION FOR DIFFERENT GROUPS IN MATHEMATICS

Evaluation and examination tools/tests play a very important role in education. It measures the achievement of students after specified learning experiences. It also stimulates learning in the right direction. It is a powerful educational tool that serves at least four functions.

First, they help us to evaluate students and assess whether they are learning what you are expecting them to learn. Second, well-designed tests serve to motivate and help students structure their academic efforts. Third, tests can help us to understand how successfully you are presenting the material. Fourth, they can reinforce learning by providing students with indicators of what topics or skills they have not yet mastered and should concentrate on.

The following types of tests/examinations and evaluation tools can be used by the teachers/ educators to test the knowledge of the learners

- A) Essay Type Tests
- B) Objective Type Test
- C) Short Answer Type Tests

7.5.1 Essay Type Test Items

Essay type test items are still commonly used tools of evaluation, despite the increasingly wider applicability of the short answer and objective type questions. There are certain outcomes of learning (e.g. organizing, summarizing, integrating ideas and expressing in one's own way) which cannot be satisfactorily measured through objective types test items.

An essay type questions may give full freedom to the students to write any number of pages. The required response may vary in length. An essay type question requires the pupil to plan his own answer and to explain it in his own words. The pupil exercises considerable freedom to select, organize and present his ideas. Essay type tests provide a better indication of pupil's real achievement in learning. The answers provide a clue to nature and quality of the pupil's thought process. That is, we can assess how pupil presents his ideas (whether his manner of presentation is coherent, logical and systematic) and how he concludes. In other words, the answer of the pupil reveals the structure, dynamic and functioning of pupils' mental life. The essay questions are generally thought to be the traditional type of questions which demand lengthy answers. They are not amenable to objective scoring as they give cope for halo-effect, inter-examiner variability and intra-examiner variability in scoring.

Advantages of Essay Type Test

- (i) **Utilisation of Higher Mental Faculties:** Higher mental faculties are to be involved while giving answers to the essay type questions. Memory, recall and reasoning power etc. all are involved. It is not easy to write an essay. All the higher mental faculties must be fully developed. Only then, one can have the capacity to write an essay.
- (ii) **Practicability:** The main characteristic of an essay type test items is that:
 - (a) Questions can be framed very easily.
 - (b) It is easier to administer such tests. A lot of students can be tested at one time.
 - (c) Even the answer books can be evaluated with much ease.

- (iii) **Measure Language and Style:** These tests measure language and style of writing of the students. The students have freedom to express that gained knowledge in the language and style of their own. So essay type tests, in a way, are the reflection of the personality of the child/pupil.
- (iv) **Freedom of Expression:** In essay type tests, students have freedom of expression to answer their questions in a way they like. They can make use of their language and style. This freedom of expression enables the child to know his capabilities, potentialities and interests.
- (v) **Attitude:** When students write answer to the topics of controversial issues, their attitudes also come to the known.
- (vi) **Encourage Creative Thinking:** Essay type tests encourage creative thinking. The evaluation can evaluate the capacity of the students in marshalling of the facts and presenting the same on paper.
- (vii) **Evaluate individual Qualities:** Essay type tests evaluate the individual qualities of the child like originality, power of imagination, organization and power of making decisions etc.
- (viii) **Economy:** Essay type tests are economical. A lot of time and money is saved.
- (ix) **Development of Power of Concentration:** In order to Marshall Facts and presenting them in a logical form requires a lot of concentration. So essay type tests develop the power of concentration among the students.

Disadvantages:

- (i) **Not Reliable:** Essay type examination is not reliable usually the score of individual on them changed from time to time and from administration to administration. They give us inconsistent results.
- (ii) **Not Valid:** Essay type examinations are not valid. They do not measure properly what they ought to measure. Thus they do not serve the very purpose of the test.

- (iii) **Not comprehensive:** They are not comprehensive. It means they are not sufficiently long so as to cover the whole area to be tested. They do not test the achievement of the students in all chapters of a given course of study. They merely measure the achievement of part out of given course.
- (iv) **Subjective in nature:** They are subjective both in items and scoring. Usually all items give different meaning to different examinees and hence, the answer vary and their scoring also varies. The same examiner may award, different marks on the same answers of same individual at different times. Different examiners give different marks on the same answer at different times or at the same time.
- (v) **Less Discriminating Power:** Essay type examination is not a discriminating tool. It fails to distinguish between dull and bright students.
- (vi) **Irrelevant Answers:** Many irrelevant facts are added to the answer of essay type questions.
- (vii) **Variability in marks:** Examiner generally assigns marks on different answer in the answer book of the student on the basis of first attempted question.
- (viii) **Encourage Cramming:** Such tests encourage selective reading and cramming

7.5.2 Objective Type Tests

The success of an evaluation scheme depends upon the suitability of its tools. In this connection the essay type examination as a tool have miserably failed in realizing these objectives. Essay type tests do not fulfill the criteria of a good test. In view of their weakness and limitations, new type tests called objective type tests have come into practice.

Objective type test are comparatively more reliable, valid, objective and comprehensive than the essay type examination. They can be easily scored and properly interpreted.

Objective type items are used when we want to test students' knowledge and understanding of facts and relationship in Mathematics. These include completion, true/false, multiple choices. This type of examination contain questions or items, which are answered by a single word or by ticking, circling, crossing or underlying the one of the choice already given.

What is objective question? An objective question is one which is free from any subjective bias either from the tester or the markers. There can only be one right or objective answer to an objective question. Objective questions can take various forms, but in variably they require brief answers with little or no writing. A simple tick or a quick written answer may be enough. Objective type of items can be divided into following categories:

1. Recall Type Tests:

These test items are also called supply type items. These include simple recall type and completion type test items. In simple recall test pupils asked simple question to test their factual knowledge. Pupil's answer these questions on the basis of their memory and previous knowledge or experiences. The answers of the questions are not suggested but are to be recalled and supplied by the pupil.

Advantages:

- i. This test items needs very brief answer does not result in bringing boredom and fatigue.
- ii. It is easy to construct.
- iii. It almost eliminates guessing as a factor in unreliability and thus minimizes one of the most common criticisms of objective tests.
- iv. These items are sufficiently reliable and highly valid.
- v. The familiarity of facts and naturalness is measured

- vi. It can serve the diagnostic purpose.
- vii. Quite comprehensive in covering the syllabus and testing of the realization of the stipulated objectives.
- viii. The scoring and interpretation of the responses of the students do not pose any problem.

Disadvantages:

- i. Such questions test only the factual things and memory. The powers of understanding, reasoning, application, interpretation etc. cannot be tested through these questions.
- ii. Preparation of such items demands great skill and experience on the part of the paper setter.
- iii. It is costly in terms and labour for its preparation.
- iv. Administration of such tests may also create so many disciplinary and administrative problems. The mode of responses of questions may also drift the students towards picking up unfair means.
- v. If not properly constructed, scoring can be subjective.

2. Completion Type Test Items

The completion test may be defined as a series of sentences in which certain important words or phrases have been omitted and blanks submitted for the pupil to fill in. A sentence may contain a simple blank, or it may contain two or more blanks. The sentences in the test may be disconnected, or they may be organized into a paragraph.

Advantages:

- i. Completion type items are easy to construct.
- ii. Such types of items are popular and widely used. The pupils are quite familiar with such items.

- iii. There is no scope of guess work and as such they are more reliable.
- iv. Such items can measure both knowledge and comprehension of the subject matter, while simple recall type items can measure the knowledge aspect only.

Disadvantages:

- i. Such items cannot measure higher levels of objective like application, analysis, synthesis or evaluation.
- ii. Such items fail to test the reasoning power, power to explain discriminate, illustrate or estimate.
- iii. These questions are mostly based on memory.
- iv. Scoring is a bit laborious as the blanks are scattered here and there.

3. Recognition Type Or True/False Type Test

This is a type of test in which two answers are given. One is correct or other is wrong. The examinee is to sort out the correct answer. The examinee has to tell whether it is true or false by writing True or False (T/F). Yes/No, Correct/Incorrect, Right/Wrong or marking or x at the given place.

Advantages:

- i. Such items easy to construct.
- ii. It can be easily administered and scored.
- iii. It measures pupil's understanding of the content or concept.
- iv. The pupils are familiar with such items and such items are quite popular.
- v. True/false items provide a simple and direct means of measuring essential outcomes.

- vi. All the important learning outcomes can be tested equally well with true/false items like other objective type items.
- vii. Such items can be used to measure:
 - The pupil's ability to identify correct statements and principles
 - The pupil's ability to distinguish fact from opinion.
 - The pupil's ability to recognise cause and effect relationship.

Disadvantages:

- i. As there are only two alternatives so it encourages guessing. A pupil who blindly answers all the items as 'true' or 'false' in a True-False test may score about 50%. Thus, such tests have low reliability.
- ii. Many of the learning outcomes measured by true-false items can be measured more efficiently by other items.
- iii. It is difficult to construct such tests when the material seems to be controversial.
- iv. They cannot be employed to test higher learning outcomes or to test the higher mental processes.
- v. A true-false item is likely to be low in reliability when the number of items is less.

4. Multiple Choice Tests

A multiple-choice test is made up of items each of which presents four or more responses, only one of which is correct or definitely better than others. Each item may be in the form of a direct question, an incomplete statement, or a word or phrase. This form of test is to be distinguished from the multiple-response type, which requires that two or more responses be made to a single item.

Of all the form of objective type test items, multiple choice type test items are considered to be the best, as they make examinees to think. According to E.F. Lindquist and L.J.Cronbach it is superior to other type of tests for testing judgment.

A multiple choice-item consists of three parts- a stem, a key and a number of distracters. The key and the distracters. The key and the distracters together are often referred to as options. The stem can be either a direct question or an incomplete statement; the key is the correct answer and the distracters are plausible but incorrect answers. The testee is asked to choose one of the alternatives for his answer. Such tests require the testee to discriminate among the alternatives. They can measure the degree of understanding, the ability to infer, judge and apply.

Example: '0' is an

- (a) Natural Number (b) Integer
- (b) Whole Number (d) None of these.

Advantages of Multiple Choice Items

1. Multiple choice questions are preferred to other types of objective-type items because such items provoke thinking and create interest in pupils.
2. Administration and scoring of these items are simple and easy.
3. They can measure leaning outcomes with respect to factual recall, ability to apply understanding, ability to interpret data, ability to reason, ability to exercise judgement, ability to justify methods, etc.
4. They can be scored entirely objectively, quickly and accurately by machines, clerks and even students themselves.
5. They are relatively efficient. T/F and matching items are slightly more efficient, while the essay questions are far less efficient.

6. Compared to T/F items, MC items have a relatively small susceptibility to score variations due to guessing.
7. They usually provide greater test reliability per item than the T/F items do.
8. They are easier to respond to and are better liked by students than T/F items. Students feel they are less ambiguous than T/F items.
9. They are less vague than completion-type items.
10. Guessing can be minimized by increasing the number of responses to four or five.
11. They can be conveniently used for numerous subject matter areas.

Disadvantages of Multiple Choice Items

1. They are very difficult to construct. Teachers cannot always think of plausible distracters. More skill and more time are required.
2. There is a tendency for teachers to write MC items demanding only factual recall.
3. They require more time for students to respond to.
4. They are not well-adapted for measuring the ability to organize and present ideas.
5. They require more space per item.

5. Matching Tests

A matching test consists of two columns or two series. The items of the column or series for which a match is required are called 'premises' and the items of the columns or series from which matching is selected are known as 'responses'. Thus each item of the premises column (or series) is to be matched with an item given in response column (or series) on some logic or basis. To

minimize guessing, the number of answers given in the right hand may be kept one or more or less than the number of questions on the first column.

Example: Match the answers from column B with the questions in column A and write the suitable number in the space provided in B.

Column A	Column B
(1) -3,-2,-1,0,1,2,3	(a) Integers
(2) Rhombus	(b) Quadrilateral
(3) 1,2,3,4,5,6.....	(c) Natural numbers
(4) 2,4,6,8....	(d) Even numbers

Advantages:

1. Matching tests require relatively little reading time, many questions can be asked in a limited period of testing time.
2. They afford us an opportunity to have a large sampling of the content, which ultimately increases the reliability of the test.
3. Like T/F or Multiple Choice items, matching tests are amenable to matching scoring. Even with hand-scoring, they can be scored more easily than the essay or short-answer test.
4. The matching tests can be constructed relatively easily and quickly.
5. Assess the knowledge of students regarding events, dates, terms, definitions, places etc. Particularly useful in History, Geography, Science and Grammar etc.
6. Very much useful in lower classes.
7. Students become interested for this test and are very curious to respond it.

8. A matching exercise can better measure the ability, to identify the relationship between two things.

Disadvantages:

1. Matching tests are limited to the measurement of factual information based on memory. Thus measures more of memory less of understanding.
2. In the matching tests there is likelihood of the presence of irrelevant clues to the correct answer.
3. It is also difficult to analyse and evaluate the matching type items.
4. While preparing such item, one faces the difficulty of finding homogenous materials that are significant from the view point of learning outcomes.

6. Classification Type

In classification type of items, some words, phrases, terms, names, objects, facts etc. are given; one of which is not related to the others. The examinee has to make the odd out i.e. to select that one.

Example: In the following item some words are given, of which one does not belong to others.

Select it and write down in the space provided at the right hand side.

(i) Triangle, Quadrilateral, Square, Mouse Ans.....

(ii) Monitor, Ten, Fifteen, Seven Ans.....

Advantages of objective type tests:

1. Examiner is bound with a chain, hence partiality is impossible.
2. Objectivity is man, no scope for subjectivity.
3. Time consumption is not a problem hence test is absolutely economical.

4. No need to go in detail, only brief and definite answers are required.
5. Time saver for examiner paper setter and students.
6. No comment is required only tick marks are needed.
7. Helpful for making score quick and easy.
8. Away from chance factor.
9. Two students equal in knowledge get equal marks.
10. Helpful in providing guidance for further teaching programme.
11. Self-satisfaction to pupils after looking marks.
12. Only knowledge is tested not the language.
13. Objective type tests are highly reliable and valid.
14. These tests do not depend on the teacher whims and fancy.
15. Written work of the students is reduced to a minimum.
16. These are easy to construct.
17. No scope for guesswork.
18. Objective type test serve the diagnostic purpose.
19. The students do not feel boredom and fatigue because such kind of questions needs very brief answers.
20. These questions are set from all parts of the course and thus they measure the achievement of the whole subject matter.

Disadvantages of objective type test

1. Objective type questions test only the factual knowledge and memory.
2. Such items cannot be employed to test higher mental processes.

3. There is no possibility of a student's how in his language grasp over the subject matter of computer science.
4. The students may guess the answer for some types of objective test items.
5. There is no freedom of expression for the students.
6. The test items demand more strain on the part of the teacher in preparing more number of test items.
7. These do not develop higher thinking abilities like synthesis, analysis etc.
8. These items required lengthy papers thus they need more investment for printing.
9. The students have less written work, thus certain abilities like expression, language, style, spellings, and pronunciation, creative critical analyses cannot be tested.
10. Preparation of a good objective type test is very difficult and is very much time consuming.

7.5.3 Short Answer Type Tests

The modern trend is to include more short answer questions in the question papers in order to improve their reliability, validity and sampling capacity. Short answer questions generally require exact answers and although taking many forms, they share the following distinctive features.

- i. They usually take less than five minutes to read and answer, many take less than a minute.
- ii. Short answer questions permit larger sampling of content.
- iii. They tend towards greater objectivity in scoring.
- iv. More reliable and valid than essay questions.

- v. The answer is supplied by the pupil, not pre-selected as in objective questions.
- vi. Precise and specific as to the scope and length of answers.

Examples:

- Q1. What is Prime Number ?
- Q2. Give five characteristics of Quadrilaterals ?
- Q3. What is Scalene Triangle ?

Advantages:

- 1. Objectivity and scoring can be better ensured in short answer type questions in comparison to long answer question.
- 2. Besides, the question-setter can ask a number of such questions as compared to long- answer type question within the same time limit. Thus, there can be a greater coverage of content.
- 3. They are more reliable than the long-answer type-questions.
- 4. There is less chance of guessing by the students.
- 5. Preparation and administration are easy.
- 6. It is a compromise between the essay and the objective forms of test items.

Disadvantages:

There are no such significant demerits of the short answer type test items. Handwriting, Language, expression and the way of organization of answer may affect the scores.

Check Your Progress-2

Note: (a) Answer the questions given below.

(b) Compare your answers with those given at the end of this lesson.

1. _____ questions may give full freedom to the students to write any number of pages.
2. Higher mental faculties are to be involved while giving answers to the questions.
3. _____ type tests generally require exact answers.
4. _____ type tests cannot be employed to test higher mental processes.
5. _____ type test are comparatively more reliable, valid, objective and comprehensive.
6. _____ type tests costly in terms and labour for its preparation.

7.6 LET US SUM UP

Evaluation, Examination and tests play a very important role in education. It measures the achievement of students after specified learning experiences. It also stimulates learning in the right direction. Examination is a powerful educational tool that serves at least four functions. First, examinations help us to evaluate students and assess whether they are learning what you are expecting them to learn. Second, well-designed tests serve to motivate and help students structure their academic efforts. Third tests can help us to understand how successfully you are presenting the material. Fourth, examination can reinforce learning by providing students with indicators of what topics or skills they have not yet mastered and should concentrate on.

7.7 LESSON END EXERCISE

1. Which is more comprehensive Evaluation or Examination?
2. Which type of tests is most suitable for competitive tests?
3. What is the difference between examination and evaluation?
4. Write note on short answer type test items.
5. Explain various test items used for evaluation.
6. Differentiate essay type and objective type test items with the help of examples.
7. Discuss the essay type and short answer type test items. Discuss their advantages.

7.8 SUGGESTED FURTHER READINGS

Cangelosi, J. (1990). *Designing tests for evaluating student achievement*. New York: Addison-Wesley.

Gronlund, N. (1993). *How to make achievement tests and assessments*. New York: Allyn and Bacon.

Haladyna, T.M., & Downing, S.M. (1989). Validity of a taxonomy of multiple-choice item- writing rules. *Applied Measurement in Education*, 2(1), 51-78.

Monahan, T. (1998). The rise of standardized educational testing in the U.S. – A Bibliographic Overview.

Phelps, R.P., Ed. (2008). *Correcting fallacies about educational and psychological testing*.

Washington, D.C.: American Psychological Association.

Ravitch, D. (1985). *The uses and misuses of tests in the schools we deserve*. New York: Basic Books.

7.9 ANSWERS TO CHECK YOUR PROGRESS

Answers to Check Your Progress-1

1. Evaluation
2. Evaluation
3. Examination
4. Examination.

Answers to Check Your Progress-2

1. An Essay type
2. Essay type
3. Short answer
4. Short answer
5. Objective
6. Objective

**CONCEPT AND USE OF CONTINUOUS COMPREHENSIVE
EVALUATION (CCE) IN MATHEMATICS**

Structure

- 8.1 Introduction
- 8.2 Objectives
- 8.3 Need of Evaluation
- 8.4 Concept of Continuous and Comprehensive Evaluation (CCE)
 - 8.4.1 Features or Characteristics of CCE
 - 8.4.2 Uses and Functions of CCE
- 8.5 Components of CCE
- 8.6 Tools and Techniques of CCE
- 8.7 Let Us Sum Up
- 8.8 Lesson End Exercise
- 8.9 Suggested Further Readings
- 8.10 Answers to Check Your Progress

8.1 INTRODUCTION

For the holistic development of the child, evaluation should be comprehensive in nature i.e. it should include both scholastic and co-scholastic areas. It should help in realizing the goals of education. Such type of evaluation is continuous and reveals the strengths and weaknesses of learners. Hence, it brings improvement in the quality of achievement of all learners at elementary and secondary level. Keeping this in mind, Continuous and Comprehensive Evaluation (CCE) system was introduced by the Central Board of Secondary Education (CBSE) in India to assess all aspects of a student's development on a continuous basis throughout the year. The assessment covers both scholastic subjects as well as co-scholastic areas such as performance in sports, art, music, dance, drama, and other cultural activities and social qualities. The National Policy on Education (1986) and the Program of Action (1992) followed by the National Curriculum Framework of School Education (1986 and 2000) reiterated the need of the developing the personal and social qualities in learners. They stressed the point that the evaluation should be comprehensive in nature, where in all learning experiences pertaining to scholastic, co- scholastic personal and social qualities are assessed. The comprehensive evaluation necessitates the assessment of cognitive abilities (summative assessment as well as the assessment of health habits, work habits, cleanliness, co-operation and other social and personal qualities) through simple and manageable means of tools. The comprehensive evaluation not only helps in checking all the standards of performance in both scholastic and co-scholastic areas, but also helps in checking all the standards of performance in both scholastic and co-scholastic in areas, but also helps in decision making regarding various aspects of teaching-learning process, promoting the students, increasing quality, efficiency and accountability.

8.2 OBJECTIVES

After going through the lesson, you will be able to :

- highlight the need of evaluation

- describe the concept of continuous and comprehensive evaluation
- explain features of continuous comprehensive evaluation
- delineate uses and functions of continuous comprehensive evaluation
- discuss the components of continuous comprehensive evaluation
- describe the tools and techniques of continuous comprehensive evaluation

8.3 NEED OF EVALUATION

- i) **Evaluation as an Integral Part:** To make evaluation an integral part of teaching- learning process.
- ii) **Development of Skills:** To help to develop cognitive, psychomotor and effective skills.
- iii) **De-emphasize Rote Memorization:** To lay emphasis on thought process and de-emphasize rote memorization
- iv) **Regular diagnosis and remedial instructions:** To use evaluation for improvement of students achievement and teaching-learning strategies on the basis of regular diagnosis followed by remedial instructions. The continuous feedback provides direction to students, teachers, and parents.
- v) **Quality control Device:** To use evaluation as a quality control device to maintain desired standard of performance by providing remedial and enriched instructions.
- vi) **Learner centered activity:** To make the process of teaching and learning a learner centered activity.
- vii) **Determine Effectiveness of Program:** To determine social utility, desirability or effectiveness of a program and take appropriate decisions about the learner, the process of learning and the learning environment
- viii) **Harmonious development:** To develop all the aspects of child's growth.

8.4 CONCEPT OF CONTINUOUS AND COMPREHENSIVE EVALUATION

It is system of assessment and evaluation that covers all the aspects of a student's development. It was designed to reduce the student stress related to board exams, and to introduce a uniform and comprehensive pattern for student evaluation across the country. It emphasizes on two broad objectives: (a) Continuity in Evaluation and (b) Assessment of broad based learning.

Continuous and Comprehensive Evaluation is an extension of the broader conception of evaluation. Continuous and Comprehensive Evaluation (CCE) refers to a system of school based evaluation of a student that covers all aspects of a student development. CCE provide accommodation for individual differences. It aims at fostering individual ability of children and helps them to realize their potentialities. It is a developmental process of student which emphasize on two fold objectives-continuity in evaluation and assessment of broad based learning and behavioural outcomes. Continuous evaluation helps in providing remedies and enriched instructions for realizing the objectives of education in the optimum growth and development of various aspects of child personality.

Continuous: The term 'Continuous' implies that evaluation is not a period of time rather spread over the entire span of academic session. It means regular assessment of every student. It is more a process than an event. Such assessment would help to diagnose learning gaps and pave the way for remedial measures. It includes regularity of assessment, frequency of unit testing, diagnosis of learning gaps, use of corrective measures, retesting and feedback of evidence to teachers and students for their self evaluation. It means evaluation of diverse aspects of learners' growth and development is 'built into the total teaching learning process and spread over the entire span of the academic session

Comprehensive: The second term 'comprehensive' acknowledges to the fact that learning can be both formal and informal; it can occur through several facets

of activities and therefore the learning profile of the learners needs to be assessed in different contexts of learning both formal and informal. It means the scheme attempts to cover both the scholastic and the co-scholastic aspects of the students' growth and development. Thus it endorses the expression of learning through a variety of activities and hence their assessments through multiple tools of assessment. In short, it is intended to scan the entire learning map of the each student. Return type of evaluation cannot assess abilities, attitudes and aptitudes. A variety of tools and techniques are required for accessing a learner's development in areas of learning like:

1. Knowledge
2. Understanding
3. Applying
4. Analyzing
5. Evaluating
6. Creating

Comprehensive and Continuous Evaluation (CCE) has been introduced by CBSE for school students. As per this pattern there would be lesser examination and more assessments. All types of achievements of the students i.e. scholastic and non-scholastic are evaluated continuously for the whole session by a variety of internal tests which are spread over the whole year. These tests are weekly, fortnightly or monthly tests. Assessment is on the basis of work done by the learners in the classroom and outside the classroom in the form of homework, assignments, debates, declamation, quizzes, dramatics etc.

8.4.1 Features or Characteristics of CCE

Continuous: The 'continuous' aspect of CCE takes care of 'continual' and 'periodicity' aspect of evaluation.

Continual: Continual means assessment of students in the beginning of

instruction and assessment during the instructional process did informally using multiple techniques of evaluation.

Periodicity: Periodicity means assessment of performance done frequently at the end of unit/ term.

Comprehensive: The ‘comprehensive’ component of CCE takes care of assessment of all round development of the child’s personality. It includes assessment in scholastic (subject specific areas) as well as co-scholastic aspects (life skills, attitudes & values and other co-curricular activities) of the pupils by using various tools and techniques of assessment.

