



UNIT 11 TOOLS AND TECHNIQUES OF ASSESSMENT

Structure

- 11.0 Introduction
- 11.1 Learning Objectives
- 11.2 Continuous and Comprehensive Assessment in Mathematics
- 11.3 Types of Test Items
 - 11.3.1 Objective based items
 - 11.3.2 Open ended items
- 11.4 Developing Question Banks in Mathematics
- 11.5 Assessment for Mathematics Learning
 - 11.5.1 Project
 - 11.5.2 Portfolio
 - 11.5.3 Participation in Exhibition
 - 11.5.4 Mathematical Quizzes and Games
 - 11.5.5 Observing children during mathematics activities
- 11.6 Let us sum up
- 11.7 Model Answers to check your progress
- 11.8 Suggested Readings and References
- 11.9 Unit-End Exercises

11.0 INTRODUCTION

Evaluation and assessment are intimately associated with the teaching-learning process. In the previous unit you have already read about the characteristics of assessment in mathematics. You have also learnt about modern trends and techniques of assessment in mathematics. Besides, in the Block 4 of the Course 3, you have extensively discussed the role of assessment in learning, the tools and techniques of assessment and the uses of assessment results in enhancing learning.

Mathematics is an important school subject in developing mathematical thinking and reasoning as well as in developing critical thinking among the learners. Uninteresting classroom transaction as well as stressful assessment procedure create phobia towards mathematics learning. In this unit attempts have been made to acquaint you with various



Notes

tools and techniques of assessment in the context of continuous and comprehensive evaluation (CCE) in Mathematics.

Use of different types of test items in mathematics is crucial to assess the child's learning in different areas like knowledge, understanding, application etc. Further, the use of open ended items in mathematics enables the learner to think of solution of a particular problem from different dimensions. In this unit, you will learn about the usefulness of open ended items. Besides the use of various techniques of assessment like project, portfolio, quiz, exhibition, game will help you to make the assessment process child friendly and more useful. Those techniques of assessment are discussed in this unit for your understanding.

For completing this unit, you will need about 8 (*eight*) hours study.

11.1 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- prepare different types of objective based test items in Mathematics to assess learner's progress through continuous and comprehensive assessment processes;
- construct and use open ended test items in Mathematics,
- understand the necessity and utility of question bank in Mathematics
- use different types of activities like mathematics exhibition, quiz, puzzle, games to assess the learners' interest in mathematics

11.2 CONTINUOUS AND COMPREHENSIVE ASSESSMENT IN MATHEMATICS

Continuous and comprehensive assessment (CCA) emphasizes on two fold objectives. These are continuity in assessment and assessment of all aspects of learning. Thus the term '*continuous*' refers to assessment on intermittent basis rather than a onetime event. When the assessment exercises are conducted in short intervals on regular basis, the assessment tends to become continuous. In other words, it can be said that if the time interval between two consecutive assessment events can be lessened or minimized then the assessment will become continuous. In order to make the assessment process continuous, the assessment activities must be spread over the whole academic year. It means regularity of assessment, frequent unit testing, diagnosis of the learning difficulty of the learners, using corrective measures, providing feedback to the learners regarding their progress etc will have to happen maximally.

The second term '*comprehensive*' means assessment of both scholastic and co-scholastic aspect of student's development. Since all the abilities of the learners'



development cannot be assessed through written and oral activities, there is a need to employ variety of tools and techniques (both testing and non-testing techniques) for the assessment of all the aspects of learners' development. .

Assessment in mathematics is linked with the aims of teaching mathematics. In the primary schools years, the aim of school mathematics is to develop useful capabilities and also to develop the ability to think and reason mathematically. Useful 'capabilities' include conceptual and spatial understanding, problem solving and mathematical modeling. While learning mathematics children develop and express self confidence, creativity, ability to communicate and use mathematical concepts and symbols (Fig. 11.1). The focusing points of learning assessment in mathematics at primary level are related to understanding:

- how children learn mathematics,
- the mathematical concepts included in primary school curriculum, and
- child understanding of mathematics.