Scholastic aspects include curricular area or subjects specific areas, whereas Co-scholastic aspects include Life skills, co-curricular activities, attitudes and values.

Scholastic Areas: Assessment in Scholastic aspect is done informally and formally using multiple techniques of evaluation continually and periodically. The diagnostic evaluation takes place at the end of unit/term test.

Co-Scholastic Areas: Assessment in Co-Scholastic areas is done using multiple techniques on the basis of identified criteria, while assessment in life skills is done on the basis of Indicators of Assessment and Checklist.

Harmonious Development: It motivates learners for systematic learning and harmonious development.

Need Based: It caters to the needs of the learner.

8.4.2 Uses and Functions of CCE

Organize effective teaching strategies: It helps the teacher to organize effective teaching strategies.

Provide immediate feedback: Immediate feedback is provided to teachers as well as to students. An individual learner’s strengths and weakness are diagnosed

and learner's knowledge and skills are improved accordingly. It also provides immediate feedback to the teachers so that he can then decide whether there is need for more discussion on a particular unit or concept or may take remedial measures of instructions in which more emphasis is required.

Motivation: It motivates learning in a friendly environment. It helps to develop good study habits, to correct errors, and to direct activities of students towards the achievement of desired goals.

Identifies areas of aptitude and interest: CCE identifies areas of aptitude and interests of the students.

Predicting future success of students: Students are prepared for life. On the basis of reports of the progress of students in scholastic and Co-Scholastic areas, CCE helps in predicting the future success of the learner. It also helps in making decisions with regard to the choice of subjects, courses and careers.

Holistic assessment: It makes a holistic assessment of learner's whole personality-assessment of scholastic as well as co-scholastic abilities and achievements.

Afford more time to teachers and students: It affords more time to teachers for transaction of curriculum. Students will also have more time at their disposal for the development of interests, hobbies and personality.

Enhances the quality of teaching learning process: CCE enhances the quality of teaching learning process in the school. The emphasis is now on learning rather than on teaching. It ensures that every child acquires not only the knowledge and skills but also the ability to apply these competencies in real life situations.

Reduces stress and anxiety: It reduces stress and anxiety during examination.

Reduces drop-out: It will reduce drop-out as there is no fear of examination.

Check Your Progress-1

Note: (a) Answer the questions given below.

(b) Compare your answers with those given at the end of this lesson.

1. Full form of CCE is.....
2. Periodicity means assessment of performance done frequently at the end of
3. The second termacknowledges to the fact that learning can be both formal and informal.

8.5 COMPONENTS OF CCE

For holistic assessment both scholastic and Co-Scholastic aspects should be considered in Continuous and Comprehensive Evaluation. So CCE comprises of two components-

- Scholastic and
- Co-Scholastic.

Scholastic Assessment:

This is done to know what a child has learnt over a period of time. Comprehensive profile for each learner has to be maintained.

It Includes:

1. Academic- Languages, Math, Science, Social Science
2. Work experience
3. Physical and Health Education
4. Art Education

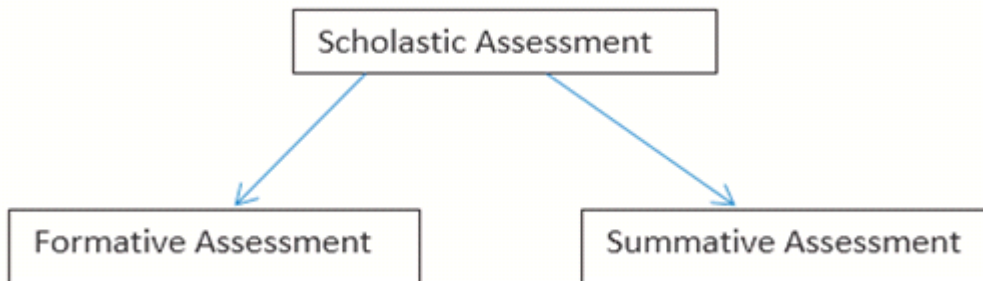
Objectives of Scholastic Assessment:

The objectives of the Scholastic domain are:

1. To bring desirable behaviour in terms of the learner's knowledge, understanding, evaluation and the ability to apply it in an unknown conditions.
2. To improve the teaching learning process.

Types of Scholastic Assessment:

Scholastic assessment can be Formative and Summative.



Formative Assessment

Formative assessment is a tool used by the teacher to continuously monitor student progress in a non-threatening, supportive environment. It includes regular descriptive feedback, a chance for the student to reflect on the performance, take advice and improve upon it. It involves students' being an essential part of assessment from designing criteria to assessing self or peers. If used effectively it can improve student performance tremendously while raising the self-esteem of the child and reducing the work load of the teacher.

Features of Formative Assessment:

1. It is remedial and diagnostic.
2. It gives effective feedback to both students' and teachers.

3. It builds on students' prior knowledge and experience in designing what is taught.
4. It recognizes the profound influence assessment has on the motivation and self-esteem of students, both of which are crucial influences on learning.
5. It provides the platform for the active involvement of students in their own learning.
6. It enables teachers to adjust teaching to take account of the results of assessment
7. It identifies the need for students to be able to assess themselves and understand how to improve it.

Summative Assessment

Summative assessment is carried out at the end of term. It provides feedback on learning to teachers and parents. It measures how much a student has gained from the course. It is usually a graded test, i.e., it is marked according to a scale or set of grades.

Features of Summative Assessment:

- ❖ It assesses students' knowledge gained.
- ❖ It is carried out at the end of the course.
- ❖ It provides the feedback to teachers and students.

Co-Scholastic Assessment:

It deals with affective domain of the learner's personality through development of the skills, attitudes and values and outdoor activities.

Co-Scholastic Areas:

Life skills: Life skills acquired via teaching direct experience for adaptive

and positive behavior. These make the students able to deal effectively with the challenges and demands of everyday life. These develop the physical, emotional, mental well-being of individuals. There are a large number of life skills. But in CCE manual of CBSE, only ten life skills are considered under the headings- Thinking skills, Social skills and Emotional skills.

- ❖ Thinking Skills
- ❖ Self-Awareness
- ❖ Problem Solving
- ❖ Decision Making
- ❖ Critical Thinking
- ❖ Creative Thinking
- ❖ Social Skills
- ❖ Interpersonal Relationships
- ❖ Effective Communication
- ❖ Empathy
- ❖ Emotional Skills
- ❖ Managing Emotions
- ❖ Dealing with Stress

Check Your Progress-2

Note: (a) Answer the questions given below.

(b) Compare your answers with those given at the end of this lesson.

1.gives quantitative as well as qualitative information.
2.is formative and summative.
3.assessment is carried out at the end of term.
4.is mainly oral, written and practical i.e. quantitative techniques.
5.assessment is remedial and diagnostic.

8.6 TOOLS AND TECHNIQUES OF CCE

The learner is evaluated continuously in CCE. The data and information regarding a learner is maintained. The quality of data and information helps in classifying a learner on the bases of his achievement. Continuous and Comprehensive Evaluation Continuous and Comprehensive Evaluation (CCE) enables the students to be evaluated throughout the year besides enabling them to develop their physical, mental, attitudinal skills by which they attain holistic personality and become responsible citizens.

In Mathematics, this includes Formative Assessment (a) (Laboratory activities), Formative Assessment (b) and Summative Assessment. In this method of assessment, teachers need to design an evaluation activity by which individual talents of each student is expressed. Formative Assessment (a) is done by involving students in activities while teaching the concepts. Mathematics Laboratory Activities help students learn mathematical concepts easily and apply them in real life situations. Formative Assessment (b) helps to assess understanding of concepts by administering student's small tests. Teachers can understand the extent of concept attainment of students and the lacunae in this process can be resolved by adopting remedial activities for enhancing concept attainment.

Skills developed by learning Mathematics

- Numerical Ability
- Mathematical Problem Solving
- Estimation of Quantities
- Approximation
- Visualisation & Representation
- Identification of Pattern
- Data Handling
- Investigation
- Thinking Skill
- Mathematical Communication
- Application of Mathematical concepts in real life situations.

Guidelines for using CCE

Teacher has to keep the following in mind while implementing CCE in classroom.

- The objective of CCE is to understand difficult areas with reference to students understanding and adopt remedial activities for enhancing concept attainment. This guideline further helps teachers and learners understand their status in the teaching- learning process.
- The assessment activities given are only suggestive. The teachers can use them as such or they can modify based on the classroom/students/local needs without affecting the objective of CCE.

- Evaluation strategies and activities for undertaking assessment activities. Based on learning objectives, expected learning outcomes, time duration, students' strength and available resources the suggested activities may be implemented.
- Teacher has to take special care in order that students are not stressed while Formative Assessment is used in classroom for assessment.

Continuous Comprehensive Evaluation Plan for Mathematics (100 Marks)

Formative Assessment (40 Marks) (Throughout the Term)

- Formative Assessment (a)-two best out of four Activities (**2 x 10 = 20Marks**)
- Laboratory Activity- Average of four Activities (**10Marks**)
- Formative Assessment (b)-one best out of two Tests (**1 x 10 = 10Marks**)

Summative Assessment (60 Marks) (End of the Term)

There are number of tools and techniques are used for collecting the data and information of students. A list of tools and techniques (given in CCE Manual of CBSE) that can be used in CCE are shown in the table given below:

Formative Assessment (Flexible Timing)		Summative Assessment (Written, End of Term)
Tools	Techniques	<ul style="list-style-type: none"> • Objective Type • Short Answer • Long Answer
Questions Observation Schedule Interview Schedule Checklist Rating Scale Anecdotal Records Document Analysis Tests and Inventories Portfolio Analysis	Examination Assignments Quizzes and competition Projects Debates Elocution Group Discussions Club Activities Experiments Research	

Check Your Progress-3

Note: (a) Answer the questions given below.

(b) Compare your answers with those given at the end of this lesson.

1.is formative and summative.
2. The assessment activities given are only
3.activities help students learn mathematical concepts easily and apply them in real life situations.
4. The objective ofis to understand difficult areas with reference to students understanding and adopt remedial activities for enhancing concept attainment.

8.7 LET US SUM UP

Continuous and Comprehensive Evaluation (CCE) enables the students to be evaluated throughout the year besides enabling them to develop their physical, mental, attitudinal skills by which they attain holistic personality and become responsible citizens. Teachers can understand the extent of concept attainment of students and the lacunae in this process can be resolved by adopting remedial activities for enhancing concept attainment.

The objective of CCE is to understand difficult areas with reference to students understanding and adopt remedial activities for enhancing concept attainment. This guideline further helps teachers and learners understand their status in the teaching- learning process. The assessment activities given are only suggestive. The teachers can use them as such or they can modify based on the classroom/students/local needs without affecting the objective of CCE.

8.8 LESSON END EXERCISE

1. What is continuous and comprehensive evaluation? Explain in detail.
2. Discuss various techniques used for evaluation.
3. Explain different tools of evaluation.
4. Discuss the components of CCE.

8.9 SUGGESTED FURTHER READINGS

Kaur, S., & Mathur, A. (2003). *Continuous and comprehensive evaluation: Teachers' handbook for primary stage*. New Delhi: National Council of Educational Research and Training.

Singhal, J.P. (2010). *Academic continuous and comprehensive evaluation in social science X*. Jalandhar: Laxmi Publications Pvt. Limited.

Sharma, N. K. (2010). *Academic continuous and comprehensive evaluation in science X*.

Jalandhar: Laxmi Publications Pvt. Limited.

Banga, P. (2010). *Solutions to academic continuous and comprehensive evaluation in Hindi X B*. Jalandhar: Laxmi Publications Pvt. Limited.

Dixit, J.B. (2010). *Comprehensive mathematics activities and projects X*. Jalandhar: Laxmi Publications.

8.10 ANSWERS TO CHECK YOUR PROGRESS

Answers to Check Your Progress-1

1. Comprehensive and Continuous Evaluation 2. Unit/term 3. Comprehensive.

Answers to Check Your Progress-2

1. Evaluation 2. Evaluation 3. Summative 4. Examination 5. Formative.

Answers to Check Your Progress-3

1. Evaluation 2. Suggestive 3. Mathematics Laboratory 4. Comprehensive and Continuous Evaluation

CONSTRUCTION OF OBJECTIVE BASED TEST ITEMS

Structure

- 9.1 Introduction
- 9.2 Objectives
- 9.3 Objective Type Tests
 - 9.3.1 Meaning of Objective Type Tests
 - 9.3.2 Types of Objective Type Test Items
 - 9.3.3 Construction of an Objective Type Test Item
 - 9.3.4 Assembling, Administering and Scoring the Test
 - 9.3.4 Merits of Objective Type Test
 - 9.3.5 Limitations of Objective Type Test
- 9.4 Essay Type Tests
 - 9.4.1 Meaning of Essay Type Tests
 - 9.4.2 Forms of Essay Type Tests
 - 9.4.3 Construction of Essay Type Test

- 9.4.4 Scoring of Essay Type Questions
- 9.4.5 Merits of the Essay Tests
- 9.4.6 Limitations of Essay Tests
- 9.5 Let Us Sum Up
- 9.6 Lesson End Exercise
- 9.7 Suggested Readings and References
- 9.8 Answers to check your progress

9.1 INTRODUCTION

Assessment of student learning provides evidence so that educational decisions can be made. We may use the evidence to help us evaluate (or judge the merit of) a teaching programme or we may use the evidence to make statements about student competence or to make decisions about the next aspect of teaching for particular students. Achievement tests generally measure the present proficiency, mastery and the understanding of general and specific areas of knowledge. Largely, they are measures of the effectiveness of instructions and learning. They are used to evaluate teachers' effectiveness, the effectiveness of different teaching methods, maintaining the school standards and in making surveys of pupils' performance. These tests also provide information for classification and placement of students in relatively homogenous groups for the purpose of differentiated instruction. These tests enable teachers and counselors to diagnose each pupil's strength and weaknesses. Different types of tests can be put to use to serve the purpose like essay type tests, objective type tests or performance tests. A test, regardless of the type, is an instrument to systematically measure a sample of student performance. It is systematic in the way that it generates a sample of performance from a domain of performance, in methods of scoring, and in interpreting results. Performance includes skills, knowledge, and attitudes. The selection of a test procedure must be based on the type of performance required of the student.

In this lesson we shall study about the construction of objective type test and essay type test in mathematics. Also we shall discuss about the advantages and limitations of objective type tests and essay tests.

9.2 OBJECTIVES

After going through this lesson, you shall be able to:

- understand the meaning of objective type tests,
 - construct objective type test in mathematics,
 - explain the advantages and limitations of objective type tests,
 - understand the meaning of essay type tests,
 - construct essay type test in mathematics, and
 - explain the advantages and limitations of essay type test in mathematics.
-

9.3 OBJECTIVE TYPE TESTS

9.3.1 Meaning of Objective Type Tests

The objective type test items are highly structured and require learners to supply (construct) or select response. It is defined as one for which the scoring rules are so specific that they do not allow students to make subjective inferences or judgments. Objective type tests occupy a unique place as they are characterized by total objectivity and unambiguity in scoring. It has one and only one correct response. Full marks are given for the correct response, which is unique, and no mark is given for an incorrect response. It is completely structured. Complete structuring of task limits student to the type of response called for. It prevents bluffing and avoids influence of writing skills. The scoring of an objective type test item is not only objective but also quick, easy and consistent, which is its greatest advantage. All ‘selection type’ objective items suffer from one drawback i.e., it is impossible to eliminate guessing. Though by constructing them in a proper manner, guessing could be reduced. Measures

which could be taken to reduce guessing have also been discussed in this unit. Objective type tests are not appropriate for all occasions. Whereas they are excellent for sampling knowledge, it is much more difficult to construct items to test higher order skills. They can never test written expression or ability to argue in one's own words. If well written, however, they can test higher order skills.

9.3.2 Types of Objective Type Test Items

There can only be one right or objective answer to an objective question. Objective questions can take various forms, but invariably they require brief answers with little or no writing. A simple tick or a quick oral answer may be enough. Objective items can be classified into two categories: one which requires students to supply the answer (**supply type**) and the second which requires them to select the answer from a given number of alternatives (**selection type**).

These two general classes are commonly further divided into the basic types of objective test item. Let us briefly discuss each type with the help of examples.

9.3.2.1 Supply Types

There are two types of the supply type items. They are:

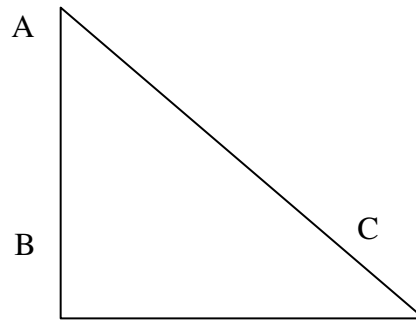
- (i) **Short Answer:** In this form, students are required to supply an answer which is very brief, generally a word or two.

e.g. What is the value of x in the equation $2x + 3 = 9$?

What is the sum of $5x^3 - 3x^2 - 1$ and $3x^2 + 1$?

- (ii) **Completion:** In this form, students are required to fill a blank by supplying the answer.

e.g. Answer questions 1 to 5 with respect of "ABC given below:



1. The value of $\cos A$
2. The value of $\tan B$
3. The value of $\operatorname{cosec} A$
4. The value of $\tan A$
5. The value of $\sin B$

9.3.2.2 Selection Types

There are three types of selection type objective questions. They are:

- (i) **True False or Alternate Response Type:** In this type a statement is provided to the students and they are required to indicate their choice as to whether the given statement is true or false, correct or incorrect, right or wrong, according to given instructions.

e.g. In the following statements write 'T' against each true statement and 'F' against each false statement:

1. If $\tan x = 1$, then x is equal to 90° . _____
2. $\sin A + \sin B = \sin (A+B)$. _____
3. The angle of elevation is numerically equal to the angle of depression.

- (ii) **Multiple Choice Type:** A multiple choice item consists of three parts - a **stem, a key and a number of distracters**. The key and distracters together are often called **options or choices**. The stem can either be a direct question or an incomplete statement. The **key** is the correct answer and the distracters are plausible but incorrect answers. Let us explain it with the help of an example.

Direct question: (Stem) What is 1004 divided by 2?

(Distracter) A.52

(Key) B.502

(Distracter) C. 520

(Distracter) D.5002

Incomplete statement: (Stem) All natural numbers and 0 are called the

(Distracter) A. Prime numbers

(Distracter) B. Integers

(Key) C. Whole numbers

(Distracter) D. Rational numbers

- (iii) **Matching Type:** The matching type item consists of two lists and students are required to correlate correctly one or more entries from one list with one or more entries from the other. Let us take an example to clarify the matching type question.

Match the trigonometric ratios of column I which are equal to those in column II

Column I

$\tan 45^\circ$

$\sin 30^\circ$

$\tan 60^\circ$

$\operatorname{cosec} 45^\circ$

Column II

$\cos 60^\circ$

$\sec 45^\circ$

$\cos 0^\circ$

$\cot 30^\circ$

$\sin 90^\circ$

Check Your Progress-1

Notes: a) Write your answers in the space given below:

b) Compare your answers with those given at the end of the lesson.

1. What do you mean by objective type tests ?

2. What are the types of objective type tests ?

9.3.3 Construction of an Objective Type Test Item

In this section, you will see the various forms in which an objective type test item can be constructed. However, it is not easy to construct a good quality objective type test item. Here we will discuss some of the points which you have to keep in mind while constructing different types of items of an objective type test item.

9.3.3.1 Supply Type

While using any form (short answer or completion) of supply type question, you have to be very certain that one and only one word (or group of words) can fill the blank correctly or is the correct answer. If a blank can be filled by two different words, such an item should not be constructed. The most distinguishing characteristic

of an objective type test item is that there is one and only one correct answer to it, which ensures its objectivity in scoring.

Let us see the following example:

Find the solution of $x^2 - 4 = 0$. Now the answer to this question could be either 2 or -2 and both of these are correct. Those of you, who have constructed such an item, might be having one learning outcome in mind while constructing the item, whereas a student may understand it differently.

It has been observed that students make mistakes and, therefore, while supplying a correct answer, a student may still make a mistake and to penalize him/her for it becomes a subjective issue, where different teachers may have varying opinions. For example, the answer supplied by the student is correct but he/she has misspelled the word. Thus, it is advisable that supply type questions should only be used in places where the learning outcome cannot be tested by selection type items and even care must be taken that the student is required to supply as brief an answer as possible. More a student writes, more are the chances of making extraneous mistakes. In order to avoid this ambiguity, more than one blank should not be provided in a single item.

9.3.3.2 Selection Type

As the expression indicates, students have to select the best answer in such questions. Clear/unambiguous instruction items of each of true-false, multiple choice and matching type should be separately clubbed in an objective type test and preceded by a clear cut unambiguous instruction to students, so that they know as to how they are expected to indicate their preference. Space should also be marked for indicating the choice. It is necessary that space is provided for putting tick () mark or cross (X) mark and this is adequately explained in the instruction. The instruction may be “Answer the following statements. Put a tick mark if you think that it is right and cross mark if you think that it is wrong.”

For true-false items instruction and example could be written in this manner: Given below are five statements, some of them are correct and some are not. Write T in the box given against the statement if you consider it to be correct and F if you consider it to be incorrect.

For multiple choice items, the instruction and examples may be provided as follows: For each of the questions given below, four possible answers A, B, C, D are given. Only one of them is correct. Put the letter of the answer you consider correct in the box given at the end of each question.

All selection type items are basically multiple choice items. In case of true/false type, multiplicity is just two whereas the multiplicity increases in a multiple choice item (as there are four choices, multiplicity is four). The multiplicity becomes maximum in a matching type where it is equal to the number of entries in the column, and which has higher number of entries as each entry of the other column is to be matched against the entries in this column. If Column A has five entries and Column B has seven entries then for each entry in Column A, there are seven choices with which it can be matched or the multiplicity is 7. Therefore, the form in which the question is constructed also has an impact on its difficulty level.

A question when asked in a true-false form is the simplest and the matching type format is the most difficult form for the same question. Thus, by changing its form, we can make a question either more or less difficult. As stated above, all types of selection type test items are basically multiple choice items.

- a) **Multiple Choice Items:** We shall now discuss multiple choice items in detail. We know that a multiple choice item has a stem, a key and distracters. Though stem can either be a direct question or an incomplete sentence, they, however, should not be mixed in the same test. Either construct all questions in such a manner that their stems are direct questions or they are all incomplete statements. Each multiple choice item must contain one and only one key (correct response). The most crucial element in a multiple choice item is its

distracters. As the name signifies, distracters are included to distract a student who is not sure of the correct response (key) and tries to guess the correct response. You as an item constructor need to find answers to the questions like:

- (i) How many distracters should be used?
- (ii) How should they be placed in a particular multiple choice item i.e. A, B, C should be distracters and D the key or any other permutation.
- (iii) A particular permutation should be used and in what percentage of items.
- (iv) And of course, the most crucial question is, what should be the distracters in a particular item?

Generally, a total of four alternatives (1 key + 3 distracters) are used in an item of this type. But there is no binding, one may use more or less number of distracters also. If there is only one distracter in a particular item i.e. total alternatives are two (1 key + 1 distracter), the item reduces to **true/false type**, as there are two alternatives in T/F type also. Thus, a multiple choice item should have at least more than two distracters. Increase in number of distracters only increases the multiplicity or the difficulty level of the item. Moreover, it becomes difficult to construct many distracters which are equally strong and have equal ability to distract (the point will be discussed later). But if you feel that having more distracters will be useful for some reason and are able to construct meaningful distracters, you can do so. However, same number of distracters should be used in all the items in a given test. The key to the quality of a multiple choice item is the quality of distracters used in the item. In an ideal item, each distracter should have equal power to distract the student. (How can we have this idea will be discussed in a later section on distracter analysis).

e.g. **Poor Example-** What is 1004 divided by 2 ?

A. 52 B. **502** C. 5200 D. 5002

This is a poor example as distracters are too obviously wrong.

Better Example- A clock strikes once at 1 o'clock, twice at 2 o'clock, thrice at 3 o'clock and so on. How many times will it strike in 24 hours?

A. 146 B. 136 C. **156** D. 196

Thus, it is imperative that all distracters have the same distracting power. You should remember the following points while constructing a multiple choice item.

- i. The stem of the item should be meaningful by itself and should present a definite problem.
- ii. The stem should include as much of the item as possible and should be free from irrelevant material.
- iii. Use a negatively stated stem only when significant learning outcome requires it. Generally we are not interested in knowing the principle which does not apply or a method which is not important. More important learning requires knowing the principle which is applicable and a method which is important. However, in certain cases a negative information may also be important and, therefore, it could be tested.
- iv. All of the alternatives should be grammatically consistent with the stem of the item.
- v. The relative length of the alternatives should not provide a clue to the answer.

b) True-false items: While constructing a true-false type item, you may keep the following points in mind:

- i. Avoid broad general statements. Words like generally, usually, commonly, often, etc., help the students to guess.

- ii. (b) Avoid long complex sentences and use of words which are not likely to be part of students' vocabulary.
 - iii. (c) Avoid putting two ideas in one statement.
 - iv. (d) The number of true statements and false statements should be approximately equal. Some students have a tendency to mark T when in doubt, whereas some students have a tendency to mark F when in doubt. Neither response set should be favored by overloading the test with items of one type.
- c) **Matching Type Items:** Some points to keep in mind while constructing a matching type item.
- i. As stated above, in a matching type item for each entry in Column A, all entries in Column B should be plausible alternatives.
 - ii. (b) There should not be a clue in the alternatives.
 - iii. (c) Within one matching test item, use a common approach such as all terms and definitions or all principles and the scenarios to which they apply.
 - iv. Ideally there should be more responses than premises so that the remaining responses don't work as hint to the correct answer.

9.3.4 Assembling, Administering and Scoring the Test

Once the items are prepared you have to organize them into a test in such a manner that students find it easy to understand how the questions are to be answered and where they have to record their answers. You should also be able to locate the answers and score them conveniently. For this you find the following guidelines useful:

- Group the same type of items together, i.e., all multiple choice items at one place, all true/false items together and do the same with short answer and matching items.

- Arrange each set of items of one type from easy to difficult, that is, among the multiple choice items the easiest item should be the first and most difficult the last. Do the same with all other types of items. Number all items starting from the first, i.e., 1,2, 3, etc., to the last item.
- Write all items legibly and avoid splitting an item on two pages, i.e., writing a part of an item in the bottom line of the page and the other part on the next page should not be done.
- Before each group of items, write simple and clear instructions for students telling them how and where to write the answer and read directions in sample items given earlier. Each set of items needs different directions.

Administration: It is better if you give each student a copy of the test to work on rather than make them copy the test written on the blackboard. Make sure that all the students are seated in a manner that they have reasonable elbow room and desk space and also ensure sufficient light and ventilation in the room where the test is conducted.

Scoring the test: Prepare an answer key for all the objective type items of the test in advance. For short answer items write out the solution steps and marking procedure for each step. After the answer sheets are scored it is desirable to tabulate and analyze the scores to get information about the level of performance of the class as a whole as well as of individual students.

9.3.5 Merits of Objective Type Test:

- a. Objective type test gives scope for wider sampling of the content.
- b. It can be scored objectively and easily. The scoring will not vary from time to time or from examiner to examiner.
- c. This test reduces (a) the role of luck and (b) cramming of expected questions. As a result, there is greater reliability and better content validity.

- d. This type of question has greater motivational value.
- e. It possesses economy of time, for it takes less time to answer than an essay test. Comparatively, many test items can be presented to students. It also saves a lot of time of the scorer.
- f. It eliminates extraneous (irrelevant) factors such as speed of writing, fluency of expression, literary style, good handwriting, neatness, etc.
- g. It measures the higher mental processes of understanding, application, analysis, prediction and interpretation.
- h. It permits stencil, machine or clerical scoring. Thus scoring is very easy.
- i. Linguistic ability is not required.

9.3.6 Limitations of Objective Type Test

- a. Objectives like ability to organize matter, ability to present matter logically and in a coherent fashion, etc., cannot be evaluated.
- b. Guessing is possible. No doubt the chances of success may be reduced by the inclusion of a large number of items.
- c. If a respondent marks all responses as correct, the result may be misleading.
- d. Construction of the objective test items is difficult while answering them is quite easy.
- e. They demand more of analysis than synthesis.
- f. Linguistic ability of the testee is not at all tested.
- g. Printing cost considerably greater than that of an essay test.

Check Your Progress-2

Note: a) Write your answers in the space given below:

b) Compare your answers with those given at the end of the lesson.

1. Write any two guidelines while constructing true/false questions.

2. Write any two delimitations of objective type tests.

9.4 ESSAY TYPE TESTS

9.4.1 Meaning of Essay Type Tests

Essay type tests are tests that require students to structure a long written response up to several paragraphs. In a mathematics test, we use essay items only when we want to assess communication skills besides logical ability and precision in thinking. Essay tests let students display their overall understanding of a topic and demonstrate their ability to think critically, organize their thoughts, and be creative and original. In these items students are required to select, organize and integrate information before writing out the answers as you can see in the following examples of essay items.

Item 1: From an external point construct a tangent to a given circle. This item requires the student to draw the construction, discuss the steps of construction and write out the proof.

Item 2: Prove that is an irrational number. In this item, the student is expected to show an understanding of deductive proof as well as demonstrate the skill to communicate each step logically.

Item 3: A boat is being rowed away from a cliff 150 meters high. From the top of the cliff the angle of depression of the boat changes from 60° to 40° in two minutes. Find the speed of the boat. This item requires the student to translate the given information correctly into symbolic form and then write out the solution giving the rationale for each step.

While essay and short-answer questions are easier to design than multiple-choice tests, they are more difficult and time-consuming to score. Moreover, essay tests can suffer from unreliable grading; that is, grades on the same response may vary from reader to reader or from time to time by the same reader. For this reason, some faculty prefers short-answer items to essay tests. On the other hand, essay tests are the best measure of students' skills in higher-order thinking and written expression. Essay type tests provide a better indication of pupil's real achievement in learning. The answers provide a clue to nature and quality of the pupil's thought process. That is, we can assess how the pupil presents his ideas (whether his manner of presentation is coherent, logical and systematic) and how he concludes. In other words, the answer of the pupil reveals the structure, dynamics and functioning of pupil's mental life.

Gilbert Sax (1986) believes that "*essay test is a test containing questions requiring the student to respond in writing. Essay tests emphasize recall rather than recognition of the correct alternative. Essay tests may require relatively brief responses or extended responses.*"

Robert L E and David A F *An essay test presents one or more questions or other tasks that require extended and written responses from the person being tested.*

9.4.2 Forms of Essay Type Tests

The freedom of response provided by long answer tests or essay tests can be a matter of degrees. In order to attain objectivity, even a long answer test can be very specific. The variations in freedom of response tend to fall along a continuum between two extremes (of a few sentences to several pages of answer). Depending upon the

length of expected response, such tests can be classified into: (i) Restricted response type and (ii) Extended response type.

- (i) **Restricted response type:** Restricted response questions usually limit the size of the expected answers (limits should not be artificial only). In order to restrict the size of the response, it is desirable that scope of the content should be restricted by indicating size, time and intent of expected responses.

e.g.: Answer the following question (in 50 words).

What is the radius of a circle that has a circumference of 3.14 meters?

Factor $3x^3y^2 - 48y^3$.

- (ii) **Extended response type:** Extended response type questions are used to provide greater freedom of response. On the one hand, this freedom will enable the learners to select appropriate factual information, organize, integrate and evaluate ideas, while on the other hand this freedom makes the extended response test items ineffective in covering more areas of learning objectives/ subject course content for measurement and introduces scoring difficulties with increase in subjectivity.

e.g. Mary learned that ants have 6 legs and spiders have 8 legs. He went to the forest preserve and saw an exhibit that had both ants and spiders. Mary counted a total of 36 legs in the exhibit. There were a total of 5 animals in the exhibit. How many ants and how many spiders are there in the exhibit? Show all your work. Explain in words how you found your answer. Tell why you took the steps you did to solve the problem.

9.4.3 Construction of Essay Type Test

While writing essay questions a proper planning is needed. The course objectives should be clearly defined in terms of measurable learning outcomes.. It also includes the relative weightage (scores, number of questions of each type), and tentative time.

Guidelines for Constructing Essay Questions

- Testing with the help of such questions requires attention of the paper setter on two main issues: How to construct such questions that can represent the desired learning outcome?
- How to score reliably the achievement of the learners?

A few suggestions are mentioned as guidelines for writing essay questions.

- I. Essay questions should be used only when learning outcomes cannot be measured by objective type questions.
- II. Question should be so worded that its intent is objectively stated. (i.e. to convey the meaning and scope of the answer and it should be interpreted in the same way by paper setter, examinee learner and scorer).
- III. There should not be any optional questions. If optional questions are provided to students, the common basis for evaluating learners' achievement is lost and different students are being evaluated for different learning outcomes. This provides a distorted measure of students' achievement and may lead to preparing for examination selectively.

The questions framed should be based on well defined instructional objectives. Some of the instructional objectives which can be assessed with the help of essay type questions are given as under:

Domain of behaviour (Instructional objectives)	Key words (Sample of be
	To compare To give reason To justify To infer Generalize
Application	To apply principles
Analysis	To identify Distinguish Analyse organizational str
193 Synthesis	Writing a theme Formulates a scheme or pl - Reconstruction of ideas
Evaluation	Judging value of work or p Making an appraisal Drawing conclusion about Use of criteria

Application	To apply principles
Analysis	To identify Distinguish Analyse organizational structure
Synthesis	Writing a theme Formulates a scheme or plan of action - Reconstruction of ideas
Evaluation	Judging value of work or policy Making an appraisal Drawing conclusion about impacts etc Use of criteria

- V. It is desired that specific time limits and scores may be indicated of each question depending upon expected length and depth of its answer required. It may be indicated either in introductory notes or in the parenthesis after each question. Since essay questions emphasize the speed, fewer questions with generous time limits should be provided.

9.4.4 Scoring of Essay Questions

Essay question should be, so constructed that it conveys the same meaning to learner, scorer and any other person. Beside other factors, the score is influenced by the language of question itself. Therefore, it is suggested that essay type questions should be so constructed that paper setter, learner and scorer all understand it in the same way with regard to its meaning, scope, size and time required. Needless to mention that no degree of proficiency in evaluating responses can compensate for poorly phrased questions. The following suggestions can be used effectively to increase the reliability of the scoring procedures:

- (i) A model answer along with a suitable scoring key should be provided to all evaluators.
- (ii) Analytic method of scoring rather than holistic method should be used. **Analytical method** employs molecular approach. Evaluator can identify the crucial elements of an ideal response. Scorer should identify the missing elements in learner's response. The crucial elements included in the students' responses are: organization, integration and relations between crucial elements. Analytical scoring is felt sometime cumbersome and tedious but its merit can't be ignored. On the other hand, **'holistic method'** involves scoring a response on the basis of global impression formed by the evaluator.
- (iii) Irrelevant criteria/factors should be controlled. There are some factors which can influence evaluation of essay questions but they are not pertinent to learning objectives being measured e.g. handwriting, sentence structure, punctuation, neatness etc. are to be ignored while scoring if not included as one of the objectives.
- (iv) **Avoid 'Halo effect':** 'Halo effect' in the scoring of essay question comes, when general impression about a person on the basis of scoring of one or two question(s) influences score(s) of subsequent questions. The evaluator should keep this factor in mind. However, to improve reliability, independent scoring of the answers to each question should be done though it is certainly troublesome and time consuming to carry out.
- (v) **Avoid students' identity:** "Halo effect" may also be influenced because of general impression of the teacher about a student. It would be better if the teacher rearranges answer books in random order and does not look at the identity of the students. One of the simplest ways would be to write only roll numbers and other particulars at the back of the answer books. However, strong intention of the evaluator to know the identity of the students can't be concealed.

9.4.5 Merits of the Essay Type Test

1. It is relatively easier to prepare and administer a six-question extended-response essay test than to prepare and administer a comparable 60-item multiple-choice test items.
2. It is the only means that can assess an examinee's ability to organize and present his ideas in a logical and coherent fashion.
3. It can be successfully employed for practically all the school subjects.
4. Some of the objectives such as ability to organize idea effectively, ability to criticize or justify a statement, ability to interpret, etc., can be best measured by this type of test.
5. Logical thinking and critical reasoning, systematic presentation, etc. can be best developed by this type of test.
6. It helps to induce good study habits such as making outlines and summaries, organizing the arguments for and against, etc.
7. The students can show their initiative, the originality of their thought and the fertility of their imagination as they are permitted freedom of response
8. The responses of the students need not be completely right or wrong. All degrees of comprehensiveness and accuracy are possible.
9. It largely eliminates guessing.
10. They are valuable in testing the functional knowledge and power of expression of the pupil.

9.4.6 Limitations of Essay Type Tests

1. These tests do not give scope for larger sampling of content. You cannot sample the course content so well with six lengthy essay questions as you can with 60 multiple choice test items.

2. Such tests encourage selective reading and emphasize cramming.
3. Moreover, scoring may be affected by spelling, good handwriting, coloured ink, neatness, grammar, length of the answer, etc.
4. The long-answer type questions are less valid and less reliable, and as such they have little predictive value.
5. It requires an excessive time on the part of students to write; while assessing, reading essays is very time-consuming and laborious.
6. It can be assessed only by a teacher or competent professionals.
7. Improper and ambiguous wording handicaps both the students and evaluator.
8. Mood of the examiner affects the scoring of answer scripts.
9. There is halo effect-biased judgment by previous impressions.
10. The scores may be affected by his personal bias or partiality for a particular point of view, his way of understanding the question, his weightage to different aspect of the answer, favoritism and nepotism, etc.

Check Your Progress-3

Notes: a) Write your answers in the space given below:

b) Compare your answers with those given at the end of the lesson.

1. When do you essay type tests ?

2. Write any two points which should be kept in mind while scoring essay type test.

9.5 LET US SUM UP

An objective type test is one which is free from any subjective bias either from the tester or the marker. It refers to any written test that requires the examinee to select the correct answer from among one or more of several alternatives or supply a word or two and that demand an objective judgment when it is scored. Whereas they are excellent for sampling knowledge, it is much more difficult to construct items to test higher order skills. The essay questions or long answer questions are best, put to use to measure those learning outcomes that cannot be measured by short answer questions or objective tests and are complex in nature. They may broadly include, a) to construct response rather than simple identification or selection, of responses including interpretative, application type test items. b) to measure ability that need selection of appropriate solution, organization, integration, explanation, discrimination, evaluation, analysis, synthesis like abilities among learners. Evaluation of objective tests is easy as the teacher gives an objective judgment for which there is prior agreement on what constitutes the correct answer. Evaluation of essay questions can be improved by taking suitable measures like making the intent of question very objective, scoring analytically by comparing answer with standard answers, ignoring irrelevant factors, and scoring without looking into students' identity.

9.6 LESSON END EXERCISE

- 1) Describe the construction of objective type tests in detail.
- 2) Explain construction of essay type test and also their scoring guidelines.

9.7 SUGGESTED FURTHER READINGS

Aggarwal, S.M. (1994). *Teaching of Modern Mathematics*. New Delhi: Dhanpat Rai & Sons.

Carey, L.M. (1998). *Measuring and Evaluating School Learning*. Boston: Allyn and Bacon.

Ebel, R.L., & Frisbie, D.A. (1986). *Essentials of Educational Measurement*. 4th. ed. N.J.: Prentice Hall, Englewood Cliffs.

Gronlund, N.E., & Linn, R.L. (1990). *Measuring and Evaluating in Teaching*. New York: MacMillan.

Hopkins, K.D., & Stanley, J.C. (1981). *Educational and Psychological Measurement and Evaluation*. N.J. : Prentice Hall, EnglewoodCliffs.

Mehrens, W.A., & Lehann, I.J. (1984). *Measurement and Evaluation in Education and Psychology*. New York: Holt Rinehart & Winston.

Nitko, A.J. (1983). *Educational Tests and Measurement: An Introduction*. New York: Hartcourt Brace Jovanovich.

9.8 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress-1

- 1) Objective type test is defined as one for which the scoring rules are so specific that they do not allow students to make subjective inferences or judgments.
- 2) Objective items can be classified into two categories:
supply type which requires students to supply the answer and
selection type which requires them to select the answer from a given number of alternatives.

Check Your Progress-2

- 1) a) Avoid broad general statements. Words like generally, usually, commonly, often, etc., help the students to guess.
- (b) Avoid long complex sentences and use of words which are not likely to be part of students' vocabulary.

- 2) a) Objectives like ability to organize matter, ability to present matter logically and in a coherent fashion, etc., cannot be evaluated.
- b) Guessing is possible. No doubt the chances of success may be reduced by the inclusion of a large number of items.

Check Your Progress-3

- 1) Essay type test is used when we want to assess communication skills of students, their ability to think critically, organize their thoughts, and be creative and original.
- 2) a) A model answer along with a suitable scoring key should be provided to all evaluators.
- b) Analytic method of scoring rather than holistic method should be used.

DIAGNOSTIC TESTING IN MATHEMATICS

Structure

- 10.1 Introduction
- 10.2 Objectives
- 10.3 Definitions of Diagnostic Test
- 10.4 Objectives of Diagnostic Test
- 10.5 Salient Features of Diagnostic Test
- 10.6 Dimensions of Diagnostic Test
- 10.7 Materials used in Diagnostic Test
- 10.8 Construction of a Diagnostic Test
- 10.9 Remedial Teaching and Preventive Measures
- 10.10 Examples of Diagnostic Test in Mathematics
 - 10.10.1 Basic Algebra
 - 10.10.2 Square Root
- 10.11 Barriers in Diagnostic Teaching

10.12 Let Us Sum Up

10.13 Lesson End Exercise

10.14 Suggested Further Readings

10.15 Answer to Check Your Progress

10.1 INTRODUCTION

The term diagnosis has been borrowed from the medical profession. It means identification of disease by means of patient's symptoms. For example, when a patient comes to a doctor, the doctor initially puts some questions to the patient to gather some basic information about the disease and then uses other techniques to get more related information to identify the disease and its probable cause(s). After careful analysis of these data, he prescribes the medicines as remedial treatment. Similarly, in the field of education, diagnosis has many such implications. Difficulties in learning occur frequently at all levels and among pupils of both high and low mental ability. In order to handle such cases, the teacher also uses similar techniques like a doctor to diagnose the relative strengths and weaknesses of pupil in the specific area of study, analyse the causes for the same and then provides remedial measures as per necessity.

Since tools and techniques used in mental measurements are not that exact, objective and precise like the tools and techniques used in sciences, the teachers are cautioned to use the diagnostic data with great care for designing remedial programmes. Diagnostic test is a test used to diagnose strength and weakness of the learning in certain areas of study whereas diagnostic evaluation is centred on schooling process such as the curriculum programme, administration and so on. Further in this lesson, we'll study the same.

10.2 OBJECTIVES

After going through this lesson you shall be able to:

- explain the aims of diagnostic test,

- enlist various steps involved in construction of diagnostic test in mathematics,
- discuss the concept of remedial teaching, and
- prepare Error Analysis Chart

10.3 DEFINITIONS OF DIAGNOSTIC TEST

Thorndike and Hagen (1970) suggested that a diagnostic test should provide a detailed picture of strengths and weaknesses of a pupil in particular area. Any test that yields more than a single overall score is diagnostic. Diagnosis has become an essential phase of developing plans of adaptational instruction to individual differences.

Literally, diagnostic testing stands for the testing and evaluation programme carried out for the diagnosis of something. Educational efforts are aimed to bring desirable behavioural changes for an all-round development, in the personality of the learner. However many times these efforts may not yield the satisfactory results or the individual students may not be duly benefitted through such efforts resulting into one or the other kinds of behavioural problems or educationally failure. Going in this way, the need of diagnostic testing arises in the subject mathematics specifically at the time when a particular student exhibits some or the other signs and symptoms of his failure or difficulties with regard to the learning of the subject mathematics. Why is one subjected to repeated failure in the subject mathematics? Why is he feeling difficulty in learning a particular concept or skill in one or the other branches and topics of mathematics? Why is he not attending the classes in the subject mathematics? Why does he create fuss or problems in the mathematics class? Why does he hate the teacher of mathematics and his subject? The list may be quite exhaustive with regard to such day to day or occasional problems faced by a teacher of mathematics with his one or more students.

It can be easily concluded from the above discussion that diagnostic testing and remedial teaching are inter-related and complementary to each other. However, the diagnosis not followed by the remedial treatment is useless. Similarly, a remedial task not based on the diagnosis of the nature and extent of the weaknesses may prove

not only the wastage of the resources but can also prove dangerous to the wellbeing of the affected persons. It is, therefore, essential that diagnostic testing in mathematics should necessarily be followed by the suitable remedial teaching. In fact, neither diagnostic testing nor remedial teaching should ever be considered in isolation. They should form a part of a cycle known as diagnostic testing and Remedial teaching cycle which may be considered to involve the following processes for its complete execution.

10.4 OBJECTIVES OF DIAGNOSTIC TEST

Following are the chief objectives of diagnostic tests:

1. To provide educational and vocational guidance to students and guardians on the basis of traits realized from specific subject-related learning unit.
2. To make teaching-learning circumstances effective.
3. To make evaluation process more meaningful and effective.
4. To arrange for remedial teaching.
5. To give advice to a teacher for proper improvement in his/ her teaching process.
6. To know about the weaknesses, deficiencies and difficulties of a student.
7. To assist in the selection of different tests, techniques and tools for knowing the causes related to the problem.
8. To assist in the selection of different types of questions for the construction of different achievement tests.
9. To amend textbooks of different subjects on the basis of the specific points and shortcomings and to make them more useful for students.

10.5 SALIENT FEATURES OF DIAGNOSTIC TEST

- (i) The diagnostic test takes up where the formative test leaves off.
- (ii) A diagnostic test is a means by which an individual profile is examined and compared against certain norms or criteria.
- (iii) Diagnostic test focuses on individual's educational weakness or learning deficiency and identify the gaps in pupils.
- (iv) Diagnostic test is more intensive and act as a tool for analysis of Learning Difficulties.
- (v) Diagnostic test is more often limited to low ability students.
- (vi) Diagnostic test is corrective in nature.
- (vii) Diagnostic test pinpoint the specific types of error each pupil is making and searches for underlying causes of the problem.
- (viii) Diagnostic test is much more comprehensive.
- (ix) Diagnostic test helps us to identify the trouble spots and discovered those areas of students' weakness that are unresolved by formative test.

Check Your Progress – 1

Note: (a) Answers the question given below:

(b) Compare your answer with those given at the end of the lesson:

(i) Diagnostic test is used to diagnose And of the learning in certain areas:

A. Strength, Weakness

B. Dullness, Brightness

C. Evaluate, Measure

D. All of the above.

- (ii) Diagnostic test is _____ in nature.
- (iii) Diagnostic test is more often limited to _____ students.
- (iv) The purpose of diagnostic test is to arrange for _____

10.6 DIMENSIONS OF DIAGNOSTIC TEST

- (i) Who can conduct '! Teacher/ Researcher
- (ii) Where '! School/Home/Work places
- (iii) On whom '! Learners
- (iv) Purpose '! Specific strength and weakness of the learner in a particular area.
- (v) Length of time '! Flexible in nature
- (vi) Techniques '! Test/ observation/ interview etc. Assessment
- (vii) Sequence '! Logical and step by step
- (vii) Method '! Negotiable/Therapeutic Remediation
- (ix) Support to '! Learner/Parents/Teacher

10.7 MATERIALS USED IN DIAGNOSTIC TEST

Classroom teachers, principals, supervisors and qualified diagnosticians use the following resources and materials in making educational diagnoses more vibrant:

1. Test records (Standardized and Teacher made).
2. Pupils' written work (themes, compositions, home assignments and test papers).
3. Pupils' oral work (discussion, speeches and oral reading).

4. Pupils' work habits (in class activities, participation, peer relationship, independent work, interest, effort etc.).
5. Physical and health records (school and family records about vision, hearing, dental, general).
6. Guidance and cumulative record data (family) background, anecdotal references, school activities).
7. Interview with pupil (problem or trouble and elimination of misconceptions).
8. Parent conference (pupil problems at home, parent interpretation).
9. Self-guidance (completing assignments, independent work and seeking teacher help).
10. Clinic or laboratory aids (vision tester, audio-meter eye photographs, tape recorder etc.).

10.8 CONSTRUCTION OF DIAGNOSTIC TEST

In general this task may involve the following three stages:

- A) Planning for the construction of the diagnostic test.
- B) Construction of the Diagnostic test.
- C) Administration and Interpretation of the Diagnostic test.

A. Planning

Planning is very much essential for the construction of a diagnostic test. Usually, it may involve the following considerations:

(i) Identifying the Areas of Weakness or Learning Difficulties

First of all the need of constructing a diagnostic test should be properly identified. It may be based on the findings of the achievement test, classroom

drill, and practice work, homework, and assignments, classroom behaviour of the students etc. The performance and behaviour of the students of the class (or a particular student) during such evaluation encounters may provide a clue or evidence of some or the other types of weaknesses and learning difficulties suffered by the students (or a particular student) in one or the other learning areas of mathematics.

(ii) Isolating a Unit, Sub-Unit or Base for Diagnosing in Depth

Suppose, section B of the class IX (or one or the other particular students) has demonstrated a quite poor performance in the subject mathematics. What are the different weak areas? Certainly, it needs a careful analysis of the results of performance tests and academic encounter with the students.

(iii) Content Analysis

The contents of the sub unit or a single concept should then be further analysed to determine;

- the pre-requisite behaviour i.e. the previous knowledge, skills etc. needed for the learning of a particular sub-unit or a single concept
- the expected behaviour demonstrated by the learner after learning the contents related to that unit or a single concept:

(iv) Deciding about the Nature of the Items of the Test

A proper decision should then be taken about the nature and numbers of the items of the diagnostic test since it should be as exhaustive, detailed and lengthy as possible, hence there must be more weight age to the short and very short answer type questions in comparison to the large and essay type questions

(v) Taking Decision about Necessary Administrative Measures

It is better to take a decision regarding the various administrative functioning of the test before sitting for its construction like the time limit, direction for the proper administration at the test scoring and interpretation etc.

B. Construction of the Diagnostic Test

In view of the things planned at the planning stage now attempts should be made to select appropriate items for being included in the proposed diagnostic test. This selection is mainly focused on the following three aspects.

- a) The nature of the contents.
- b) The previous knowledge, skills needed for learning.
- c) The terminal behaviour i.e. knowledge, skills, and application etc. acquired by the students after studying the contents.