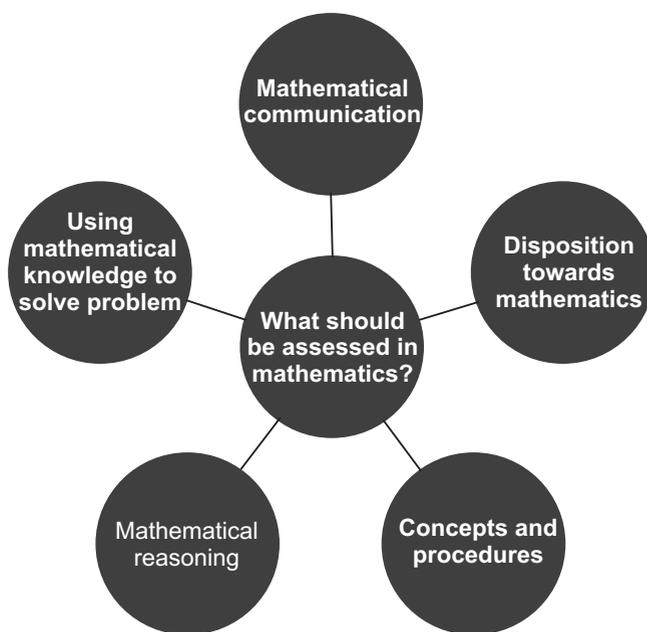


Fig. 11.1 Aspects of Assessment of Mathematics Learning at Primary Level

Source: NCERT(2008)

There is a wide choice of methods or *tools and techniques* which can be used by the teacher to assess different dimensions of child's learning in mathematics. Apart from the traditional paper pencil test and oral tests, the teacher can use other modes of observation, assignments, projects, portfolio, checklists, rating scales, anecdotal records etc. Use of multiple tools are required to enable you to assess the learners in a more



Notes

comprehensive and objective manner. A simple test should be record every day the number of questions asked by distinct students in a maths class/activity more the number of questions, more the learning

11.3 DIFFERENT TYPES OF TEST ITEMS IN MATHEMATICS

As discussed in the previous section, the teacher needs to assess the students progress in mathematics learning and to help him for further learning on the basis of the assessment results. The teacher may use different types of test items for this purpose. Teacher made tests which are constructed by the teachers for use within their classroom are quite useful for this purpose. You have already read about the principles of construction of teacher made tests and different types of test items in the Unit- 14 of the Course 3. In this section you will learn about how to prepare different types of test items in mathematics.

11.3.1 Objective-Based Items

As you know, before starting the teaching-learning process, objectives are to be formulated and by employing appropriate teaching learning process, the teacher and students jointly try to achieve the predetermined set of objectives.

The objective based test item is supposed to measure a specific objective of instruction (learning outcomes). Such types of items describe the learners' achievement more accurately. The items are based on the specific objectives of a particular concept. Let us discuss some objectives along with items in mathematics. Observe the table given below:

Table 1: Examples of Specific Objectives of Mathematics Learning

Objectives	Behavioral specifications
Knowledge	<ul style="list-style-type: none"> ● Recalls facts, rules, theorems, definitions, principles, terms. ● Recognizes facts, relations, definitions, formulae etc
Comprehension	<ul style="list-style-type: none"> ● Detects errors in figures, statements and rectifies these. ● Interprets the principle in his/her own term ● Converts words into symbols and vice versa ● Classifies on the basis of certain criteria ● Provides more example on a principle/rule



	<ul style="list-style-type: none"> ● Verifies the mathematical conclusions ● Discriminate between similar things
Application	<ul style="list-style-type: none"> ● Suggests alternative plan or method for solution of a mathematical problem ● Makes generalization on the basis of given facts ● Takes decision about sufficiency of the given facts ● Makes predictions and verifies them
Skills	<ul style="list-style-type: none"> ● Uses geometrical instruments correctly ● Represents a given data diagrammatically ● Draws geometrical figures with accuracy and speed.