C) Administration and Interpretation of the Diagnostic Test

The constructed diagnostic test should now be administered to the class for knowing about the weaknesses and learning difficulties pertaining to the learning of the sub unit or a single concept. The necessary directions related to the proper administration of the test should here be clearly explained or demonstrated to the students. When they have finished their task, the answer sheets along with the test paper should be carefully collected for the analysis and interpretation of their responses. For this purpose, these may be scored on the basis of the scoring key and model answers suggested in the constructed test. Further weakness is diagnosed and accordingly the remedial teaching is designed.

10.9 REMEDIAL TEACHING AND PREVENTIVE MEASURES

1. Remedial Teaching

Remedial-Teaching is conducted to eradicate the shortcomings which are found out by the diagnostic tests. The success of remedial measures depends on the fact how widely the teacher knows of the students' shortcomings. The plan for individual or collective remedial measures are adopted according to the nature of shortcomings. It is necessary that the remedies of shortcomings are

done readily and immediately, else the shortcomings may become permanent. For remedial measures, the students are divided into different groups, as dull, common and intelligent, etc. The collective and individual remedial measures for these different groups are prepared differently for each of these groups. The form of remedial measures are determined by the teachers, but this task must be conducted immediately. The following factors should be kept in view while conducting remedial measures:

- (1) The weak students should be asked to sit on the front seats in the class.
- (2) The development of the subject matter should be done with the help of examples and illustrations.
- (3) The attention of the students should be drawn to those concepts, principles and activities related to the subject matter in which they commit errors.
- (4) The fundamental concepts of mathematics and other subjects, such as factors, percentage, unit, square root, etc. Should be taught carefully.
- (5) The students should be provided sufficient opportunity for thinking and reasoning in the class.
- (6) The concepts should be made clear to the weak students by using models, charts and other audio-visual aids.
- (7) The matter written on the blackboard should be clear, correct, orderly and useful.
- (8) The exercises on each sub-topic should be such which the students can think about themselves.
- (9) The correction in the written work of the students should be done in their presence.

- (10) The students should be given individual counselling even after the class, to help them in learning.

Despite the different methods and techniques needed for remediation, there are guiding principles:

1. Remediation should be accompanied by the strong motivational programme.
2. Remediation should be individualised in terms of the psychology of learning,
3. There should be continuous evaluation giving the pupil a knowledge of results.
4. Remediation programme may not always need a separate time allocation but they will always need some extra work for both the teachers and the affected students. Following are some key points for remedial teaching:
 - (a) These methods are not full proof against idiots.
 - (b) If remedial work does not succeed, then the form of the programme should be changed.
 - (c) The students who are making progress should be admired for motivation.
 - (d) These tests are not so successful with brilliant students as they are effective with dull students.
 - (e) It may take time to eradicate bad habits of brilliant students, therefore, a teacher should work with patience.
 - (f) There should be a graph and chart of each students' progress.
 - (g) The subject in which a student is weak, he should be given related literature, magazines, periodicals etc. To read.
 - (h) In order to make work more lively, attractive aids and effective method of teaching should be used.

2. Preventive Measures

If we desire that a student may not commit any error in the subject in future, then we should effect such changes in his school and domestic environment so that his problem of maladjustment can be permanently eradicated. For this, we have to construct a multidimensional project, so that the student can be given a suitable environment; such as, improvement in school environment, amendment to curriculum, improvement in examination system, construction of suitable ability tests, better environment etc. Prognostic tests can be administered to see whether a student is ready to learn abstract topics or not. When a student is weak in learning arithmetic as well as lacks intelligence, it would be proper to teach him generalized arithmetic. A prognostic test is constructed with this in view. These tests predict a student's learning in future. Students are given individual remediation as follows:

- 1 Drill work to practice problems.
2. The practice of geometrical figures.
3. Video clipping to remember the definition of concepts.
4. Review work for finding the areas.

Check Your Progress – 2

Note: (a) Answer the questions given below:

(b) Compare your answer with those given at the end of the lesson:

- (i) Remedial Teaching is based on:
- A. Diagnosis
 - B. Preventive Measure
 - C. Educational Measure
 - D. All of the above.

(ii)	Explain the Principles of Remedial Teaching.

(iii)	Which of these does not go with remedial teaching measures in mathematics
A)	The concepts should be made clear by using teaching aids.
B)	The students should be given individual counselling
C)	The weak students should be asked to sit on back seats in the class.
D)	Remedies of shortcomings should be done immediately.

10.10 EXAMPLES OF DIAGNOSTIC TEST IN MATHEMATICS

Diagnostic Test is conducted for educational diagnosis, and remedial teaching is conducted on the basis of diagnosis. We shall clarify it by the following examples:

10.10.1 Example of Basic Algebra

Construction of Diagnostic Tests in Algebra:

Name of Student:

Class and section: 7A

School's Name:

Date :

Instructions

1. Some questions based on simple equations are given. Find out the value of 'x'.
2. Write the answers on the specified places.
3. Pay specific attention to neatness and cleanliness. If the space is inadequate for calculation, you may take extra sheet for rough work.

4. There is no time limit for the test, still solve all questions as soon as possible.

1. $X + 15 = 35$

2. $7x + 14 = 35$

3. $2x + \frac{23}{5} = \frac{74}{9}$

4. $3x + 0.6 = 4.5$

5. $0.05x + 7 = 14$

6. $5x - 12 = 23$

7. $7x - 13x = 49$

8. $0.023x - 17 = 19x - 30$

9. $14x + 6 = 4 - 5x$

10. $4x + 2 = 0.8x + 1$

11. $\frac{x}{4} - \frac{3x}{5} = 6$

12. $2x + \frac{3x}{9} = 8$

13. $X + \frac{2X}{3} = 18$

14. $X + 17 = 32$

15. $5x = 25$

16. $4x = \frac{2}{25}$

17. $3x - 9 = \frac{x}{15}$

18. $5x + 7x = 36$

19. $\frac{x}{4} + \frac{1}{4} = \frac{5}{4}$

20. $5(x + 3) = 20$

The above questions comprise of those based on simple equation of different forms. All questions have been constructed on the basis of maxim 'from simple to difficult'. The sole purpose of the test is to find out the difficulty level upto which the students of class VII can solve the questions. If they are not able to solve them all, then what and where their difficulties are. The above format of test can be helpful to locate the students' difficulties in simple equations. The following diagnostic chart contains the errors committed by seven students, on the basis of which we can locate their difficulties and weaknesses.

On the left side are written the students' names who are administered the diagnostic test, and on the right, different columns are noted with the different types of questions. Now, the difficulties faced by each student are marked in the related column, with details of number of times a student commits that error. The total number of questions is 20, and the number of different types of questions included in the test have been indicated in the brackets.

S. No.	Students' Names	Subtraction in equation	Multiply	Equation and fraction	Equation and decimal	Simple addition	Side difference	Scores	Absence in class	remarks
1.	Rajendra	-	-	-	-	-	-	20	1	I
2.	Nitin	-	-	-	2	1	-	17	5	III
3.	UshaPande	-	-	-	-	-	1	19	3	II
4.	Karuna Singh	1	-	4	2	-	1	12	7	V
5.	Imran	1	-	-	1	2	6	10	12	VI
6.	Jitendra	-	2	-	-	1	-	17	4	III
7.	Nishi	3	-	-	-	-	1	16	6	IV
8.	Total errors in the entire class	9	-	-	12	1	17			
9.	Number of right responses in the entire class	46	3 2	58	43	8	74 6			
10.	Total number of questions	60	3 5	60	70	1	90 0 0			
11.	Percentage of right responses	76	9 1	96	62	8	82 6			

In the above chart, the weaknesses of seven students have been analysed. It is clear from the chart that Imran is the weakest student of the class. He has obtained only 10 marks out of 20. Secondly, his absence in the class has been the highest. This can be the cause of his weakness. He has incorrectly done all six of the questions on side difference. It appears that his disinterest in the subject, carelessness, misunderstanding or absence in the class has caused him to remain weak in the subject. Rajendra is the most brilliant student of the class, who has scored 20 out of 20, which indicates that he has understood the subject well. Usha Pande too is a talented student of the class, who has mistaken in only one question. Maybe she has committed the mistake by chance. In the same way, the chart gives information about other students in the group. From the standpoint of difficulty level of questions, the percentage of students solving decimal fraction questions is very low, which is 62%. From this viewpoint, the teacher should give more exercise pertaining to these questions, and should teach them more carefully. From the standpoint of remedial teaching, Imran requires remedial teaching, else he will lag behind in the class. Thus, the above diagnostic chart is a blueprint of the weakness and difficulties of students. It indicates about a particular student what error he has committed and where, and what remedy can be arranged for him.

10.10.2 Example of Square Root

For example, take teaching of a sub-topic of mathematics: square root. Suppose, after the teacher has taught the method of finding out square root, some of the student still commit error in it. The teacher will conduct diagnostic and remedial work in this order:

1. First, the teacher will construct different questions of decimal numbers to find out square root; such as :

Find out square root of the following numbers:

- (i) 1355.23 (ii) 25.2143 (iii) 44.135678

Find out square root of the following numbers up to two decimal points:

(i) 210.7 (ii) 12345.071 (iii) 7.0357

2. He will give this question paper to the group of students which commit errors.
3. He will analyse the students' answers and then arrange their causes.

Suppose, the students commit the following errors in solving the above questions:

- a. Some students do not take down the pairs of numbers while calculating square root.
 - b. Some students do not pay attention to decimal point while making pairs.
 - c. Some students do not add zero after decimal point to make pairs.
4. On the basis of the above errors, the teacher will classify the students and prepare their lists; such as—the list of students who do not take down the pairs correctly, the list of students who overlook the decimal point, and the list of students who do not add zero after decimal point to make pairs.
 5. After this, the teacher will formulate different types of hypotheses. These hypotheses will be formulated on the basis of student-related hindering factors, teacher-related hindering factors, home-related hindering factors and culture related hindering factors. Some of the student-related and teacher-related hypotheses are given here, for illustration:

- (i) The student is not attentive in the class.
- (ii) The student thinks that mathematics is a difficult subject and overlooks to learn it.
- (iii) There is no coordination between the rate of students' learning and teacher's teaching.

- (iv) The student has not done sufficient exercise.
- (v) The teaching method is not suitable.
- (vi) The teacher has not made the students practice enough.
- (vii) The teacher has not improved the errors in checking work.

In the same way, if the teacher considers it necessary, he can also formulate hypotheses about curriculum-related, home-related, guardians-related and culture-related hindering factors.

- 6. The teacher will construct questions to test various types of hypotheses.
- 7. The teacher will select correct hypotheses by analysis of the answers to these questions.

At last, the teacher will conduct remedial teaching on the basis of correct hypotheses.

10.11 BARRIERS OF DIAGNOSTIC TEST

- (i) Attitudinal change.
- (ii) Will Power and patience of the teacher.
- (iii) Time Scheduling.
- (iv) Sequencing of Study.
- (v) Faulty method of data collection and test.
- (vi) Maintaining records impartially.
- (vii) Costs.

In this way the, corrective measures for the removal of the learning difficulties and weakness of the students in the subject mathematics must involve all the aspects and domains of the learner. Many times, the problems deficiencies and weakness do

not arise On account of a single factor. There may be multiple numbers of causes, academic, physical or emotional in character responsible for one or the other learning difficulties and weaknesses of the students in a particular area of learning aspects of the subject Mathematics.

10.12 LET US SUM UP

In this lesson you have learnt about Diagnostic Testing which is the most important part of the teaching-learning process. It implies a detailed study of learning difficulties. Its aim is to analyse, not to assess. The nature and purpose of Diagnostic Testing is to identify the areas of difficulties where the learner commits errors. The stages of diagnostic testing are: i) Identifying the students who need help. ii) Locating the error/learning difficulties. iii) Discovering the causal factors. After locating the area where the difficulty lies, as a teacher you will devise some strategy to remove problems in learning and the causes due to which the learner has faced the difficulties. The strategy used by you to remove the weakness of the learner is known as remedial teaching. Diagnostic Testing leads to remedial teaching in which you have to prepare instructional material for quality learning, adopting different methodologies as per needs of the individual or a particular group.

10.13 LESSON END EXERCISE

1. Define diagnostic test and explain its nature in detail.
2. Prepare remedial teaching material for enhancing the learning of division technique.
3. What are the barriers of diagnostic testing?
4. Explain various steps involved in construction of diagnostic test.

10.14 SUGGESTED FURTHER READINGS

Gronlund, N.E. (1965). *Measurement and Evaluation in Teaching*. New York: Macmillian

Linn, R.L. (1999). *Measurement and Assessment in Teaching*. Chennai: Pearson Education India

McDavid, James C., Huse, Irene, & Hawthorn, R.L. (2018). *Program Evaluation and Performance Measurement*. Thousands oaks: Sage Publications.

Rani, J.S. (2004). *Education Measurement and Evaluation*. New Delhi: Discovery Publishing house.

10.15 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress -1

- Ans-** (i) A
- (ii) Corrective
- (iii) Low ability
- (iv) Remedial Teaching

Check Your Progress - 2

- Ans-** (i) A
- (ii)
- Remediation should be accompanied by the strong motivational programme.

- Remediation should be individualised in terms of the psychology of learning,
 - There should be continuous evaluation giving the pupil a knowledge of results.
 - Remediation programme may not always need a separate time allocation but they will always need some extra work for both the teachers and the affected students.
- iii) C

PORTFOLIO ASSESSMENT AND PERFORMANCE ASSESSMENT

Structure

- 11.1 Introduction
- 11.2 Objectives
- 11.3 Idea Behind Portfolio Assessment
- 11.4 Definitions of Portfolio Assessment
- 11.5 Need of Portfolio Assessment
- 11.6 Characteristics of Portfolio Assessment
- 11.7 Aims of Portfolio Assessment
- 11.8 Focus and Content of Mathematics Portfolio
- 11.9 Types of Portfolio Assessment
- 11.10 Steps of Portfolio Development
 - 11.10.1 Designing the Portfolio
 - 11.10.2 Planning for and Collecting the Necessary Data
 - 11.10.3 Analysing the Portfolio Content
 - 11.10.4 Using the Results

- 11.11 Advantages of Portfolio Assessment
- 11.12 Disadvantages of Portfolio Assessment
- 11.13 Performance Assessment
- 11.14 Definitions of Performance Assessment
- 11.15 Key Components of Performance Assessment
- 11.16 Steps of Performance Assessment
- 11.17 Advantages of Performance Assessment
- 11.18 Disadvantages of Performance Assessment
- 11.19 Let Us Sum Up
- 11.20 Lesson End Exercise
- 11.21 Suggested Further Readings
- 11.22 Answer to Check Your Progress

11.1 INTRODUCTION

The ongoing reforms of mathematics instruction creates a need to refine student assessment practices. Evaluating student's computational skills by traditional methods cannot provide enough information related to the component of the overall evaluative process needed in mathematics. Current standardized tests seem like to measure performance on rote mathematical tasks instead of creating environments for students to reason, communicate, and problem solve. In present lesson we will discuss some refined assessment methods like portfolio and performance assessment.

11.2 OBJECTIVES

After going through this lesson, you shall be able to:

- explain the meaning of portfolio assessment,
- delineate the process of portfolio development,
- enumerate the merits and demerits of portfolio assessment,
- explain the meaning of performance assessment,
- describe the process of performance assessment development, and
- enumerate the merits and demerits of performance assessment.

11.3 IDEA BEHIND PORTFOLIO ASSESSMENT

In regard to measuring students' performance, NCTM (1989) states that "to demonstrate real growth in mathematical power, students need to demonstrate their ability to do major pieces of work that are more elaborate and time consuming than short exercises. Portfolio Assessment is supported by many educators, because portfolio is considered as a collection of student work representing their mathematical power, a showcase for a student work or a place where many types of assignments, projects, reports, and writing can be collected. The idea of portfolio is close enough to satisfy educators' belief that assessment is most effective when it becomes an integral part of instruction.

Portfolios present a practical approach to assembling student work, interpreting evidence of student performance, and assessing student performance relative to instructional objectives. The concept of portfolios has been adopted from the arts where students maintain evidence of their best work to illustrate their accomplishments. In classroom instruction, portfolios are used in a similar manner, but the contents of the portfolio may represent work in progress, formal products, and ratings or other evidence of student knowledge relative to specific objectives or purposes. There is

no “right” way to design portfolios. Each classroom, school, district, and state will reflect a unique approach to authentic assessment, and in this sense, each student’s collection of documents will differ somewhat, depending on the purpose of the assessment. Creating and maintaining student portfolios require that a variety of teacher and staff decisions be made concerning the instructional goals or objectives to be assessed, who will be involved in the portfolio design and interpretation, what instruments will be selected and how student performance will be demonstrated, how portfolio information will be used, and how the results will be conveyed to others. Because the entire portfolio process can be complex, systematic review and evaluation of the process should be conducted on a periodic basis.

11.4 DEFINITIONS OF PORTFOLIO ASSESSMENT

A portfolio is a purposeful collection of student work that tells the story of a student’s efforts, progress, or achievement. It must include student participation in the selection of portfolio content, criteria for selection, criteria for judging merit, and evidence of student self-reflection.

Arter, 1990 specifically defined a portfolio consists of purposeful, not random collections of student work—a number of pieces of work produced by individual students and assembled for a specific purpose.

A student portfolio is a systematic collection of student work and related material that depicts a student’s activities, accomplishments, and achievements in one or more school subjects. The collection should include evidence of student reflection and self-evaluation, guidelines for selecting the portfolio contents, and criteria for judging the quality of the work. The goal is to help students assemble portfolios that illustrate their talents, represent their writing capabilities, and tell their stories of school achievement.

After going through the above definitions it is clear that portfolio assessment:

- is the use of records of a student’s work over time and in a variety of modes to show the depth, breadth, and development of the student’s abilities;

- is the purposeful and systematic collection of student work that reflects accomplishment relative to specific instructional goals or objectives;
- can be used as an approach for combining the information from both alternative and standardized assessments; and has as key elements student reflection and self-monitoring.

11.5 NEED OF PORTFOLIO ASSESSMENT

In this new era of performance assessment related to the monitoring of students' mastery of a core curriculum, portfolios can enhance the assessment process by revealing a range of skills and understandings one student possesses; support instructional goals; reflect change and growth over a period of time; encourage student, teacher, and parent reflection; and provide for continuity in education from one year to the next. Instructors can use them for a variety of specific purposes, including :

1. Encouraging self-directed learning.
2. Enlarging the view of what is learned.
3. Fostering learning about learning.
4. Demonstrating progress toward identified outcomes.
5. Creating an inter section for instruction and assessment.
6. Providing a way for students to value themselves as learners.
7. Offering opportunities for peer-supported growth.
8. To give students the opportunity to reflect on their growth over a period of time
9. To use as a basis for assigning grades (based on effort)
10. To use as a basis for communication with parents
11. As placement/entrance requirements.

11.6 CHARACTERISTICS OF PORTFOLIO ASSESSMENT

Following are the characteristics of Portfolio Assessment:

- Focus is on development of self-evaluation skills.
- Teacher and students must meet to discuss evaluations (teachers can get a good window into students' understanding of their progress).
- In addition to improving instruction, the goal is to help student internalize criteria for excellence.
- Can be used for student-directed conferences with parents
- Focus is on evaluation of student work in its entirety and certifying accomplishment.
- Teacher should provide student with clear guidelines about content of portfolio and scoring criteria.
- If used to assess program goals, the content and organization of portfolios must be highly standardized.

11.7 AIMS OF PORTFOLIO ASSESSMENT

Why might you use a portfolio assignment? Portfolios typically are created for one of the following three purposes: to show growth, to showcase current abilities, and to evaluate cumulative achievement. Some examples of such purposes include:

1. Growth Portfolios
 - (a) To show growth or change overtime
 - (b) To help develop process skills such as self-evaluation and goal-setting
 - (c) To identify strengths and weaknesses
 - (d) To track the development of one more products/performances

2. Showcase Portfolios

- (a) to showcase end-of-year/semester accomplishments
- (b) to prepare a sample of best work for employment or college admission
- (c) to showcase student perceptions of favourite, best or most important work
- (d) to communicate a student’s current aptitude to future teachers

3. Evaluation Portfolios

- (a) to document achievement for grading
- (b) to document progress towards standards
- (c) to place students appropriately.

Growth Portfolios: What samples might be included ?

Purpose	Some possible inclusions
(a) to show growth or change over time	<ul style="list-style-type: none"> • early and later pieces of work • early and later tests/scores • rough drafts and final drafts • reflections on growth • goal-setting sheets • reflections on progress toward goal(s)
(b) to help develop process skills	<ul style="list-style-type: none"> • samples which reflect growth of process skills • self-reflection sheets accompanying samples of work • reflection sheets from teacher or peer • identification of strengths/weaknesses • goal-setting sheets • reflections on progress towards goal(s) • seem or e detail below under Process below

(c) to identify strengths/weaknesses	<ul style="list-style-type: none"> • samples of work reflecting specifically identified strengths and weaknesses • reflections on strengths and weaknesses of samples • goal-setting sheets • reflection on progress towards goal(s)
(d) to track development of one or more products or performances	<ul style="list-style-type: none"> • obviously, drafts of the specific product or performance to be tracked • self-reflections on drafts • reflection sheets from teacher or peer

Showcase Portfolios: What samples might be included ?

Purpose	Some possible inclusions
(a) to showcase end-of-year/semester accomplishments	<ul style="list-style-type: none"> • samples of best work • samples of earlier and later work to document progress • final tests or scores • discussion of growth over semester/year • awards or other recognition • teacher or peer comments
(b) to prepare a sample of best work for employment or college admission	<ul style="list-style-type: none"> • cover letter • sample of work • reflection on process of creating sample of work • reflection on growth • teacher or peer comments • description of knowledge/skills work indicates

(c)to showcase student perceptions of favorite, best or most important to communicate a student’s current aptitude	<ul style="list-style-type: none"> • samples of student’s favorite, best or most important work • drafts of that work to illustrate path taken to its final form • commentary on strengths/weaknesses of work • reflection on why it is favorite, best or most important • reflection on what has been learned from work • teacher or peer comments • representative sample of current work • match of work with standards accomplished • self-reflection on current aptitudes
--	---

Evaluation Portfolios: What samples might be included?

Purpose	Some possible inclusions
(a) to document achievement for grading	<ul style="list-style-type: none"> • samples of representative work in each subject/unit/ topic to be graded • samples of work documenting level of achievement on course/grade- level goals/standards/objectives • tests/scores • rubrics/criteria used for evaluation of work (when applied) • self-reflection on how well samples indicate attainment of course/grade- level goals/standards/ objectives • teacher reflection of attainment of goals/standards • identification of strengths/weaknesses
(b) to document progress towards standards	<ul style="list-style-type: none"> • list of applicable goals and standards • representative samples of work aligned with respective goals/standards • rubrics/criteria used for evaluation of work • self-reflection on how well samples indicate attainment of course/grade- level goals/standards/ objectives • teacher reflection of attainment of goals/standards

	<ul style="list-style-type: none"> • analysis or evidence of progress made toward standards over course of semester/year
(c) to place students appropriately	<ul style="list-style-type: none"> • representative samples of current work • representative samples of earlier work to indicate rate of progress • classroom tests/scores • external tests/evaluations • match of work with standards accomplished • self-reflection on current aptitudes • teacher reflection on student's aptitudes • parent reflection on student's aptitudes • other professionals' reflections on student's aptitudes.

11.8 FOCUS AND CONTENT OF MATHEMATICS PORTFOLIOS

Some of the main goals of portfolios are to see “student thinking, student’s growth over time, mathematical connections, student views of themselves as mathematicians, and the problem solving process”. A variety of items can be included in a mathematical portfolio in order to achieve these goals.

Suggested Items to Consider for Mathematics Portfolios

- * Open-ended questions.
- * A report of group project.
- * Problems posed by student.
- * Art projects.
- * A book review.
- * Excerpts from a student’s daily journal.
- * A table of contents.

- * Draft, revised, and final versions of student work on a complex mathematical problem.
- * A description by the teacher of a student activity that displayed understanding of a mathematical concept.
- * Newspaper and magazine articles.
- * A letter from the student to the reader of the portfolio, explaining each item.
- * Audio tapes of student-teacher interview.
- * A photo or sketch made by student of student's work with manipulations.
- * Papers that show the student's correction of errors or misconceptions.
- * Notes from an interview by the teacher or another student.
- * Sample journal entries.
- * Work in the student's primary language.
- * Teacher-complicated checklists.
- * Videotapes of student's work.
- * A mathematical autobiography.
- * Mathematical research.

11.9 TYPE OF PORTFOLIO ASSESSMENT

According to Columba & Dolgos (1995), there are basically three types of portfolios to consider for classroom use.

❖ Showcase

This type of portfolio focuses on the student's best and most representative work. This type of portfolio is similar to an artist's portfolio where a variety of work is selected to reflect breadth of talent. Therefore, in this portfolio the

student selects what he or she thinks is representative work. This folder is most often seen at open houses and parent visitations.

❖ **Teacher-Student Portfolio**

This type of portfolio is often called the “working portfolio” or a “working folder”. This is an interactive teacher-student portfolio that aids in communication between teacher and student. The teacher and student conference to add or delete within the content of the portfolio.

❖ **Teacher Alternative Assessment Portfolio**

All the items in this type of portfolio are scored, rated, ranked, or evaluated. Teachers can keep individual student portfolios that are solely for the teacher’s use as an assessment tool. This is a focused type of portfolio and is a model of the holistic approach to assessment (Columba & Dolgos, 1995, p. 175).

But broadly speaking there are two main types of portfolio assessment& they are as follow:

- ✓ Process Portfolios
- ✓ Product Portfolios

A **process portfolio** documents the stages of learning and provides a progressive record of student growth. Teachers use process portfolios to help students identify learning goals, document progress over time, and demonstrate learning mastery... In general, teachers prefer to use process portfolios because they are ideal for documenting the stages that students go through as they learn and progress.

What does Developmental Portfolio (or working or process portfolios) contain?

- Samples of independent work (initial work compared to more current work)
- Evaluations by teacher, peer, self

- Reflections on the growth over a period of time
- May be used for instructional purposes and may include various stages of products, various drafts, etc.

A **product portfolio** demonstrates mastery of a learning task or a set of learning objectives and contains only the best work.

What does Finished (product) portfolio contain?

- Samples of best independent work
- Evaluations by teacher, peer, self
- Samples organized according to some system
- Usually used to provide a summative evaluation and is standard format.

11.10 STEPS OF PORTFOLIO ASSESSMENT

Following are the steps involved in the process of development of portfolio:

Each of these points will be described in the following sections.

11.10.1 Designing Portfolios

For the purposes of assessment, the material in a student portfolio is most useful when each piece collected reflects progress toward particular learning goals. To this end, portfolios can be designed following a multi-step process that involves:

- Purpose;
- Specific Focus;
- Instrument Selection /Performance Task;
- Setting Criteria;
- Student Selection;

- Staff Collaboration;
- Staff Development; and
- Students- parents' involvement.

Each of these step is discussed below:

Purpose

Before collecting any samples of student work, the first step in planning a portfolio is to determine the purpose for conducting the assessment, and how the results will be used .Will the results be used for making decisions related to classroom instruction? Will they be used to aid in assigning a student grade? Specifying how the results of the portfolio assessment are to be used will assist in determining the goals to be assessed and the samples of student work to be collected.

Specific Focus

The second step in portfolio design is focusing the portfolio on specific learning goals. Each portfolio should have a specific focus determined by school staff. The focus may be on oral or written language skills or on content area skills such as those required in mathematics, science, or social studies. It may be possible to collect student work for all content areas as well as for Mathematical skills in a single student folder.

Performance Task/Instrument Selection

Once learning goals and performance objectives have been identified, portfolio designers need to identify performance tasks and instruments to be used to measure whether learning goals are being attained. School staff should strive to combine traditional and performance assessment measures in order to get multiple indicators of a student's ability level. Standardized tests are often required for distinct accountability needs. Using results obtained on standardized achievement tests together with anecdotal records, rating scales, teacher observation checklists, and writing samples to assess literacy skills provides much more information than standardized

test results alone. Furthermore, having multiple indicators of student performance enables teachers to cross-check one type of information against another. Required items might include those which are necessary to communicate a student's progress to other teachers or can include a student's "best work," while optional items could include drafts of work in progress, ongoing ratings of performance, and occasional pieces selected by the student. By making certain items obligatory and others optional, teachers get the information they need for making instructional decisions.

Setting Criteria

Teachers or school staff should determine criteria (performance standards) for interpreting portfolio contents before collecting any student data. Performance criteria must be established in order to determine the degree to which a student has attained the objectives in each task/instrument which is designed to assess. Teachers need to identify and establish a minimum number of specific objectives that illustrate attainment of the instructional goals. One way to set criteria is to require students to perform tasks either independently or with assistance. Another possibility is to define expected student performance in narrative or anecdotal form. The narrative can specify what the students should be able to do to meet the criterion for performance or growth over time.

Staff Collaboration

If portfolio assessment is to be undertaken by a school-based team, it will be essential to identify school staff willing to participate in the assessment process. Ideally, a cross-section of teachers, staff, and administrators at each school who serve the same student(s) could become members of a portfolio assessment team. If portfolio assessment is a totally new experience for school staff, it is probably a good idea to pilot test the approach with a small number of staff and students before using it on a school-wide or district-wide basis.

Staff Development

All staff involved in the portfolio process should receive information and training on how to plan, implement, and interpret portfolios, especially when portfolio

assessment is to be conducted at the school-building or district-wide level. Staff preparation not only enables staff to collaborate with and support each other, it also builds critical support for the portfolio process itself. Staff should receive training on how to design portfolios, how to target specific learning objectives and select students (if portfolios are limited to only a part of the student population), and how to set criteria for each portfolio. Staff development will also be essential to planning individual portfolio contents and to designing, administering, and scoring holistic, performance-based measures such as oral interviews, teacher observation checklists, rating scales, and writing samples.

Student Selection

Portfolio teams or individual teachers need to consider several factors when deciding whether to implement portfolio assessment with one or more students. If the classroom teacher is acting on his/her own to gather the information (without any support from other school staff), initially it may be advisable to limit the number of portfolios to only a few students. This can prevent teachers from being overwhelmed by the data collection and analysis effort and giving up before experiencing the benefits of portfolio assessment. On the other hand, if portfolio assessment is to be a school- or district-wide initiative, and if more than a few teachers are going to be involved and provided staff development in its systematic implementation, then many or all students can be included in the procedure.

Questions to ask regarding which students will participate in the portfolio process are: Will the portfolio be used in only one classroom? Will it be used only with students participating in a particular program? Will the process be limited to a single or multiple grade levels? Will all students in each classroom be assessed using a portfolio? Will the procedure be limited to only those individuals needing frequent monitoring?

Student/Parent Involvement

The teacher and/or portfolio assessment team should encourage the active involvement of both students and parents in the assessment process. A key element in portfolio assessment is student self-evaluation. Students are asked to reflect on their

progress toward learning goals and encouraged to select samples of their work which they believe illustrate progress toward these goals. Teacher/student/parent conferences can be scheduled at times convenient for the parents so that they can be informed of their child's progress. Portfolio contents provide much more information to parents about their child's learning than the percentiles represented on standardized achievement tests. Furthermore, parents appreciate being given an opportunity to respond to examples of student work, particularly items that show progress and substantiate grades given to the student.

10.12.2 Planning for and Collecting the Data

Data collection for portfolio assessment consists of identifying information to be entered into the portfolio, determining the frequency of data collection, creating a system to record and monitor the frequency of data collection, and setting guidelines for the removal and updating of portfolio material. These guidelines may vary depending on the purpose of the portfolio. At the elementary and middle school levels, portfolios can be updated on a semester basis or at each grading period. Some schools are experimenting with portfolios which present increasingly comprehensive information on students by beginning with an initial portfolio every nine weeks, a semester portfolio drawn from these, and a year-end portfolio. However, if the purpose is to closely monitor student progress, assessments should take place approximately every four to six weeks. Occasional items can be placed in the portfolio on a more frequent basis and removed when they have been superseded by more recent work or have become redundant. The decision to remove or maintain portfolio materials is a collaborative one to be made between the student and the teacher.

11.12.3 Analysing Portfolio Contents

To determine whether a portfolio's contents reflect a student's progress toward learning goals, the teacher or portfolio assessment team can match contents to specific learning goals and objectives on a cover sheet. When additional evidence of student progress for each objective is entered or found in the portfolio, relevant page citations can be added. Summary comments, interpretations, and recommendations can be added at the bottom of the Portfolio Analysis Form.

Sample Portfolio Analysis Form

(NOTE: Figure has been reconstructed within the constraints of the electronic environment)

DATE: 25/10/2019

STUDENT: XYZ

TEACHER: ABC

CLASS: 10

EDUCATIONAL GOAL: Student demonstrates ability on variety of Linear Equations in Two variables

<u>Performance Task</u>	<u>Content Illustrating Student Progress</u>	<u>Date</u>
1. <u>Nature of solution of Linear Equations without actually solving</u>	<u>Different type of linear equations</u>	<u>07/10/2019</u>
2. <u>Calculation of solution of Linear Equations</u>	<u>Cross-Multiplication Method</u>	<u>12/10/2019</u>
3. <u>Calculation of solution of Linear Equations</u>	<u>Substitution Method</u>	<u>17/10/2019</u>
4. <u>Verification of solution of Linear Equations</u>	<u>Different type of linear equations and their solutions</u>	<u>22/10/2019</u>
<u>Summary Comments:</u>		

11.12.4 Using Portfolio Results

There are a variety of ways in which portfolio results can be used.

- * **Diagnosis and Placement-** Student strengths and needs are examined with regard to major curriculum objectives;
- * **Monitoring Student Progress-** Growth in learning over the course of the semester or school year can be monitored;
- * **Feedback on the Effectiveness of Instruction-** If individual students are not progressing, the instructional approach should be re-evaluated and appropriate adaptations made to meet each student's needs. One possible conclusion is that a student needs instructional support beyond the services provided by the classroom(s) in which the portfolio has been maintained;
- * **Communication with other Teachers-** This includes other members of the portfolio team and those at other schools to which students may transfer;
- * **Student Feedback-** Portfolios enable students to comment and reflect on their progress and plan what they would like to do to maintain or change it; and
- * **Communication with Parents-** Portfolios provide parents with concrete evidence which supports instructional decisions.

11.11 ADVANTAGES OF PORTFOLIO ASSESSMENT

Following are the advantages of portfolio Assessment:

- Promoting student self-evaluation, reflection, and critical thinking.
- Measuring performance based on genuine samples of student work.
- Providing flexibility in measuring how students accomplish their learning goals.
- Enabling teachers and students to share the responsibility for setting learning goals and for evaluating progress toward meeting those goals.

- Giving students the opportunity to have extensive input into the learning process.
- Facilitating cooperative learning activities, including peer evaluation and tutoring, cooperative learning groups and peer conferencing.
- Providing a process for structuring learning in stages.
- Providing opportunities for students and teachers to discuss learning goals and the progress toward those goals in structured and unstructured conferences.
- Enabling measurement of multiple dimensions of student progress by including different types of data and materials.

11.12 DISADVANTAGES OF PORTFOLIO ASSESSMENT

The disadvantages of Portfolio Assessment are as follow:

- Requiring extra time to plan an assessment system and conduct the assessment.
- Gathering all of the necessary data and work samples can make portfolios bulky and difficult to manage.
- Developing a systematic and deliberate management system is difficult, but this step is necessary in order to make portfolios more than an ad hoc collection of student work.
- Scoring portfolios involves the extensive use of subjective evaluation procedures such as rating scales and professional judgment, and this limits reliability.
- Scheduling individual portfolio conferences is difficult and the length of each conference may interfere with other instructional activities.

Check Your Progress – 1

Note: (a) Answer the questions given below:

(b) Compare your answers with those given at the end of the lesson.

(i) Process and Product are two types of :

- A. Assigning grades to learners
- B. Performance Assessment
- C. Portfolio Assessment
- D. None of these.

(ii) Explain the focus and content that can be included in Mathematical Portfolio.

(iii) Portfolios present practical approach to assembling students work.
(True / False)

(iv) The focus of Portfolio Assessment is development of _____ skills.

(v) The focus of Portfolio Assessment is on evaluation of student work in its totally _____
(True / False)

(vi) Portfolios encourage _____ Learning

(vii) Portfolios demonstrate progress towards identified outcomes. (True / False)

11.13 PERFORMANCE ASSESSMENT

Assessment is one of the critical components of classroom instruction. Assessment refers to the judgement of students' work. Similarly, Rust (2002) describes assessment as making a judgement, identifying the strength and weakness, the good and the bad, and the right and the wrong in some cases of something. Assessment is

an integral part of learning and the practice of teaching, and helps improve learners' achievement. Performance assessment is changing for many reasons. Changes in the skills and knowledge needed for success; in understanding of how students learn; and in relationship between assessment and instruction have necessitated the change in assessment strategies. People within the educational community, which includes policymakers, educators, students, parents, administrators, have different ideas regarding the implementation of assessment strategies. While some believe traditional assessment methods are more effective, others are of the view that performance and portfolio assessment tools are superior. For example, Oloruntegbe and Omoifo (2000) were of the view that teachers seldom teach and assess skills and attitudes. As a result stakeholders in education are beginning to recognize that minimums and basics are no longer sufficient and are calling for a closer match between the skills that students learn in schools and the skills they will need upon leaving school. Law and Eckes (1995), on the other hand, believe that for validity and reliability reasons, teachers should stick to traditional assessment. This dilemma has been an issue to teachers on which assessment strategy to employ in assessing learners.

11.14 DEFINITION OF PERFORMANCE ASSESSMENT

Performance assessment is an alternative form that requires students to construct rather than select responses; it measures students' higher order thinking skill, deep understanding of concepts, and general inquiry strategies. Involve authentic, real world problems that help students demonstrate their ability to apply academic knowledge (theory) to practical situations. (Ryan, 2006).

Performance assessment is “product and behaviour-based measurements based on settings designed to emulate real-life contexts or conditions in which specific knowledge or skills are actually applied”.

Palm (2008) mentioned that performance assessment is seen as having better possibilities to measure complex skills and communication, which are considered important competencies and disciplinary knowledge needed in today's society.

Performance assessment is best understood as a continuum of formats that range from the simplest student-constructed response to comprehensive collections of large bodies of work over time. Constructed-response questions require students to produce an answer to a question rather than to select from an array of possible answers (as multiple-choice items do). For example, answers supplied by filling in the blank; solving a mathematics problem; writing short answers”.

According to Elliott (1995), there are two major concepts that describe performance assessment: Performance - a student’s active generation of a response that is observable either directly or indirectly via a permanent product; and Authentic - the nature of the task and context in which the assessment occurs is relevant and represents “real world” problems or issues. Some form of essay tests come in the form of performance-based assessment but there are many others including experiments in science, writing speeches, letter to newspaper editor, artistic production and conducting surveys.

After going through the above definitions we can conclude that performance assessment:

- is a type of alternative assessment;
- is an exercise in which a student demonstrates specific skills and competencies in relation to a continuum of agreed upon standards of proficiency or excellence; and
- reflects student performance on instructional tasks and relies on professional rather judgment in its design and interpretation.

11.15 KEY COMPONENTS OF PERFORMANCE ASSESSMENT

1. **Basic knowledge:** determine what facts and detail the students already knows
2. **Inquiry:** observe how the students obtaining information and then applying it to form hypothesis and interpretations
3. **Explanation:** The student demonstrate understanding beyond basic knowledge by using factual knowledge to explain concepts and principles

4. **Problem Solving:** The student solves the problem and is able to explain how he/she solved it
5. **Representation of knowledge:** the student's ability to choose the most important ideas and communicate understanding effectively
6. **Metacognition:** The students' ability to sets challenging yet attainable goals and evaluate their own progress.

11.16 STEPS INVOLVED IN PERFORMANCE ASSESSMENT

1. Purpose

The first step involved in performance assessment is purpose. The purpose or the reason why the assessment is being conducted is identified.

2. Type of activities involved

After finalizing the purpose it is decided that what kind of activities will be involved in it. These can include: oral calculations, dogging tables, simulations/ situations, direct & indirect calculations, blank spaces which students are asked to complete, picture cues, teacher observation checklists, and student self-evaluations.

3. Design

Designing the activities is another important step in performance assessment. In this step it is decided that what kind of activities will best meet our objective of testing the performance of students. for example if one want to assess the multiplication skill of 2nd grade student then dogging table will be the best activity for this and the teacher will plan accordingly

4. Administration

A major obstacle to conducting mathematical assessment in the classroom is the time involved in administering the assessment to students one at a time.

Alternatives to individual student assessment in large classes include the use of teacher observation checklists and the assessment of pairs or small groups of students at one time. So in this step, the teacher decides whether to choose individual student or small group at a time.

5. Scoring

Teachers and/or raters should establish scoring criteria for a range of grade levels. This will enable the teacher to design instruction more appropriate to students' needs and to monitor growth from one band to the next within levels as well as from level to level.

Scoring criteria should be holistic, with a focus on the student's ability to receive and convey meaning. Holistic scoring procedures evaluate performance as a whole.

11.17 ADVANTAGES OF PERFORMANCE ASSESSMENT

- Performance assessment can assess complex learning outcomes.
- It provides a natural, direct, and complete evaluation of some types of skills.
- It is meaningful learning/performance makes the student more motivated.
- It encourages the application of learning to real-life situations.

11.18 DISADVANTAGES OF PERFORMANCE ASSESSMENT

- Performance assessment is vulnerable to effect of rating biases (personal, generosity).
- It requires a lot of time and effort to implement.
- Evaluation must be done individually (not in groups).
- It can do only few of these – especially if they are extended response.

Check Your Progress – 2

Note: (a) Answer the questions given below:

(b) Compare your answer with those given at the end of the lesson:

(i) **Performance Assessment is an alternative form that requires students to rather than select responses:**

- A. Construct
- B. learn
- C. Construct and learn
- D. None of these.

(ii) Write advantages and disadvantages of Performance Assessment.

(iii) Enlist the steps involved in Performance Assessment

11.19 LET US SUM UP

The ongoing reforms of Mathematics instruction creates a need to refine student assessment practices. Portfolio Assessment and Performance Assessment are two new methods of assessment. Portfolio assessment is the use of student's work over time and in variety of modes to show the depth and development of student's abilities. On the other hand, performance assessment is product and behaviour based measurement on settings designed to emulate real life contexts or conditions in which specific skills are actually applied. It measures students' higher order thinking skills.

Both of the assessment methods are best suitable in their respective fields but they require a lot of time and effort to implement.

11.20 LESSON END EXERCISE

Answer the following questions:

1. Explain the content that can be included in growth portfolios.
2. Discuss the steps involved in Portfolio Assessment.
3. What are the key components of Performance Assessment?
4. Explain the advantages and disadvantages of Performance Assessment.

11.21 SUGGESTED FURTHER READINGS

Sewell, M., M. Marczak, & M. Horn. (2007). *The Use Of Portfolio Assessment in Evaluation*. The University of Arizona

Shepard, L.A. (1989). Why We Need Better Assessments. *Educational Leadership*, 46(7): 4–9. Valencia, S.W. (1990b). Alternative Assessment: Separating the Wheat from the Chaff. *The Reading Teacher* 43, 60–1.

Wiggins, G. (1989a). A True Test: Toward More Authentic and Equitable Assessment. *Phi Delta Kappan* 70, 703–13.

11.22 ANSWER TO CHECK YOUR PROGRESS

Answers to Check Your Progress-1

(i) C

(ii) Some of the main goals of portfolios are to see “student thinking, student’s growth over time, mathematical connections, student views of themselves as mathematicians, and the problem solving process”. A variety of items can be included in a mathematical portfolio in order to achieve these goals.

Suggested Items to Consider for Mathematics Portfolios

- * Open-ended questions.
- * A report of group project.
- * Problems posed by student.
- * Art projects.
- * A book review.
- * Excerpts from a student's daily journal.
- * A table of contents.
- * Draft, revised, and final versions of student work on a complex mathematical problem.
- * A description by the teacher of a student activity that displayed understanding of a mathematical concept.
- * Newspaper and magazine articles.
- * A letter from the student to the reader of the portfolio, explaining each item.
- * Audio tapes of student-teacher interview.
- * A photo or sketch made by student of student's work with manipulations.
- * Papers that show the student's correction of errors or misconceptions.
- * Notes from an interview by the teacher or another student.
- * Sample journal entries.
- * Work in the student's primary language.
- * Teacher-complicated checklists.
- * Videotapes of student's work.

- * A mathematical autobiography.
- * Mathematical research.
- (iii) true (iv) Self evaluation (v) true (vii) self directed (vii) True

Answers to Check Your Progress-2

Ans.- (i) A

(ii) Advantages:

- Performance assessment can assess complex learning outcomes.
- It provides a natural, direct, and complete evaluation of some types of skills.
- It is meaningful learning/performance makes the student more motivated.
- It encourages the application of learning to real-life situations.

Disadvantages:

- Performance assessment is vulnerable to effect of rating biases (personal, generosity).
 - It requires a lot of time and effort to implement.
 - Evaluation must be done individually (not in groups).
 - It can do only few of these – especially if they are extended response.
- (iii) Purpose, types of activities involved, Design, Administration and Scoring.

ACHIEVEMENT TEST IN MATHEMATICS

Structure

- 12.1 Introduction
- 12.2 Objectives
- 12.3 Definitions of Achievement Test
- 12.4 Aims of Achievement Test
- 12.5 Construction & Standardization of achievement Test in Mathematics
 - 12.5.1 Planning of the Test
 - 12.5.2 Preparation of the Test
 - 12.5.3 Administration of the test
 - 12.5.4 Item analysis
 - 12.5.5 Standardization of the Test
- 12.6 Characteristics of Good Achievement Test
- 12.7 Uses of Achievement Test
- 12.8 Let Us Sum Up

12.9 Lesson End Exercise

12.10 Suggested Further Readings

12.11 Answer to Check Your Progress

12.1 INTRODUCTION

The most important part of Teaching-learning process is evaluation. It is important because it helps in the area of appraisal for a guidance programme for the benefit of the students. The feedback of evaluation comes with the help of a tool, generally known as an achievement test. An achievement test is designed to evaluate a unit during the teaching-learning process. The unit of teaching-learning may be, one lesson or a group of lessons transacted in a particular time period. Achievement test measures present proficiency, mastery and understanding of general and specific areas of knowledge. Achievement tests attempt to measure what and how individual has learnt, viz. his present standard of performance. Scores of achievement test indicate the academic status of the individual learner in different subjects as a whole or individually. In this unit we will discuss the same in detail. It involves a determination of how quickly, how accurately and at what level an individual can perform the tasks taken to represent accomplishment.

12.2 OBJECTIVES

After going through this lesson, you shall be able to:

- explain the aims of achievement test,
- enlist various steps involved in construction of achievement test in mathematics,
- discuss the difference between difficulty level and discriminating power, and
- enlist the uses of achievement test in mathematics.

12.3 DEFINITIONS OF ACHIEVEMENT TEST

Mathematics is the gate and key of the Science. Mathematics is an important school subject because it is associated with more academic and or career opportunities. Teaching work in schools is carried out in a controlled manner. Under it, the teachers try to find out after a certain interval, how much the students have learnt. The tests which are prepared to find it out, are called achievement tests. In the words of Ebel

“An achievement test is one designed to measure a student’s grasp or knowledge of his proficiency in certain skills.” —Ebel

At present, the teaching objectives are determined as changes in the cognitive, conative and affective domains of the students. So, the achievement tests should be defined in the following way:

“The tests which are constructed to measure cognitive, conative and affective changes occurring as a result of teaching school subjects, are called achievement tests”.

12.4 AIMS OF ACHIEVEMENT TEST

The Achievement Tests in Mathematics have the following aims:

1. Achievement tests are used in selection of candidates in different fields and for admission of students in schools.
2. These tests are important from the standpoint of determination of class and promotion.
3. In the field of mathematics achievement tests are used extensively. These tests are very important from the standpoint of identifying backward students diagnostic and remedial teaching.
4. Achievement tests are helpful in measurement of minimum abilities of an individual.

5. Achievement tests are used widely in different types of classifications and for appointment.
6. These tests are helpful in providing educational and vocational guidance.
7. These tests are used to evaluate a teacher's proficiencies and effectiveness in teaching mathematics.
8. The use of these tests is helpful in the amendment and revision of curriculum of mathematics.
9. Construction of these tests and study of related literature helps teachers to develop their professional attitude towards mathematics.
10. These tests provide assistance in learning. A student knows well how much he has studied and how much he has yet to study. It gives him motivation for studying in future.
11. These tests help to give reports to guardians and issue certificates.
12. These tests evaluate the effectiveness of different methods of teaching mathematics and help to select the most suitable method of teaching.
13. The use of these tests is helpful in the amendment of content in mathematics.
14. It is possible to undertake comparative study of educational levels of different schools on the basis of these tests.

It is clear from the above evidence that an achievement Test is an integral part of teaching process because it makes mathematical instruction a dynamic process through continuous evaluation and regular feedback.

Check Your Progress –1

Note: (a) Answer the questions given below:

(b) Compare your answer with those given at the end of the lesson:

- (i) Achievement Test is Used for :
- A. Assigning grades to learners
 - B. Encourage the students
 - C. Evaluate teaching work of teachers
 - D. All of the above.
- (ii) Achievement tests are used for admission of students in schools. (True / False)
- (iii) Achievement tests are useful from the standpoint of determination of Personality Patterns of students. (True / False)
- (iv) Achievement tests are helpful in providing personal guidance. (True / False)
- (v) Achievement tests are used to issue certificates and degrees to the students. (True / False)

12.5 CONSTRUCTION & STANDARDIZATION OF ACHIEVEMENT TEST IN MATHEMATICS

The following steps are involved during the Construction and Standardization of the Achievement Test in Mathematics of grade XI:

1. Planning the Test

- Objective of the Test
- Weightage to Content of the Test
- Size and Type of Test
- Blue Print of Test

2. **Preparation of the Test**

- Item Writing
- Checking by Expert
- Item Editing
- Marking Scheme and Scoring Key

3. **Administration of the Test**

- Individual Try-out
- First Try-out (Preliminary Try-out)
- Final Try-out

4. **Item Analysis**

- Analysis of essay type Questions
- Analysis of Short answer type questions
- Analysis of Objective (Multiple Choice) Questions
 - ❖ Difficulty level
 - ❖ Discriminating Power

5. **Standardization of Test**

- Validity
- Reliability
- Writing the Final Draft

12.5.1 Planning of a Test

As it is obvious that, a planning made carefully to begin with. The design of the test is prepared so that it may be used as an effective instrument of evaluation. A proper design would increase the validity, reliability, objectivity and suitability of the test. The following aspects have to be looked up on while planning for a test and they are:

a) Objective of the Test

First of all the teacher must analyse the whole unit into its sub-units. Sub-units may be listed under sub headings and must be organized logically. The content analysis must be done for each one of the sub units separately by listing the important facts, concepts, principles, generalizations etc. The relative importance of each objective is to be considered. For example, subject like Mathematics the objectives are knowledge, understanding, application and skill. The main task here is to decide the weightage to be given to the different objectives included in the planning.