Now look at the following objective type of items:

- Which is the smallest prime number?
- What is the sum of the measures of the interior angles of a triangle (in degree)?
A. 90 B. 180 C. 270 D. 360
- The number 9 is an odd number, because
A. It is the biggest one digit number.
B. It is not divisible by 2.
C. It has three factors.
D. It is the square of 3.
- In which of the following conditions a triangle ABC *CANNOT* be constructed?
A. $AB = 5\text{cm}$, $BC = 4\text{cm}$, $CA = 3\text{cm}$
B. $AB = 6\text{cm}$, $BC = 5\text{cm}$, $CA = 3\text{cm}$
C. $AB = 5\text{cm}$, $BC = 4\text{cm}$, $CA = 1\text{cm}$
D. $AB = 7.5\text{cm}$, $BC = 4\text{cm}$, $CA = 3.9\text{cm}$

All the four items are objective type of items. You have already read about different types of objective type of items in unit-14 of paper- .

Try to say, which type of items are there in (a), (b), (c), (d)?

Observe that, the item in (a) demands the learner's ability in recalling specific facts. If you will observe the table given above, you will definitely mark that this item is a



Notes

knowledge based item. This type of items is known as knowledge based item. Some examples of knowledge based objective type items are given below.

- What is the formula to find out the perimeter of a rectangle?
- What is the definition of rational number?
- An equilateral triangle has
 - a. three equal sides
 - b. two equal sides with an angle of 90 degree
 - c. three unequal sides
 - d. one obtuse angle
- What is the sum of the measure of the interior angles of a quadrilateral?

if you will observe all the four items, definitely you will mark that all the items demand either *recall* of facts, principles, rules, formula etc or *recognition* of facts, relations etc. To answer such type of items, the learner has to recall the facts or information he has acquired earlier.



ACTIVITY-1

Prepare ten knowledge based objective type of test items from the concept of numbers in class-IV

.....

.....

.....

Now let us consider the item in (b), this item does not require mere recalling the facts directly from the text, rather allows the learner to restate the problem and respond logically. Such type of items are termed as understanding/comprehension based items. Here are some examples:

- The three angles of a triangle can be respectively-
 - A. Obtuse angle, Acute angle, Obtuse angle
 - B. Right angle, Obtuse angle, Acute angle
 - C. Acute angle, Acute angle, Acute angle
 - D. Right angle, Right angle, Acute angle



- A triangle cannot be constructed with three angles measuring
 - A. $75^\circ, 55^\circ, 60^\circ$
 - B. $60^\circ, 35^\circ, 85^\circ$
 - C. $90^\circ, 40^\circ, 50^\circ$
 - D. $5^\circ, 10^\circ, 165^\circ$
- Which of the following represent a set of parallel straight lines?
 - A. Spokes of a cycle wheel
 - B. Opposite edges of a book
 - C. Concentric circles
 - D. Minute hand and hour hand of a clock at 12 noon

Observe these items carefully. The learner can answer these questions if he/she has understood the mathematical concepts and processes. Simple cramming the principles will not help the learner to answer these questions.

-
- E1. Some statements are given below. Choose the statements which are *true* for an understanding based item.
- i. Understanding based items demands simply recalling of the facts.
 - ii. Understanding based items requires higher order thinking in comparison to knowledge based items.
 - iii. It is easier to frame in comparison to knowledge based item.
 - iv. Sole purpose of understanding based items is memorizing the facts.
 - v. Drawing conclusions from an event is an understanding based item.
-

In the application based items, the learner has to apply the acquired knowledge and comprehension in a new situation. Responding to such type of questions requires higher mental functioning than the knowledge and understanding based questions. Examples of application based questions are given below:

- Using the property of a triangle regarding the sum of the measures of its angles, find out the sum of the measures of the angles of a quadrilateral.
- In which of the following cases the principle of inverse variation can be used?
 - a. One pen costs 8 rupees. Find out the price of 10 pens.
 - b. 10 boys get 3 chocolate each. Calculate the total numbers of chocolates required for 10 boys.
 - c. 10 persons complete a work in 8 days. In how many days 5 persons will complete that work?
 - d. One child is given 2 toffees. How many children will get 10 toffees?



Notes

- If the length and breadth of a rectangle are increased by two times, then the area of the rectangle will be :

A. Increase by 2 times	B. Decrease by 2 times
C. Increase by 4 times	D. Decrease by 4 times

To develop the application based questions, you may refer table no-1 given in this unit. The behavioural specifications given against the application objectives will help you to design application based test items.