Sr. No.	Name of the Objective	Marks	Percentage
1	Remembering (knowledge)	9	9%
2	Understanding	42	42%
3	Application	39	39%
4	Skill	10	10%
	Total	100	100%

b) Weightage to Content

The content of a unit is taught in the classroom by providing suitable learning experiences. All the subject matter does not have equal importance. Therefore in order to test the understanding of the content, a proper weightage must be given looking into the nature, scope & importance of the content. The content

weightage must be given in such a way that the teacher must see no content/ sub unit should left out.

Sr.No.	Sub Units	Marks	Percentage
1	Concept of Sets	10	10%
2	Set Notation	10	10%
3	Types of Sets	30	30%
4	Sub Sets	10	10%
5	Union Set	10	10%
6	Intersection of Sets	10	10%
7	Venn Diagram	20	20%
	Total	100	100%

c) Size and Type of Questions

The size of the test refers to number of items in the test. It is difficult to prepare good items at first attempt, therefore more items are prepared than the desired items in the final draft. If the investigator has a good skill in item construction then 50% more items have to be prepared, but for the fresher double the desired number of items should be prepared. On the other hand, Reliability of the test also depends on the size of test. Therefore, first version of this Achievement Test in Mathematics included 64 items which were Multiple Choice Type, Essay Type and Short Answer Type for testing different abilities of learners and subunits of content. These types of questions must given weightage on the basis of their adequacy etc. So that they can achieve our Instructional objectives. It should also be kept in mind that some essay-type questions are such which may only be answered by 20% students of high ability, and rest of the questions can be answered by all students. The short-answer-type questions are such which may only be answered by 20% students

of high ability, and rest of the questions can be answered by all students. The short-answer-type questions too are constructed in the same way. The objective- type questions are constructed such that 27% questions can be answered by the students of higher level only and 27% can be answered by all.

Sr.No.	Type of Questions	No. of Questions	Marks	Percentage of Marks
01	Objective Type	50	50	50%
02	Short Answer Type	10	30	30%
03	Essay Type	4	20	20%
	Total	64	100	100%

d) Preparation of Blue-Print

Blueprint is the last level of the planning of the test which acts as a guide for writing items for preliminary draft. Here test constructor put various types of questions in blueprint and allots them marks. The investigator writes down his/her decisions in the form of a blueprint. The blue print is a 3 dimensional chart showing the weightage given to Objectives, Content and Types of questions in terms of marks. The Blueprint consisting of 64 questions is as follows :

Objective Content	Knowledge			Understanding			Application			Skill			Total Marks
	Obj.	SAT	Ess	Obj.	SAT	Ess.	Obj.	SAT	Ess.	Obj.	SAT	Ess.	
Concept of Sets	1(1)			3(1)	1(3)		3(1)						10
Set Notation	0			3(1)			4(1)	1(3)					10
Types of Sets	2(1)	1(3)		2(1)	1(3)	1(5)	2(1)	1(3)	1(5)	2(1)	1(3)		30
Sub Sets	0			4(1)	1(3)		3(1)						10
Union Set	1(1)			3(1)			3(1)	1(3)					10
Intersection of Sets	1(1)			2(1)	1(3)		3(1)			1(1)			10
Venn Diagram	1(1)			3(1)		1(5)	2(1)		1(5)	1(1)	1(3)		20
Total	6(1)	1(3)		20(1)	4(3)	2(5)	20(1)	3(3)	2(5)	4(1)	2(3)		100

Where, Obj: Objective Type Questions (MCQ), SAT: Short Answer Type questions

Ess: Essay Type Questions, A(B): A= No. of Questions B= Marks of Each Question

The blue print serves many useful purposes :

1. It helps to improve the content validity of teacher made tests.
2. It defines as clearly as possible the scope and emphasis of the test.
3. It relates objectives to content.
4. It acts as a guide to construct the unit test.

12.5.2 Preparation of the Test

Once the design is thoroughly prepared. The next step is to edit the test items in the form of question paper. The task of preparation of an achievement test in mathematics is full of hard work and intelligence. It includes the following three steps:

a) **Item-Writing**

The next step after the finalization of the blueprint is writing appropriate questions in accordance with the broad parameters set out in the blueprint. One should take one small block of the blueprint at a time and write out the required questions. Thus, for each block of blueprint which is filled in, questions have got to be written one by one. Once it is done, we have all the questions meeting the necessary requirement laid down in the blueprint. While selecting each small block for writing a question, you can proceed in several ways.

- ❖ either writing all questions (one by one) belonging to one objective at a time i.e. knowledge or understanding or application followed by other objectives, or
- ❖ by taking up questions according to their form or type i.e. Essay Type followed by Short Answer and Very Short Answer Type or in any other order, or
- ❖ by writing questions for one unit of the syllabus or portion to be covered by the test at a time.

Each approach has its advantages and disadvantages, too. Irrespective of the method followed, the questions then have to be arranged in a logical sequence.

b) **Checking by Expert**

All the items are evaluated by the subject experts and other experts of different domains as well as by the investigator in order to remove vagueness, ambiguous terms and language difficulty in the format of test items.

c) Item-Editing

As the test items are reviewed by the subject experts, the modifications (addition or deletion) of item is done. Here 4 items were deleted and few items are modified as per suggestions received from the experts. In this way preliminary draft with 60 items was made.

d) Marking Scheme or Scoring Key

The forth step is to prepare the “Marking Scheme”. The marking scheme helps prevent inconsistency in judgement. In the marking scheme, possible responses to items in the test are structured. The various value points for response are graded and the marks allowed to each value point indicated. The marking scheme ensures objectivity in judgement and eliminates differences in score which may be due to idiosyncrasies of the evaluator. The marking scheme, of course, includes the scoring key, which is prepared in respect of objective type questions. Let us discuss this in detail.

Apart from the quality of the question paper, reliability of assessment, to a great extent, depends on the degree of consistency of scores assigned to the students by different examiners or by the same examiner on two different occasions. Thus, variation can occur because of any one of two different reasons:

- (i) Due to inconsistency of the same examiner when he/she examines different answer scripts adopting different standards.
- (ii) Due to different examiners using different standards of judgement.

If an answer script is awarded the same grade or marks on repeated exposure to the same examiner, the examiner is said to be consistent in awarding the marks. As such, the assessment done by him/ her could be said to be more reliable and consistent than the other examiner in whose case variation in award of marks is higher.

The factor contributing to variations in the standards of assessment, both at the intra-and the inter- examiner levels, can be controlled by supplying a detailed scheme of marking along with the expected answers so that every examiner may interpret the questions in the same way and attain the same standard of marking without being too lenient or strict or varying in his/her assessment. Subjectivity, is thus minimised and it is believed to give a more reliable picture of the students' performance.

Highlights of a Good Marking Scheme

- (1) It is a three column statement showing serial number of the questions, their expected outline answer and the marks allotted to each value point under them.
- (2) In respect of long answer or essay type questions, the expected outline answers should :
 - (i) be complete and cover all possible or major areas as demanded by the questions
 - (ii) clearly indicate each expected point or the parts under the outlined major areas
 - (iii) provide direction as to whether all points will count towards a complete or correct answer or a set of points will be adequate enough for full credit (All this should clearly reflected), and
 - (iv) indicate marks for each expected point. Marks so distributed over expected points or their sets should be equal to the total marks assigned for a question.
- (3) In respect of short answer questions a complete answer may be provided with its break-ups where ever necessary along with the break-up of marks.
- (4) Out of the total marks assigned for a question, each point so enumerated/ explained may be assigned marks according to their significance in the answer.

- (5) In some situations, apart from the content, other qualities of answer may also matter significantly, particularly in long answer or essay type questions. These could be logical approach, coherence, lucidity of expression, the style of presentation etc. Some marks may also be set apart for such overall quality of answer which cannot be usually covered in enumeration of the content points.
- (6) The scheme of marking needs to be comprehensive enough not to leave any point unexpected and thus should provide clear guidelines in respect of the break-up of marks over different points or parts of the answer.
- (7) If a question entails some other points beyond one's expectation, a provision may also be made to take them into account and suitably reward them.

12.5.3 Administration of the Test

i) Individual Try-out

After finalizing, the test items are administered on 5 students for individual try-out. The purpose of individual try-out is to find out the language difficulty on the part of students.

ii) First Try-out

After individual try-out, the test items are administered on the 40 students of XI class for 1st try-out (Preliminary try out). This attempt was made to check the difficulty level of the test items. There was no time limit and time taken by every student was noted down. Out of 60, 5 items were found to be confusing/difficult by the students. Therefore out of 60 items these 5 items are also removed from the draft. Thus, the first draft of the achievement test consists 55 items keeping in view the nature of content and difficulty level.

iii) Final Try-out

The test is again administered on 400 students of XI class who had just passed X class exams for final try-out. The answer sheets were collected from all the

students. The answer sheets were scored with the help of scoring key which was already prepared by the investigator.

12.5.4 Item Analysis

It is necessary to understand the meaning of item analysis. The questions asked in a test are called item of the test. By item analysis is meant numerical analysis of the obtained scores of each item, the analysis of its validity and reliability, and deciding its suitability accordingly. Item analysis is such a process by which some items are selected for the test, some items are cancelled and some items are improved. . At present, generally three types of questions are asked in the achievement tests—essay type, short answer-type and objective type questions. These questions are selected on different basis.

1. Analysis of Essay Type Questions (Items)

The marks should be adequately divided on the basis of recall, logic and analysis. It should be made clear in the instructions that the division of marks should be on the basis of division of marks given in the model answers. Only then some objectivity can be brought in the evaluation of essay type questions. The following procedure should be followed in selection of these questions (items):

- (1) The test should at first be administered on a representative sample of students.
- (2) Then the calculation of the obtained scores of each student on the essay type questions be done.
- (3) Then the percentage of the obtained scores of the essay type questions be calculated on the basis of total obtained scores.
- (4) The questions on which the candidates secure less than 10% or more than 90% marks should be left out. Rest of the questions should be selected with due analysis (on the basis of the blue print). In our

example, two essay type questions have to be selected. For it, 4 questions are constructed. One question should be selected out of the questions 10% to 20% scores and the other, out of the questions between 50% and 80% scores.

2. Analysis of Short Answer Type Questions (Items)

Construction and marking of short answer type questions should be done on the basis of suitable instructions. Then the similar procedure should be applied as for the selection of essay type questions. The questions in required number should be selected with scores between 10% and 80%.

3. Analysis of Objective Type Questions (Items)

The Difficulty Level and Discriminating Power of these type of questions are known by statistical methods, questions are selected accordingly. For it, the following procedure is adopted: and the

- (1) The test is at first administered on a representative sample.
- (2) The obtained scores of each student is calculated.
- (3) The answer-books are put in descending order on the basis of obtained scores.

a) Difficulty Level of Items

The difficulty level of a question or item is known from the percentage of students who succeed to respond it correctly. The difficulty level of an item indicates whether it is easy or difficult. For selection of an item in a test, generally, the percentage of students solving it correctly is taken into consideration. The questions being solved correctly by all students of a group are easy in nature, and on the opposite, the questions which are not solved by any student are extremely difficult. Both these type of questions are not accepted in a good test. Generally, if an item

of a test is solved by 50% of the students, then it is taken to be of suitable difficulty level. It does not mean that only those items are selected for the test which have been solved by 50% students. Some such items too are selected which are solved by students of higher achievement only. Generally, the items falling in the range of 30% to 70% are selected.

- **Finding out Difficulty Level of the Items**

All specialists are of the opinion that the level of difficulty of an item can be found out by comparing the number of students answering it correctly with those of answering it incorrectly. Different formulae are used in different circumstances to find out the difficulty level of an item. If the number of students is large, it needs more time and labour to find out the difficulty level of each item. In such a situation, Kelley has suggested to divide the total students, on the basis of their obtained marks, into three classes—high, medium and low.

High Class: The top 27% of the total number of students

Medium Class: The middle 46% of the total number of students

Low Class: The lowest 27% of the total number of students

Only the data obtained from students of high and low classes is used to know the difficulty level of an item. Kelley has suggested that the test should be administered on at least 370 students to use the formula propounded by him so that about 100 students can be included in the 'high' and 'low' classes. The formula is as follows:

$$\text{Difficulty Level} = \frac{R_H + R_L}{2N}$$

Where

R_H = Right Responses in High Class

R_L = Right Responses in Low Class

N = Number of Students

The more is the percentage of difficulty level, the easier is the item.

Though no norm has been determined as regards difficulty level for the selection of items in the construction of a test, yet most specialists consider the selection of items of different level from 30% to 70% as suitable. Some of the specialists are of the opinion that it should be limited from 40% to 60%. Katiz has written in this context that if only proficiency of the students in a subject is to be found out, then the test should be constructed using less difficult items; but if the students have to be divided into different classes as high, medium and low then comparatively difficult items should be used to construct a test. He has demonstrated it by the following table :

Form of Item	Difficulty Level (in %)
Essay type	50
Five choice type	60
Four choice type	62
Three choice type	66
Two choice type	75

b) Discriminating Power of Items:

Discriminating power of a question or item intimates how far it can discriminate the students of higher and lower achievement. If a question does not possess this quality, then it is not selected for the test. If a question or item in a test is solved by students of higher and lower levels in an equal or almost equal percentage, then its discriminating power is zero and it is not considered worth for inclusion in the test.

However, if the percentage of the students of higher level is sufficiently more than the students of lower level, the positive discriminating power of the question is high and such a question is selected. The determination of high and low levels is done on the basis of obtained scores of the test.

Finding out Discriminating Power of the Items

The formula for discriminating power of items in achievement test is as follows:

$$\text{Discriminating Power} = \frac{R_H - R_L}{N}$$

Where

R_H = Right Responses in High Class

R_L = Right Responses in Low Class

N = Number of Students

It is considered suitable to select the items from 0.3 to 0.7 difficulty level and about 0.5 discriminating power. The decision regarding selection of each item used in the test is displayed by writing yes or no in the last column.

Item Number	Number of Students Correctly Solving the Item		Difficulty Level (D_L)	Discriminating Power (D_P)	Suitability
	R_H	R_L	$R_H + R_L/2N$	$R_H - R_L/N$	Yes/No

Definite number of questions is selected out of such questions whose D_L and D_p values are between 30% and 70%. 05 more items are not found suitable so these are also left out. Finally, we have 50 questions in our final draft. These 50 items are numbered 1 to 50 in continuous order and the item analysis chart for these 50 items is as follows :

Item Analysis Chart (Final Try-out)				
Level of Difficulty → Discriminating Power ↓	Highly Difficult ≤ 0.33	Moderate Difficult 0.34 to 0.66	Low Difficult ≥ 0.67	Total Questions
0.40 and Above	29, 36, 40	1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 21, 22, 23, 24, 25, 26, 27, 28, 44, 45, 46, 47, 48, 49, 50	17, 32	34
Between 0.30 to 0.39		30, 31, 35, 42	18, 33	6
Between 0.20 to 0.29	6, 41, 43		34, 37, 39	6
≤ 0.19	20	7, 19	38	4
Total Questions	7	35	8	50

12.5.5 Standardization of the Test

The questions selected on the basis of item analysis are arranged in the form of a test. The difficulty level is of great importance for an achievement test. Generally, the items of 50% difficulty are considered adequate for a test. So, in the first step of evaluation, the difficulty level is studied. Such items should not be included in the test which both of the high and low groups are able to solve, or are not able to solve.

- **Validity**

At the first step of evaluation the validity of the test is examined. Generally, content validity is emphasised upon in an achievement test. Validity refers to the attainment of purpose for which the test is prepared. There are different methods of estimating validity such as face validity, content validity, construct validity, predictive validity and concurrent validity. The investigator opted for content validity. The content validity is concerned with the relevance of the contents of the items, individually and as a whole. In which expert judgment was taken into consideration. To estimate content validity of an achievement

test, test was given to four Maths teacher and four experts to compare test items with the content and objectives of content. Out of the eight experts, four experts have solved the test so the scoring key could be verified. The experts agreed with the investigator with the distribution of content and objective of the content as well as with the scoring scheme. In this way content validity of the achievement test was established

- **Reliability**

The coefficient of reliability of the test is found out by using a suitable method. Generally, a test with .80 or more coefficient of reliability is considered a good test. Reliability is one of the important characteristics of any test and measuring instrument. Reliability refers to consistency of scores obtained by same individual when re-examined with test on different sets of equivalent items or under other variable examining condition. The reliability of the test is measured by test-retest method. The test was administered to a group of students and is re-administered to the same group of students after fifteen days and two sets of scores are correlated. The reliability co-efficient of the present test was 0.89. This shows that achievement test has high reliability.

- **Writing the Final Draft of the Test**

After the preliminary and final evaluation of the test, the final draft is prepared. Only those questions are included in the test which are valid and are of required difficulty level. The related instructions of the test too are written clearly. The method of administration of the test, time limit, marking method, etc. too are finalised at this stage. It is the stage when the test is examined from all aspects.

- ❖ **Special Mention**

Dividing the teaching objectives or the measurable objectives of the test into cognitive, conative and affective aspects does never mean that there is complete absence of conative and affective objectives in the cognitive aspect, or cognitive and affective in the conative aspect, or cognitive and conative in the affective aspect. This difference is done only on the basis of relative density.

- (1) No achievement test can be fully valid and fully reliable. Our aim should be to make it more and more valid and reliable.
- (2) The essay type questions cannot be made fully objective however. Our effort should be guided towards making them more and more objective. The same criterion applies to short answer type questions; of course, they can be made more objective than the essay type questions.
- (3) As far as the tests with only objective questions or items are, concerned, they can be made fully objective, but they cannot be made fully valid and fully reliable.

It is clear that no achievement test can be fully valid, reliable, objective and discriminating. We can standardise it by making it more and more valid, reliable, objective and discriminating.

12.6 CHARACTERISTICS OF GOOD ACHIEVEMENT TEST IN MATHEMATICS

1. The content of these tests is as per the students' level, abilities, interests and aptitudes.
2. The test items in these tests are objective, so there is no question of awarding partial marks.
3. These tests are discriminating besides being reliable and valid.
4. These tests are very economical from the standpoint of money, time and energy.
5. The purpose of these tests is predetermined.
6. These tests are useful from the practical viewpoint.
7. These tests have a wide content.
8. These tests possess all characteristics of standardized tests, such as scoring key, manual of instructions, norms etc. All these are prepared in advance and are got printed in the form of a booklet.

9. These tests are made separately for different classes.
10. The scoring, time limit etc of these tests are determined before their administration.
11. The number of questions in these tests is large, so there is no question of chance factor.
12. The results of these tests provide such material to a teacher by which he can construct his entire instructional plan.

12.7 USES OF ACHIEVEMENT TEST IN MATHEMATICS

1. They help in knowing the learner's achievement in mathematics.
2. They are useful to know the weaknesses and strengths of students in different skills of mathematics.
3. They are helpful in classifying the students.
4. They help in deciding the effectiveness of teaching mathematics.
5. They help in knowing the objectives of teaching mathematics are achieved (or) not.
6. They become the part of continuous evaluation.
7. They help the teacher to improve his/her teaching effectively.
8. They help in development of self-confidence in facing the examinations.

Check Your Progress – 2

Note: (a) Answer the questions given below:

(b) Compare your answer with those given at the end of the lesson:

(i) Blueprint is the..... level of planning of the achievement test :

- A. First
- B. Last
- C. Third
- D. None of these

(ii) Explain the process of Item Analysis of Objective Type Questions.

(iii) Which of there is not true in case of achievement test in Mathematics.

- A. The Purpose of this test in predetermined
- B. The scoring of the test is determined before its administration
- C. It is not reliable and valid
- D. The test items are objective

(iv) Achievement tests in Mathematics are helpful in classifying the students.

(True /False)

(v) Achievement tests in mathematics are useless to know the strength and weaknesses of students in different mathematical skills (True / False)

12.8 LET US SUM UP

The most important part of Teaching-learning process is evaluation which comes with the help of a tool, generally known as an achievement test. Achievement test measures present proficiency, mastery and understanding of general and specific areas of knowledge. The achievement tests are used in schools for the following functions: To select the students for admission, To classify the students, To encourage the students, To promote the students, To issue certificates on the basis of public examinations and results, To evaluate educational problems, To evaluate teaching work of the teachers etc. The following steps are involved during the Construction and Standardization of the Achievement Test in Mathematics:

1) Planning the Test 2) Preparation of the Test 3) Administration of the Test 4) Item Analysis 5) Standardization of Test. No achievement test can be fully valid and fully reliable. Our aim should be to make it more and more valid and reliable. As far as the tests with only objective questions or items are, concerned, they can be made fully objective, but they cannot be made fully valid and fully reliable.

12.9 LESSON END EXERCISE

1. Discuss the Definition, Need and Importance of Achievement test.
2. Enlist various steps of Construction of Achievement Test.
3. Explain the Highlights of Good Marking Scheme.
4. Differentiate between Difficulty level and Discriminatory Power of Test Items.

12.10 SUGGESTED FURTHER READINGS

Ebel, R. L. (1979). *Essentials of Educational Measurement* (3rd Edition). Englewood Cliffs, NJ: Prentice Hall.

Good, C.V. (1959). *Dictionary of Education*. New York: McGraw Hill Book Company Inc. Henning, G. (1987). *A Guide to Language Testing-*

Development, Evaluation, Research.

London: Newbury House Publisher.

12.11 ANSWER TO CHECK YOUR PROGRESS

Answers to Check Your Progress-1

- Ans.-** (i) D
(ii) true
(iii) False
(iv) False
(v) True

Answers to Check Your Progress-2

- Ans.-** (i) B
(ii) **Item Analysis of Objective Type Questions**

The Difficulty Level and Discriminating Power of these type of questions are known by statistical methods, questions are selected accordingly. For it, the following procedure is adopted: and the

- (1) The test is at first administered on a representative sample.
- (2) The obtained scores of each student is calculated.
- (3) The answer-books are put in descending order on the basis of obtained scores.

Difficulty Level of Items

The difficulty level of a question or item is known from the percentage of students who succeed to respond it correctly. The difficulty level of an item indicates whether it is easy or difficult. For selection of an item in a test, generally, the percentage

of students solving it correctly is taken into consideration. The questions being solved correctly by all students of a group are easy in nature, and on the opposite, the questions which are not solved by any student are extremely difficult. Both these type of questions are not accepted in a good test. Generally, if an item of a test is solved by 50% of the students, then it is taken to be of suitable difficulty level. It does never mean that only those items are selected for the test which have been solved by 50% students. Some such items too are selected which are solved by students of higher achievement only. Generally, the items falling in the range of 30% to 70% are selected.

- **Finding out Difficulty Level of the Items**

All specialists are of the opinion that the level of difficulty of an item can be found out by comparing the number of students answering it correctly with those of answering it incorrectly. Different formulae are used in different circumstances to find out the difficulty level of an item. If the number of students is large, it needs more time and labour to find out the difficulty level of each item. In such a situation, Kelley has suggested to divide the total students, on the basis of their obtained marks, into three classes—high, medium and low.

High Class: The top 27% of the total number of students

Medium Class: The middle 46% of the total number of students

Low Class: The lowest 27% of the total number of students

Only the data obtained from students of high and low classes is used to know the difficulty level of an item. Kelley has suggested that the test should be administered on at least 370 students to use the formula propounded by him so that about 100 students can be included in the ‘high’ and ‘low’ classes. The formula is as follows:

$$\text{Difficulty Level} = \frac{R_H + R_L}{2N}$$

Where

R_H = Right Responses in High Class

R_L = Right Responses in Low Class

N = Number of Students

The more is the percentage of difficulty level, the easier is the item.

Though no norm has been determined as regards difficulty level for the selection of items in the construction of a test, yet most specialists consider the selection of items of different level from 30% to 70% as suitable. Some of the specialists are of the opinion that it should be limited from 40% to 60%. Katiz has written in this context that if only proficiency of the students in a subject is to be found out, then the test should be constructed using less difficult items; but if the students have to be divided into different classes as high, medium and low then comparatively difficult items should be used to construct a test. He has demonstrated it by the following table :

Form of Item	Difficulty Level (in %)
Essay type	50
Five choice type	60
Four choice type	62
Three choice type	66
Two choice type	75

Discriminating Power of Items:

Discriminating power of a question or item intimates how far it can discriminate the students of higher and lower achievement. If a question does not possess this quality, then it is not selected for the test. If a question or item in a test is solved by students of higher and lower levels in an equal or almost equal percentage, then its discriminating power is zero and it is not considered worth for inclusion in the test. However, if the percentage of the students of higher level is sufficiently more than the

students of lower level, the positive discriminating power of the question is high and such a question is selected. The determination of high and low levels is done on the basis of obtained scores of the test.

Finding out Discriminating Power of the Items

The formula for discriminating power of items in achievement test is as follows:

$$\text{Discriminating Power} = \frac{R_H - R_L}{N}$$

Where

R_H = Right Responses in High Class

R_L = Right Responses in Low Class

N = Number of Students

It is considered suitable to select the items from 0.3 to 0.7 difficulty level and about 0.5 discriminating power.

(iii) C (iv) True (v) False

LESSON PLANNING

Structure

13.1 Introduction

13.2 Objectives

13.3 Lesson Plan

13.3.1 Meaning of Lesson Plan

13.3.2 Importance of Lesson Planning at Macro Level

13.3.3 Pre-requisites for Effective Lesson Planning

13.4 Unit Plan

13.4.1 Meaning of Unit Plan

13.4.2 Purpose of Unit Plan

13.4.3 Steps involved in Unit Plan

13.5 Monthly Plan

13.5.1 Meaning of Monthly Plan

13.5.2 Purpose of Monthly Plan

- 13.6 Let Us Sum Up
- 13.7 Lesson End Exercise
- 13.8 Suggested Further Readings
- 13.9 Answers to Check Your Progress

13.1 INTRODUCTION

The success of any activity depends largely upon its planning. Any activity well planned in advance comes out to be successful so is the classroom teaching. Teaching is a complex activity. It needs proper preparation and planning. As a teacher, suppose you are given charge of a certain class to teach mathematics. So you have to cover the given course in the available time span and also ensure effective learning amongst children. Now the challenge is to do it successfully. This very idea may generate thinking with regard to sequencing, ordering, arranging and grouping the items of the curriculum, matching these with the available time slot and identifying suitable activities to be performed. This is nothing but planning for teaching. Lesson plan is the blue print of those teaching activities that are to be done in the classroom. A lesson plan is a teacher's detailed description of the course of instruction or 'learning trajectory' for a lesson. A lesson plan is the teacher's guide for running the particular lesson, and it includes the goal (what the students are supposed to learn), how the goal will be reached (the method, procedure) and a way of measuring how well the goal was reached (test, worksheets, homework etc.)

In the planning and execution of the lesson plan, a teacher has to apply the theoretical knowledge of education, teaching and instruction. He has to follow the accepted principles of education and maxims of teaching and take help of various devices, technology and teaching aids, multimedia and make the teaching-learning process interesting, successful and effective. Every teacher who intends to teach has to prepare an outline of his topic and make a note in written form. At cognitive level, the written form of outline of the topic is known as lesson plan and the process of

preparing it is called lesson planning. Teacher should know very clearly, what to teach and how to teach. He should have a clear aim of the subject matter before him with knowledge of social and physical environment of the pupil. He should also know, how he should introduce, present the lesson and the aids to be used. He should also know how to evaluate his lesson in the light of the objectives specified. A practical outline of the topic to be taught in a period with above mentioned considerations is called the lesson plan.

13.2 OBJECTIVES

After going through this lesson, you shall be able to:

- understand the meaning of lesson plan,
- recognize the need and importance of lesson plan,
- enumerate the prerequisites of an effective lesson plan,
- list steps involved in unit planning, and
- describe the need and importance of monthly plan

13.3 LESSON PLAN

13.3.1 Meaning of Lesson Plan

A lesson plan is a detailed guide for teaching a lesson. It's a step-by-step guide that outlines teacher's objectives for what the students will accomplish from that lesson. A lesson plan outlines in detail the various steps which the teacher proposes to undertake in his/her class. As such, a lesson plan concerns itself with the teaching of one period. Planning for a lesson means identification of the sequence and style of presentation and evaluation procedures to be adopted for classroom teaching of a lesson. Hence it is a proposition in advance which establishes a linkage between the why, what and how of teaching in one period. While attempting to do this teacher may foresee likely problems in classroom communication and may arrange certain materials and decide about techniques to be adopted to ensure a smooth and effective teaching-

learning situation. Thus a lesson plan is a means of taking advance decisions about the selection, sequencing and execution of various activities to be performed in a classroom with a view to ensuring learning of children. In other words, lesson plan is a blue print, a guide map for action in the real future, a creative piece of work, a comprehensive chart of classroom teaching, a systematic but elastic approach for the development of concepts, skills, understanding etc.

An effective lesson plan includes several elements: learning objectives, quality questions, supplies and activities. It is important to have the learning objectives in mind because those should drive the development and implementation of all activities in the classroom. Quality questions are inquiries that the teacher plans to direct at the students over the course of the lesson. Sometimes these questions are rhetoric in nature, but more often they are designed to help the student think at a higher level than simple memorization and comprehension. It is important to come up with a plan for assessment to determine whether the class has met its targets. Lesson planning is a complex yet essential part of the teaching process that changes over time as teachers gain more hands-on experience.

“Daily lesson planning involves defining the objectives, selecting and arranging the subject matter and the methods and procedures.” Binning & Binning

“Lesson plan as a draft of the lesson but upon paper with all the important points whether of matter or method clearly marked.” Joseph Landon

“A lesson plan is a teaching outline of the important points of lesson arranged in an order in which they are to be presented. It may include objectives, points to be asked, references to materials, assignments etc.” Carter V. Good

Thus, lesson planning means the detailed description, which a teacher completes in a definite time period that differs from institutions to institutions. It is the responsibility of the teacher of each and every school to prepare the lesson plan for a period ranging from 30 to 50 minutes. In a lesson plan, a teacher should give emphasis on the description of the following items i.e. general aims, specific aims, previous knowledge

of the students, appropriate strategies of teaching, techniques of teaching, teaching aids, correlation between the new knowledge of the students and other subjects, teacher's activities, evaluation of the knowledge acquired by the students etc. Lesson planning helps the teacher to remain on the right tract so that the ultimate goal of an effective teaching is achieved.

Check Your Progress-1

Note: a) Write your answers in the space given below :

b) Compare your answers with those given at the end of the unit.

1) What do you mean by lesson planning ?

2) Write any one definitions of lesson planning.

13.3.2 Importance of Lesson Planning at Macro Level

Lesson planning is important because it gives the teacher a concrete direction of what he/she wants to take up for the day. Research has shown that student learning is correlated to teacher planning. One major explanation is that when plan is ready teachers can focus on its implementation. When teachers do not have to think so much about what they need to do next they are able to focus on other parts of the lesson. Lesson planning is important because it helps the teacher in following ways:

- The predetermined and well defined objectives of the lesson plan help the teacher to make wise and appropriate selection in respect of the contents, its organization, method of the presentation and evaluation. In this way, the whole

teaching task become well planned and systematically organized through the help of lesson planning.

- Lesson planning brings economy in the teaching learning process through its proper organization, orderly treatment and systematization. It keeps the teacher as well as students on right track and thus serves as a desirable check on the possible wastage in time and energy of both the teachers and the students.
- Lesson planning helps teacher to make use of the principle of correlation and integration seeking the following types of links:
 - Linking the new knowledge of the subject with the previous knowledge acquired by the students.
 - Linking the lesson with the knowledge of other related subjects or socio physical environment of students.
- Lesson planning helps the teacher to realize, imagine and go through the mental and emotional experiences of the classroom interaction, behavior processes and controlling of classroom activities in a desirable direction.
- Lesson planning enables the teacher to have an adequate mastery over the contents of the subject matter to be presented in the lesson.
- Lesson planning makes possible to select suitable strategies for the presentation of the selected contents and accordingly plan before hand for the proper use of audio visual aid.
- Lesson plan helps in seeking appropriate cooperation from the students for the successful realization of the teaching objectives. It suggests solution in advance for the various classroom problems.
- Lesson planning provides sufficient help to both the teachers as well as students in respect of evaluating the process of teaching leaning activities.

- Lesson planning helps the teacher as well as the taught in fixing the new learning by making adequate provision for revision, practice, drill work and home assignments.
- In all aspects lesson planning helps a teacher to use and practice essential component behavior and skills of teaching helpful in the realization of educational objectives.
- Overall in general, lesson planning helps a teacher in developing his decision making ability, teaching competency and teacher effectiveness. It goes to build up his confidence in his teaching abilities and make him a successful teacher.

Lesson planning is at the heart of being an effective teacher. It is a time when we envision the learning we want to occur and analyse how all the pieces of the learning experience should fit together to make that vision a reality.

13.3.3 Pre-Requisites for Effective Lesson Planning

The effective lesson planning requires some pre-requisites. A teacher should be equipped with certain abilities to fulfill these pre-requisites. The followings are important pre-requisites or elements of lesson planning.

1. The first and foremost pre-requisite is the thorough knowledge of subject-matter. Therefore, the teacher should have mastery on the content to be taught, identifying learning objectives in taxonomic categories.
2. The teacher should know his pupils and their need. He should have the awareness of individual differences of pupils and should make the provision in lesson plan to adjust the individual differences of the group.
3. The selection of appropriate teaching strategies, tactics and teaching aids in view of content and objectives to be achieved is an important step.
4. The teacher should have ability to select and make use of required procedures and support device.

5. The teacher must have the competency in relating teaching activities to learning structures by using appropriate teaching and communicating strategies.
6. The teacher should be competent in planning and organizing the teaching activities. He should also be able in reinforcing the pupils' activities and monitoring their behavior.
7. He should have the skill for the effective use of black board visuals in presenting the content.
8. A teacher should have good knowledge and skill of developing working questions, explanations for the lesson plan.
9. The teacher should be able to construct criterion test for evaluating the learning outcomes of pupils.

Check Your Progress-2

Note: a) Write your answers in the space given below:

b) Compare your answers with those given at the end of the unit.

1) Why is lesson plan important ?

2) Write any two pre requisites of lesson planning.

13.4 UNIT PLAN

13.4.1 Meaning of Unit Plan

The curriculum of mathematics may be available to you in terms of either content/concepts or competencies. Your target would therefore be to ensure acquisition of certain understanding and skills among children with regard to dealing with mathematical concepts and processes. Planning a unit is similar to lesson planning. A unit may have several lessons. Therefore it may not be complete in one class period. It may take several class periods to complete a unit. A unit in mathematics comprises of a chunk of interlinked competencies/concepts/content which have some common basis or characteristics. So, within any area of mathematical learning several units can be formed. It is the nature of competencies content and experience of the teacher about teaching mathematics and his/her formulating the units. Thus a unit plan is a series of lesson plans designed around a specific topic, lesson etc. Unit planning begins with the selection of a unit a starting point for this process could be examination of the chapter headings in the textbook.

Now you will appreciate that teacher has to organize the given set of competencies/content prescribed for the given class in a meaningful manner which will make his/her teaching and evaluation systematic and convenient. A unit in mathematics may be covered in one day, several days or even several weeks. You will have to decide the number of lessons to be delivered under one unit, having arranged the mathematical competencies in a graded manner and divided them into units for classroom transaction, You would like to think of the ways of communicating the same to the children. This will obviously make you think of the sequence of lessons within a unit, the method of teaching instructional aids, students' activities and the evaluation procedures. This decision if presented in an organized manner would result into a unit plan.

“A unit is a comprehensive and significant aspect of the environment of an organized science and art.”

Morrison, H.C.

“A unit is as large a block of related subject’s matter as can be overviewed by the learner.” Preston

“The unit is an organized body of information and experience designed to effect significant outcome of the learner.” Wisely

13.4.2m Purpose of unit plan

You may like to ask why we need a unit plan or can’t we do without a unit plan? The answer is simple that unit planning may bring about significant changes in the quality of teaching-learning. The following points highlight the advantages of unit planning and thus clarify how unit planning makes teachers talk easier and effective:

- It helps teachers to have a holistic view of teaching-learning which may help in organizing time and resources available at his/her disposal.
- It helps in designing a systematic, sequential and graded arrangement of course content which may give insight to develop teaching activities in the best possible manner.
- It helps in giving a balanced emphasis to various aspects of course content or competency under reference.
- It provides an opportunity to correlate textual content with competencies to be dealt with in the class.
- It may help thinking about alternative approaches to teaching-learning and adapt to individual differences. It may help unit wise evaluation of children and in organizing remedial teaching and undertaking enrichment measures as per the requirements.

13.4.3 Steps Involved in Unit Planning

Unit planning involves two major processes, namely, sequencing and selection. The main focus of unit planning should be to ensure effective learning on the part of children. After arranging the given set of competencies/content into a teaching-learning

sequence, a unit can be formed on the basis of identification of meaningful segments of competencies/content which may also be viewed in terms of time available for teaching-learning. Some people divide the course content to be covered month wise and call them 'units'. Still more important is the nature of course content or competencies and as such, some units may be small and some big in terms of time taken for teaching them. So a teacher has to apply judgment. Since we cannot leave the whole thing in intuitive ways of formulating units, some steps to be followed are suggested below:

- a) Estimate the whole course content/set of competencies for class during the year.
- b) Estimate the teaching time available to the teachers
- c) Arrange the given course content/set of competencies in a teaching-learning sequence.
- d) Identify interlinked aspects of course content/competencies
- e) Distribute the whole course content/competencies into units. Hence you may like to consider the following;
 - i) a unit should not be too small or too lengthy.
 - ii) it should have some element of commonness within its components.
 - iii) It should be such that it should not require more than a month in any case to complete in the class and
 - iv) It should be such that its completion develops a sense of accomplishment to both the teacher and the students.
- f) For each listed unit, further breaking up of teaching lessons would be requires.
- g) For each lesson within the unit, decide about the appropriate teaching methods, teaching aids, students activities and the evaluation process.

- h) Present these decisions and the breakup in a tabular form which may be considered to be unit plan.

13.5 MONTHLY PLAN

13.5.1 Meaning of Monthly Plan

Monthly plan is defined as the preparation of lesson prepared for whole month. The whole syllabus is divided into monthly plans and then lessons are prepared according the division of the syllabus. Lessons should be prepared on the basis of quarterly, monthly, weekly and unit bases. It should include both theory and practice in teaching of mathematics. The present syllabus is divided into units and is tested unit wise. But the units are divided into monthly bases. It should include the syllabus/ contents which could be easily covered. At the end of month it should be reviewed whether the syllabus has been completed or not. If not completed the reason thereof is to be sorted and explained. In the next month's plan, this reduce syllabus should be included and the system of teaching is so devised to cover the whole syllabus of that month, keeping in view the mental levels and workload, capacities, capabilities of the students, whether they can pick up the lessons taught by the teacher in the month.

After the month, the monthly test should be held so as to assess the achievement of mathematics curriculum. Students weak in monthly plan should be given extra time so that they could be brought to average level, at least.

Monthly days are very useful in teaching of mathematics otherwise the teacher teaches according to his/her own speed either too fast or too slow. Only expert teacher teach as per requirements of the monthly, weekly or unit plan. Even the students come to know how much they have achieved and how much difficulty is being faced. This needs regular study on the part of the teacher; otherwise the importance of monthly plan is lost. For this purpose the teacher should prepare his diary in which all facts including syllabus is to be maintained.

13.5.2 Purpose of Monthly Plan

- To discover the inadequacies in learner's learning and assist the weaker sections of learners to reach the level of other students through a regular programme of remedial instructions.
- To provide adequate information relating to the purpose, time limits and scoring of monthly test.
- The purpose of monthly plan to be stated clearly and concisely within time limit to cover the whole syllabus of that month, keeping in view the mental level and work load, capacities and capabilities of the students, whether they can pick up the lesson taught by the teacher in the month.
- The classroom teacher prepares his diary in which all facts including syllabus is to be maintained and finish the prescribed courses in time.
- It provides opportunities to students to work consciously and thereby to develop in them self-reliance and initiative.
- It provides desirable expansion and supplementation of materials and experience.
- It helps in diagnosis of students weaknesses in preparation and understanding.
- It also helps in diagnosis of teachers weaknesses.

Check Your Progress-3

Note: a) Write your answers in the space given below:

b) Compare your answers with those given at the end of the unit.

1) What do you mean by unit plan ?

2) Enumerate briefly any two purpose of Monthly Plan

13.6 LET US SUM UP

Lesson planning is a blue print through which the teacher prepares before going to deliver a particular lesson in front of the students. The significance of lesson planning gets reflected in the accomplishment of teaching objectives by the teacher which farther helps him/her in making the teaching learning process in an orderly and systematic manner. After going through the preceding sections you would be able to appreciate the need and importance of u lesson planning, unit and monthly planning. Unit, monthly and lesson plan do help teachers in organizing their actions in advance and help them undertake teaching in an interesting and efficient manner. If planned properly, unit plan monthly plan and lesson plans may lead to better quality of learning amongst children. It is, therefore, important for every teacher to develop a habit of unit, monthly and lesson planning and keep doing it throughout his/her teaching career.

13.7 LESSON END EXERCISE

- 1) What do you mean by lesson planning and what is its importance?
- 2) Explain the various steps involved in unit planning.

13.8 SUGGESTED FURTHER READINGS

Aggarwal, J.C. (1996). *Principles, Methods and Techniques of Teaching*. New Delhi: Vikas Publishing House.

Bhatia, K., & Bhatia, B.D. (1994). *The principles and Methods of Teaching*. Delhi: Doaba House.

Burich, G.D. (1988). *Effective Teaching Methods*. Toronto: Merrill.

Jacobson, David et al. (1985). *Methods for Teaching: Skill Approach*. Columbus: Charles E. Merrill Pub.Co.

Singh, Y.K. (2008). *Teaching Practice: Lesson Planning*. New Delhi: APH Publishing Corporation.

http://edweb.sdsu.edu/Course/EDTEC470/sections/F02-10/lesson_planning.htm<http://egyankosh.ac.in/bitstream/123456789/7185/1/Unit-2.pdf><http://egyankosh.ac.in/bitstream/123456789/8512/1/Unit-8.pdf>

13.9 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress-1

- 1) Lesson plan is the blue print of those teaching activities that are to be done in the classroom. A lesson plan is a teacher's detailed description of the course of instruction or 'learning trajectory' for a lesson.
- 2) "*Lesson plan as a draft of the lesson but upon paper with all the important points whether of matter or method clearly marked.*"

Joseph Landon

Check Your Progress-2

- 1) Lesson planning is important because it gives the teacher a concrete direction of what he/she wants to take up for the day.
- 2).
 - i. The first and foremost pre-requisite is the thorough knowledge of subject-matter.
 - ii. The selection of appropriate teaching strategies, tactics and teaching aids in view of content and objectives to be achieved is an important step.

Check Your Progress-3

1. Unit planning is the planning of the lessons or concepts covered under one unit.
2. The monthly Planning is meant to discover the inadequacies of learning in learners any to provide remedial instructions. It is also meant to diagnose weaknesses of teachers.

STEPS FOR PREPARING LESSON PLAN

Structure

- 14.1 Introduction
- 14.2 Objectives
- 14.3 Herbartian Approach
- 14.4 Steps for Preparing Lesson Plan Using Herbartian Approach
- 14.5 Herbartian Lesson Plan Format
- 14.6 RCEM Approach to Lesson Planning
- 14.7 Steps of RCEM Approach
- 14.8 RCEM Lesson Plan Format
- 14.9 Let Us Sum Up
- 14.10 Lesson End Exercise
- 14.11 Suggested Further Readings
- 14.12 Answers to Check Your Progress

14.1 INTRODUCTION

A lesson plan is the teacher's road map of what students need to learn and how it will be done effectively during the class time. The first task in planning a lesson is to analyse the contents of the topic in terms of concepts, principles, laws, theories, etc. the second task is to set learning objectives which are based on content analysis. Then you have to design appropriate learning activities and develop strategies to obtain feedback on student learning. Thus a successful lesson plan addresses and integrates the following key components:

- Content analysis
- Objectives for student learning
- Teaching/learning activities including selection of methods and media
- Strategies to assess students 'understanding

A lesson plan provides you with a general outline of your teaching goals, learning objectives and means to accomplish them and is by no means exhaustive. Having carefully constructed lesson plan allows a teacher to enter the classroom with more confidence and maximizes your chance of having a meaningful learning experience with your students.

14.2 OBJECTIVES

After going through this lesson, you shall be able to:

- classify the steps in preparation of an effective lesson plan,
- explain the steps involved in Herbartian approach of lesson planning, and
- describe the steps involved in RCEM Approach of lesson planning

14.3 THE HERBARTIAN APPROACH

Herbartian approach is also known as Herbartian five steps approach. It is one of the most followed approaches to lesson planning propounded by John Fredrik

Herbart (1776-1841). J.F. Herbart was a German philosopher and a great educationist. This lesson planning is an ancient concept. This approach is very popular even in today's perspective. Herbartian approach is theoretically based on apperceptive mass theory of learning. According to this theory, the child receives or learns the new knowledge easily if it is connected with the knowledge learnt previously by him. This approach is widely used in teaching of various school subjects. Originally, Herbart proposed four steps, they were **Clearness, Association, System and Method**, but his followers changed the names of the steps to **Preparation, Presentation, Abstract and Application respectively**. It was further modified to include five steps, i.e. **Preparation, Presentation, Association and Comparison, Generalisation and Application**.

14.4 STEPS FOR PREPARING LESSON PLAN USING HERBARTIAN APPROACH

- 1) Preparation:** It is the most preliminary stage where the mindset of the children's is involved whether they can absorb the new knowledge or not. It is very critical in making the children inquisitive and desirous to learn new knowledge. The preparation entirely depends upon the teacher's understanding of the class and the students. In other words, a thorough knowledge of the students' mindset is necessary to start a good preparation. It pertains to preparing and motivating students by checking their previous knowledge, by arousing their curiosity and by appealing to their senses. For this the teacher uses method of questions and answers having a bearing on the previous knowledge of the students. This step should not take more than 7-8 minutes. Preparation means preparation of child's mind to receive new knowledge, just as the fields are prepared for sowing seeds. The teacher can be effective only if recipients (students) are active learners. To know where the pupils are and where they should try to be are the two essentials of good teaching. Besides the teacher, the roles of students are also very important in the preparation. They should realize the need of studying the present lesson. In dealing with preparation, the following points are to be adhered to

- i. Curiosity or inquisitiveness should be ignited.
- ii. No new knowledge should be included.
- iii. Little time should be devoted to the preparation and it should be as brief as possible.

In its modified form, as it stands now a days in writing lesson notes on our teacher training programme, the following activities are involved in this step:

- Introductory particulars, indicating Pupil Teacher's name or Roll No., date, class, section, subject, topic, average age of the class pupils, duration of the period etc.
- The general and specific aid material to be used.
- The general and specific aims of the lesson.
- The assumption about the previous knowledge of the students in relevance to the lesson.
- The testing of the previous knowledge.
- Utilizing the previous knowledge for introducing the lesson.
- Motivating the students for studying the present lesson.
- Announcement of the aim of the lesson in a clear, concise and specific form.

2) Presentation or Development: This step involves the actual development of the lesson. In other words, after the teacher introduces the lesson and announces the aim clearly, he/ she proceeds to present the new knowledge which marks the actual commencement or beginning of the lesson. With the aid of numerous communication devices, the teacher should undertake the presentation stages, like explanations, questions, demonstrations, sensory aids etc. The information or knowledge that is given in this step should be nicely

explained and revealed. Like preparation step, this step also involves some points, which should be looked into. They are:

- i. **Principle of Selection and Division:** The course material should be very carefully selected and divided into various sections. In this presentation step the teacher should keep in his/her mind how much to divulge in front of the students and in case of students, how much they will grasp from the lesson.
 - ii. **Principle of Successive Sequence:** The divisions that are prepared in the preparation of a lesson should be well connected with each other and the teacher should keep in his/her mind that the succeeding and the preceding knowledge are clear to the pupils.
 - iii. **Principle of Absorption and Integration:** Though the lesson is divided into various divisions and segments, but in a holistic approach, it should be an integral part and the real meaning emerges with the understanding of the whole.
 - iv. **Principle of Revision and Fixation:** The unit should be always revised by the teacher so that he becomes quite clear that the students have grasped the unit and the new knowledge thus imparted is fixed in their mind.
- 3) **Association and Comparison:** This crucial step involves the acquisition of new knowledge by the students. The new knowledge should be imparted to them in such a way that it has a strong link with the old knowledge. After the new knowledge is imparted, the pupils are told to go through it very carefully and associate this new knowledge with the already present old knowledge i.e. compare and contrast these new ideas or facts with the facts and ideas they have already learnt. This step is really very important in case of inductive lesson like grammar, formula in algebra, theories and principles in science to name a few instances. Thus, the step of comparison and association helps in

the process of teaching and learning by blending the old and new to create something new for the growth in the knowledge and experience of the students.

- 4) **Generalisation:** After the mind has grasped a new knowledge and compared it with the old knowledge, it comes to form a general idea underlying various ideas and formulate some principles or laws. The main aim of this step is to aid students in evolving the conclusion by themselves through thinking, reflection and experience. According to Ryburn, it is bad teaching, where the teacher gives the ready-made conclusion to the students instead of the students evolving the conclusion by themselves. The teacher at this stage should try to remain in the background for providing only necessary guidance and correction.
- 5) **Application:** The last step is the Application, where the knowledge given is used and tested so that the real power of the knowledge emerges out of it. Knowledge that cannot be applied is useless and dead. According to psychology, the real consolidation of the knowledge takes place when it is applied to some real situations so that it becomes clear and gets absorbed in the mindset of the students. Some forms of application are : i. Problem solving ii. Essay writing iii. Maps, models, graph preparation etc.

Recapitulation: The importance of this word can be observed during the entire course of development of a lesson. It actually means the revision and repetition of the knowledge gained. It can be resorted after the end of the lesson or can be laid out after each unit of a lesson through illustration of the main or major points. It is done for assessing the effectiveness of the lesson and also for assessing the students' progress.

Home task: In order to strengthen the knowledge and the experience, the students should be given some home task. The students should be asked to write out certain things or to do some practical experiments.

Herbartian approach has contributed a lot in making teaching a well-planned enterprise. It represents an orderly and systematic procedure based on sound

psychology laws and is easily applicable to the teaching of almost all the school subjects. This approach makes the task of lesson planning quite methodological, simple and easy.

14.5 HERBARTIAN LESSON PLAN FORMAT

Subject:	Date:
Unit:	School:
Topic:	Class:
Duration:	Period:

- 1) General Objectives:
- 2) Specific Objectives:
- 3) Teaching Aids:
- 4) Method of teaching:
- 5) Previous Knowledge:
- 6) Introduction:
- 7) Statement of the Topic/Aim:
- 8) Presentation or Development of the Lesson :

Teaching Points	Teacher's Activity	Learner's Activity
-----------------	--------------------	--------------------

OR

Content	Objective	Teaching Learning Activities	Evaluation
---------	-----------	------------------------------	------------

- 9) Recapitulation:
- 10) Application
- 11) Black Board Summary:
- 12) Home Assignment:

Check Your Progress-1

Note: a) Write your answers in the space given below:

b) Compare your answers with those given at the end of the unit.

- 1. List out the various steps of Herbartian Approach.

14.6 RCEM APPROACH TO LESSON PLANNING

The Indian educationists developed a new approach to lesson planning which is an improvement over the earlier approaches. This approach was developed in Regional College of Education Mysore in 1972. So, it is known as RCEM approach of lesson planning. This approach gives emphasis on “mental abilities” or “mental processes” rather than “terminal behavior”. In RCEM approach emphasis is given on learning processes. It also considers the Bloom’s taxonomy of educational objectives in identifying the teaching objectives with some modifications. Bloom’s taxonomy’s last three categories are denoted by one category only i.e. creativity. Thus in this approach the objectives of cognitive domain have been classified in four categories such as Knowledge, Understanding, Application and Creativity. These four categories further involve 17 mental abilities for writing the objectives in behavioral or functional form. The classification of objectives given by RCEM is as follows :

S.No.	Objectives	Mental Abilities/Mental Processes
1.	Knowledge	Recall, Recognition
2.	Understanding	Cite examples, See relationship, Classify, Generalise, Interpret, discriminate, Verify
3.	Application	Establish Hypothesis, Predict, Infer, Reasoning, Formulate Hypothesis
4.	Creativity	Analyse, Synthesis, Evaluate

14.7 STEPS OF RCEM APPROACH

In this approach of lesson planning, the design plan convene on learning of three aspects: 1. Input 2. Process 3. Output

1. **Input:** This aspect is concerned with the identification of objectives. Input may also be termed as ‘expected behavioral outcomes’ (EBOs). These objectives are broadly classified into four categories viz. knowledge, understanding, application and creativity. These objectives are written in behavioral by employing seventeen mental abilities. The entering behaviors of the students are also identified. The sequence of instructional procedure is determined with the help of these objectives.

2. **Process:** This aspect is concerned with the presentation of content and learning experiences. The main focus of process aspect is to create the learning situations for providing appropriate learning experiences to the learners. Therefore, the teaching strategies and tactics are selected for achieving the specified objectives. The communications strategy and audio-visual aids are employed for the effective presentation of the content. The process also includes the technique of motivation, so that student’s behavior can be reinforced for the desirable responses. The process implies the interaction of teacher and students.

3. **Output:** This aspect of instructional procedure is concerned with the 'Real Learning Outcomes' (RLOs). In the process aspect learning experiences are provided for the desirable change in students behaviors. The change in behaviors is known as the 'Real Learning Outcomes' (RLOs). The various measuring devices are employed to measure the RLOs. The evaluation devices are specified for measuring the criterion behaviors.

In this way RCEM approach may be taken as an attempt to bring necessary improvement in the prevailing practice of lesson planning. It has a number of merits over Herbartian approach, Unit approach and Bloom's evaluation approach. The teaching learning situations, strategies and aid material is properly stated in the name of communication and interaction process going inside the classroom. The evaluation aspect is also properly attended in this approach.

14.8 RCEM LESSON PLAN FORMAT

Date:

Subject:

School:

Unit:

Class:

Topic/Lesson:

Duration:

- 1) Concepts:
- 2) Teaching Aids:
- 3) Previous Knowledge:
- 4) Introduction:
- 5) Statement of the Topic:
- 6) Presentation:

Expected Behavioural Outcomes (EBO's)	Sequential Learning Experiences/Activities (SLEs)	Real Learning Outcomes (RLO's)
---------------------------------------	---	--------------------------------

7) Black Board Summary:

8) Home Assignment:

Check Your Progress-2

Notes: a) Write your answers in the space given below:

b) Compare your answers with those given at the end of the unit.

1. Write the mental abilities for understanding objective in RCEM Approach.

2. What do you mean by RLO's ?

14.9 LET US SUM UP

There are various approaches of teaching mathematics in our schools, but every where it is emphasized that there is a need to apply the right approach. The approach should serve 'as a drawing out process and not as a pouring in process'. Their successful application depends upon the personality of the teacher. In every case the teacher is the moving force in the whole teaching learning process and he should be very well conversant about the right use of appropriate approach. Whether the teacher use Herbartian approach or RCEM approach or any other approach, modification of pupil's behavior is the pressing requirement.

14.10 LESSON END EXERCISE

- 1) Explain the various steps involved in herbartian approach of lesson plan.
 - 2) How will you prepare a lesson plan using RCEM approach?
-

14.11 SUGGESTED FURTHER READINGS

Aggarwal, J.C. (1996). *Principles, Methods and Techniques of Teaching*. New Delhi: Vikas Publishing House

Rao, R.R. (2004). *Methods of Teacher Training*. New Delhi: Discovery Publishing House. Serdyukov, P.R., & Mark. (2008). *Writing Effective Lesson Plans: The 5-Star Approach*. Boston: Allyn & Bacon.

Singh, Y.K. (2008). *Teaching Practice: Lesson Planning*. New Delhi: APH Publishing Corporation. http://shodhganga.inflibnet.ac.in/bitstream/10603/186595/7/07_chapter%25201.pdf<http://egyankosh.ac.in/bitstream/123456789/466781/1/Unit-5.pdf>

14.12 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress-1

1. i. Preparation ii. Presentation iii. Association and Comparison iv. Generalisation v. Application

Check Your Progress-2

- 1) Cite examples, See relationship, Classify, Generalise, Interpret, Discriminate, Verify
- 2) In the process aspect learning experiences are provided for the desirable change in students behaviors. The change in behaviors is known as the 'Real Learning Outcomes' (RLOs).

**THE TOPICS OF TRIANGLE, CRITERIA FOR SIMILARITY
(THEOREM OF BPT) AND THEOREM OF PYTHAGORUS,
HCF & LCM**

Structure

- 15.1 Introduction
- 15.2 Objectives
- 15.3 Theorem of BPT
- 15.4 Herbartian Lesson Plan on Pythagoras theorems
- 15.5 RCEM Lesson Plan on LCM and HCF
- 15.6 Advantages and Limitations of Herbartian and RCEM lesson Plans Approaches
 - 15.6.1 Advantages Herbartian Approach
 - 15.6.2 Limitations of Herbartian Approach
 - 15.6.3 Advantages of RCEM Approach
 - 15.6.4 Limitations of RCEM Approach
- 15.7 Let Us Sum Up
- 15.8 Unit End Exercises

15.9 Suggested Further Readings

15.10 Answers to Check Your Progress

15.1 INTRODUCTION

In this lesson the learner will understand concept of some mathematics concept with respect to secondary level which includes Concept of triangle namely BPT Theorem, Pythagoras Theorem, and some other concepts like HCF and LCM. You will also go through the examples related to concepts so that you will understand the concepts clearly.

15.2 OBJECTIVES

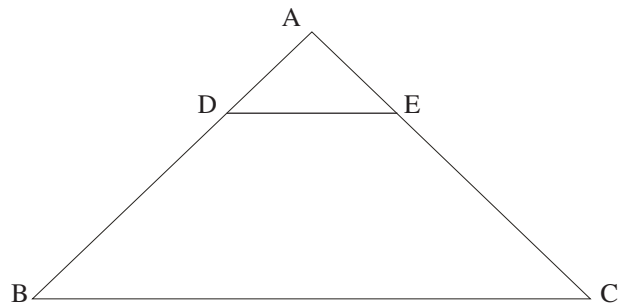
After studying this lesson, you will be able to:

- To explain the concept of basic proportionality theorem.
- To state and understand the concept of Pythagoras theorem.
- To frame a lesson plan based on Herbartian approach
- To prepare a lesson plan based on RCEM approach
- To explain concept of HCF and LCM.
- To differentiate between Herbartian and RCEM approach of Lesson plan

15.3 BASIC PROPORTIONALITY THEOREM (OR THALES THEOREM)

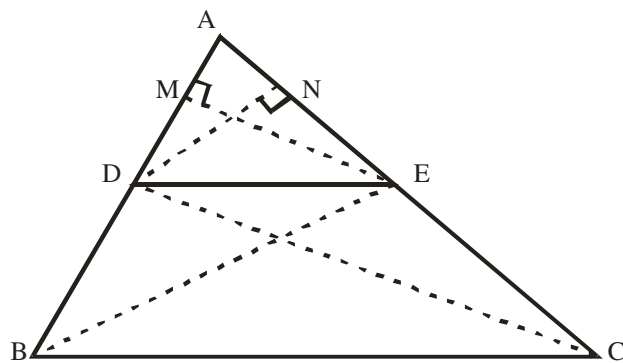
Statement- If a line is drawn parallel to one side of a triangle intersecting the other two sides in distinct points, then the other two sides are divided in the same ratio.

Given: Let $\triangle ABC$, as shown in the given figure. In this triangle, we draw a line DE parallel to the side BC of $\triangle ABC$ and intersecting the sides AB and AC in D and E respectively.



To Prove: We need to prove: $AD/DB = AE/EC$

Construction: Join the vertex B of $\triangle ABC$ to E and the vertex C to D to form the lines BE and CD and then drop a perpendicular EN to the side AB and also draw $DM \perp AC$ as shown in the given figure.



Proof:

$$\text{Now, Area } (\triangle ADE) = \frac{1}{2} \square \text{Base} \square \text{Height} = \frac{1}{2} \square AD \square EN \dots\dots\dots (1)$$

$$\text{Area } (\triangle BDE) = \frac{1}{2} \square \text{Base} \square \text{Height} = \frac{1}{2} \square BD \square EN \dots\dots\dots (2)$$

Dividing Equation (1) and (2)

$$\frac{\text{Area } (\triangle ADE)}{\text{Area } (\triangle BDE)} = \frac{\frac{1}{2} \square AD \square EN}{\frac{1}{2} \square BD \square EN} = \frac{AD}{BD} \dots\dots\dots (A)$$

$$\text{Also, Area } (\triangle ADE) = \frac{1}{2} \square \text{Base} \square \text{Height} = \frac{1}{2} \square AE \square DM \dots\dots\dots (3)$$

$$\text{Area } (\triangle DCE) = \frac{1}{2} \square \text{Base} \square \text{Height} = \frac{1}{2} \square EC \square DM \dots\dots\dots (4)$$

Dividing Equation (3) and (4)

$$\frac{\text{Area } (\triangle ADE)}{\text{Area } (\triangle DCE)} = \frac{\frac{1}{2} \square AE \square DM}{\frac{1}{2} \square EC \square DM} = \frac{AE}{EC} \dots\dots\dots(B)$$

Now,

$\triangle BDE$ and $\triangle DCE$ are on the same base DE and between the same parallel lines BC and DE .

$$\square \text{ Area } (\triangle BDE) = \text{Area } (\triangle DCE)$$

$$\text{Thus, } \frac{\text{Area } (\triangle ADE)}{\text{Area } (\triangle BDE)} = \frac{\text{Area } (\triangle ADE)}{\text{Area } (\triangle DCE)}$$

$$\frac{AD}{BD} = \frac{AE}{EC} \text{ [From equation (A) and (B)]}$$

Hence, proved

Check Your Progress-1

Notes: a) Write your answers in the space given below:

b) Compare your answers with those given at the end of the lesson.

1. Who introduced Basic Proportionality Theorem ?

2. What is another name of BPT ?

15.4 HERBARTIAN LESSON PLAN ON PYTHAGORAS THEOREM

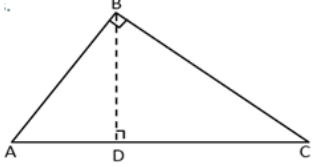
In a right triangle, the square of the hypotenuse is equal to -the sum of the squares of other two sides.

TOPIC:Proof and Applications of the Pythagorean Theorem.

OBJECTIVES: Following are the objectives of the lesson plan

1. Students should learn to prove the Pythagorean Theorem.
2. Students will be able to apply the Pythagoras theorem.

PRESENTATION

Teacher's Activity	Student's Activity	B.B. Summary Teaching Aids
<p>P.T. will explain to the students that Pythagoras theorem is actually based on the special property of right-angle triangle. For this, let us suppose “ABC right angle at B. Draw $BD \perp AC$</p> <p>Further, P.T. will say that we have to prove that $AC^2 = AB^2 + BC^2$</p> <p>In order to prove this, we will first make the triangle similar then only we can make their corresponding parts proportional.</p>	<p>Student will listen carefully</p> <p>Student will listen carefully and write on their notebooks.</p> <p>Student will listen carefully and write on their notebooks.</p>	<div style="text-align: center;">  </div> $AC^2 = AB^2 + BC^2$ <p>Since $BD \perp AC$,</p> <p>In $\triangle ABD$ & $\triangle ABC$</p> <p>$\angle A = \angle A$ (common)</p> <p>$\angle ABC = \angle ADB$ (Each 90)</p> <p>$\triangle ABD \sim \triangle ABC$ (By AA Criteria)</p> <p>So, $\frac{AD}{AB} = \frac{AB}{AC}$ (Sides are Proportional)</p> <p>or, $AD \cdot AC = AB^2 \dots \dots (1)$</p>

Teacher's Activity	Student's Activity	B.B. Summary Teaching Aids
<p>P.T now will move further by saying that similar we can make other two triangle similar that is $\Delta BDC \sim \Delta ABC$ (By AA Criteria)</p> <p>P.T. will proceed further that now adding equation 1 and 2, we will get</p> <p>P.T. now ask students how they would solve the word problems that apply the Pythagorean Theorem</p>	<p>Student will make the things to understand and note it down.</p>	<p>$\Delta BDC \sim \Delta ABC$ (By AA Criteria)</p> <p>So, $\frac{CD}{BC} = \frac{BC}{AC}$</p> <p>or, $CD \cdot AC = BC^2 \dots\dots (2)$</p> <p>Adding equation (1) and (2), we get</p> <p>$AD \cdot AC + CD \cdot AC = AB^2 + BC^2$</p> <p>or, $AC \cdot (AD + CD) = AB^2 + BC^2$</p> <p>or, $AC \cdot AC = AB^2 + BC^2$</p> <p>or, $AC^2 = AB^2 + BC^2$</p> <p>Check whether triangle with 5cm, 65cm and 4cm, is a right triangle or not.</p>

The above theorem was earlier given by an ancient Indian mathematician Baudhayan (about 800 B.C.) in the following form:

“The diagonal of a rectangle produces by itself the same area as produced by its both sides (i.e., length and breadth”.

For this reason, this theorem is sometimes also referred to as the Baudhayan Theorem

Check Your Progress-2

Notes: a) Answer the question given below.

1. The sides of a triangle are 5, 12 & 13 units. Check if it has a right angle or not.

15.5 HERBARTIAN LESSON PLAN ON LCM AND HCF

TOPIC: Highest Common Factor

OBJECTIVES: Following are the objectives of the lesson plan:

1. Student will be able to find the HCF of a pair of numbers by listing.
2. Students will also be able to find the HCF by using prime factorization method.

PRESENTATION

Teacher's Activity	Student's Activity	B.B. Summary Teaching Aids
P.T will ask the students that what are the common factors of 12 and 16?	Students will answer that they are 1, 2 and 4.	Factors of 12 and 16 are 1, 2 and 4.
P.T will further ask to students that what is the highest of these common factors?	Students will listen carefully and write it down in the notebook that It is 4.	4
P.T will tell that 4 is the highest common factor amongst all the factors of 12 and 16. So, HCF of 12 and 16 is 4.	Students will listen carefully.	

Teacher's Activity	Student's Activity	B.B. Summary Teaching Aids
<p>P.T will then ask one of the students to write the factors of 20, 28 and 36 on the blackboard.</p> <p>P.T will further explain that amongst the factors of 20, 28 and 36 again 4 is the highest of these common factors. P.T will too explain that the highest common factor (HCF) of two or more given numbers is the highest (or greatest) of their Common factors. It is also known as Greatest Common Divisor (GCD).</p>	<p>Students will observe the blackboard carefully and then write it down on their notebook.</p> <p>Student will listen carefully.</p>	<p>Factor of 20- 4,5 Factor of 28- 7,4 Factor of 36- 9,4</p> <p>HCF of 20, 28 and 36 is 4.</p>

Check Your Progress-3

Notes: a) Answer the questions given below :

1. Find the Highest Common Factor of 25, 35 and 45.
2. Frame a lesson plan on finding HCF and LCM for the students of class 7th

15.5.3 LCM (Lowest Common Multiple)

TOPIC: Least Common Multiple

OBJECTIVES: Following are the objectives of the lesson plan:

1. Student will be able to find the LCM of a pair of numbers by listing.

Teacher's Activity	Student's Activity	B.B. Summary Teaching Aids																								
<p>number of times the factor 3 occurs is two; this happens for 18. The LCM of the two numbers is the product of the prime factors counted the maximum number of times they occur in any of the numbers.</p> <p>Now, P.T will give a practical method of finding LCM of more than two numbers i.e. 20, 25 and 30. Following are the steps to follow :</p> <ol style="list-style-type: none"> 1) Firstly, we write the numbers as follows in a row. 2) Divide by the least prime number which divides any one of the given numbers. Here, it is 2. The 	<p>Student will be carefully understanding and write in their notebook.</p>	<p>Thus, in this case LCM = $2 \times 2 \times 3 \times 3 = 36$.</p> <table border="1" data-bbox="954 945 1273 1169" style="margin-left: auto; margin-right: auto;"> <tr><td>2</td><td>20</td><td>25</td><td>30</td></tr> <tr><td>2</td><td>10</td><td>25</td><td>15</td></tr> <tr><td>3</td><td>5</td><td>25</td><td>15</td></tr> <tr><td>5</td><td>5</td><td>25</td><td>5</td></tr> <tr><td>5</td><td>1</td><td>5</td><td>1</td></tr> <tr><td></td><td>1</td><td>1</td><td>1</td></tr> </table> <p>So, LCM = $2 \times 2 \times 3 \times 5 \times 5$.</p>	2	20	25	30	2	10	25	15	3	5	25	15	5	5	25	5	5	1	5	1		1	1	1
2	20	25	30																							
2	10	25	15																							
3	5	25	15																							
5	5	25	5																							
5	1	5	1																							
	1	1	1																							

Teacher's Activity	Student's Activity	B.B. Summary Teaching Aids
<p>numbers like 25 are not divisible by 2 so they are written as such in the next row.</p> <p>3) Again divide by 2. Continue this till we have no multiples of 2.</p> <p>4) Divide by next prime number which is 3.</p> <p>5) Divide by next prime number which is 5.</p> <p>6) Again, divide by 5.</p> <p>Thus, the LCM comes out to be</p> <p>$2 \times 2 \times 3 \times 5 \times 5$</p>		

Check Your Progress-4

Notes: a) Answer the questions given below :-

1. Find the Least Common Multiple of 36 and 44.
2. What activities will you plan to teach the concept of LCM and HCF ?

15.6 ADVANTAGES AND LIMITATIONS OF APPROACHES

15.6.1 Advantages Herbartian Approach

Herbartian Approach is based on apperceptive mass theory of learning. All the knowledge and information is to be given from outside by the teacher because the student is considered similar to a clean slate. For the students, if an old knowledge makes a base for new knowledge (his previous knowledge or experiences), it may be acquired easily and retained for a longer period.

1. **Organized Teaching.** Each step has been organized in a logical order which provides an opportunity to the fresh teacher to become aware of future mistakes. Originality is never affected and the teaching goes on in a very organized way.
2. **Acquiring thoughts as apperception.** Herbart believed that when the new thought related to the thoughts lying in unconscious mind of the pupils are presented, the thoughts of unconscious mind come to the conscious mind, establish relationship with the new thought and again go to the unconscious mind. Herbart termed this material process of acquiring thoughts as apperception.
3. **Use of Inductive and Deductive Methods.** While presenting the new knowledge, help of various examples is sought through 'generalization' and rules are derived. it is an inductive method. In the step application, these rules are to be executed, this is a deductive method. Thus, both inductive and deductive methods are used in this five steps approach.
4. **Recapitulation.** Such question is asked while recapitulating which, on answering, result in the learning and application of the acquired knowledge in new situations.

5. **Correlation Possible.** Herbart considered entire knowledge as a single unit. The knowledge of the pupils is acquired in a single unit. This allows to establish a correlation between previous and new knowledge and between all subject of the curriculum.

15.6.2 Limitations of Herbartian Approach

1. **Mechanical Method of Teaching.** The use of these steps takes away the freedom of the teacher as he cannot incorporate his independent thought in any step. This reduces his originality. Hence, Herbartian approach is a mechanical method of teaching.
2. **No Place for Individual Differences.** While using Herbartian approach. Similar questions are asked to the entire. This overlooks individual differences.
3. **Useful in Knowledge Lesson only.** Herbartian approach is useful in the knowledge lesson only, not in appreciation and skill lessons.
4. **Teacher More Active.** In Herbartian approach, the teacher has to be more active. It is more desirable if the pupils remain more active than the teachers. As this teaching method is not activity-centered, pupils don't get any motivation for learning.
5. **No need of Generalization.** Generalization is not needed while teaching language, geography, history, music and arts etc. Thus, all the five steps are not needed while teaching.
6. **Uninteresting.** This approach stresses upon the teaching of all the subjects of curriculum in a similar sequence overlooking the interests, attitudes, abilities, and capacities of the pupils according to their mental development. The entire teaching becomes monotonous. The pupil does not show any interest in acquiring new knowledge. Thus, Herbart's teaching method is not interesting

7. **Difficulty of Correlation.** Considering the knowledge as a complete unit, Herbart emphasized correlation between different subjects for the unity in the mental life of the pupils, but following these five steps teachers impart the knowledge of different subjects to the pupils differently. They seek to establish a correlation between various subjects in order to bring integration in the mental life of the pupils which is essentially difficult, if not impossible.

15.6.3 Advantages of RCEM Approach

Indian educationists developed a new approach to lesson planning which is an improvement over the earlier approaches. This approach was developed in Regional College of Education Mysore. So, it is known as RCEM method of lesson planning. It also considers the Bloom's taxonomy of educational objectives in identifying the teaching objectives with some modifications. It involves 17 mental abilities for writing the objectives in behavioral or functional form. In this approach of lesson planning, the design plan consists of three aspects:

- a. Input
- b. Process
- c. Output

RCEM approach have some good characteristics which are as follows:

1. Writing or converting objectives into the behavioral terms is easy.
2. The construction of test items is convenient.
3. The approach lays more emphasis on mental activities.
4. This approach has been developed in and according to the Indian context.

5. All the educational objectives can be written in behavioural terms in this approach.
6. The objectives in behavioural terms are more specific and definite.
7. RCEM approach gives more importance to the learning process than learning outcome.

15.6.4 Limitations of RCEM Approach

1. If we see the table of objectives, it would be clear that there is no balance between the mental activities for different objectives. In cognitive objectives there are two, in understanding there are five and in creativity objective there are three mental activities.
2. It is difficult task to associate various elements of the content with the various mental activities.
3. Guildford has suggested 120 mental abilities, while this system has suggested only 17 mental activities.
4. This approach is more useful for cognitive objectives only because use of single design for cognitive, affective and psychomotor objectives does not seem to be appropriate.

15.7 LET US SUM UP

In this lesson you studied about concept of triangle including the basic proportionality theorem and Pythagoras theorem concept for the learners as an instructional aid in teaching mathematics. Also, we discussed about a highest common factor and Least Common Factor (LCM) and uses for the quality of learning outcome in the process of teaching. Along with this, the lesson also discussed about examples solving HCF and LCM.

15.8 UNIT END EXERCISE

1. State and prove Basic Propormes.
2. State and prove Pythagoras Theorem.
3. Define LCM and HCF with examples.
4. Frame the Lesson plan on Pythagoras theorem based on Herbartian Approach.

15.9 SUGGESTED FURTHER READINGS

Aggarwal, J.C. (2018). *Essentials of Educational Technology*. New Delhi: Vikas Publication House

<https://ncert.nic.in/textbook.php>

Kochhar, S.K. (1992). *Methods and Techniques of Teaching*. New Delhi: Sterling Publisher Pvt. Ltd.

Russel, J. (2004). *Teaching of Mathematics*. New Delhi: Campus Book International. Sidhu, K.S. (1982). *Teaching of Mathematics*. New Delhi: Sterling Publisher Pvt. Ltd. www.sribd.com

15.10 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress

1. Basic Proportionality theorem was introduced by a famous Greek Mathematician, Thales, therefore, it is also called Thales Theorem.
2. Another name for BPT is Thales theorem. As per this theorem, if a line is drawn parallel to one side of a triangle intersecting the other two sides in distinct points, then the other two sides are divided in the same ratio.