**ACTIVITY-2**

Go through the Mathematics textbook for class-V. Analyze the test items given in the exercises, examples and practice works. Note down the application based items from them.

.....

.....

.....

From the above discussion on objective based objective type items, you should not think that objective types of items are only suitable for assessment of learning outcomes in Mathematics. On the contrary, it is the nature of learning outcome (specific objective) that determines the type of item to be used for assessment. For example, let us consider the following situations of assessing the objectives of mathematics learning:

- *Objective: 'Represents a given data diagrammatically'.*
A suitable item would be a performance type item in which we can give some data (say, the average attendance figures of boys and girls in different classes of your school during a month and ask them to draw graph on it.
- *Objective: 'Suggests alternative plan or method for solution of a mathematical problem'.*

Instead of an objective type of item, you should ask your students to give alternative method of solving a mathematical problem elaborating its steps.

Therefore, you should develop skills in construction of different types of items, not just objective types, which would help you to choose appropriate type of item in assessing the objectives effectively. For discussion on constructing different types of objective based items, study the Unit 15 of the Course 3 carefully. Use of open-ended items is now considered more effective in assessment for learning than the objective types.



11.3.2 Open-ended Items

In this section, you have been acquainted with different types of objective type of test items which are based on certain learning objectives. You might have observed that the objective type of test item has a definite and unique answer that helps scoring the response easily and objectively.. Such types of items are described as closed ended items. But there are test items which allow a variety of correct responses and elicit different kind of students thinking. Such types of items are known as *open ended items*. You have already learnt about open ended items in the Block 4(unit 14) of Course 3.

Compare both the test items given in each row.

Closed ended items	Open ended items
<p>a. Find out the average of 78, 83 and 91.</p> <p>b. Find out the greatest common factor of 10, 15 and 25</p> <p>c. Find out the percentage of different parts of the rectangle given below.</p> <div style="border: 1px solid black; width: 150px; height: 40px; margin: 10px auto; display: flex; justify-content: space-between;"> <div style="width: 45%;"></div> <div style="width: 45%;"></div> </div> <p>d. Calculate 58 divided by 8.</p> <p>e. Find out the perimeter of the rectangle whose length and breadth are 7 cm and 3 cm respectively.</p> <p>f. Say the following statement is <i>true</i> or <i>false</i>.</p> <p style="padding-left: 20px;">All rectangles are parallelograms.</p>	<p>a. The average of three numbers is 84. What are those numbers?</p> <p>b. Identify three numbers whose greatest common factor is 5.</p> <p>c. Divide and level the a rectangular shape garden plot in such a manner that 50% of the garden is planted with marigold plants, 25% is planted in dahlia flower plants and the rest 25% with other flower plants.</p> <p>d. A number is divided by 8 and leaves a reminder of 2. What might the number be?</p> <p>e. Draw a rectangle with perimeter of 20 cm</p> <p>f. Write correct statements choosing combinations from the bracket given below.</p> <p style="padding-left: 20px;">(<i>Kites, parallelogram, quadrilateral, rectangle, square, trapezium</i>)</p> <p style="padding-left: 20px;">All _____ are _____</p>



Notes

In the above table, in each row there are two different test items. The item in the left side is a closed ended one while that of the right column is an open ended item. Each open ended item has more than one correct answer. Let us consider the item given at (a)

Question: The average of three numbers is 84. What are those numbers?

Answer: five numbers of students have written the answer to the above question as follows:

Student 1: 100, 150 and 2

Student 2: 82, 88 and 82

Student 3: 78, 83 and 91

Student 4: 66, 94 and 92

Student 5: 1, 11 and 240, 250, 1,1; 200. 45, 7.

The answers to the test item (a) given by all the five students are correct. Even the last student has given three responses which are all correct. Given chance every student can give more than one response.

Observe the open ended items carefully. Write down the characteristics of such type of items.

Check your list with the following characteristics/features of the open ended items in mathematics:

- No fixed answer i.e. many possible answers
- Solved in different ways and on different levels. Students of different abilities can be able to give at least one correct answer.
- Offer students scope for own decision making and natural mathematical way of thinking. Each child can think according to his own experience.
- Provide teachers with valuable information regarding individual student way of thinking and way of solving mathematical problems.
- Open to student's creativity and imagination when relates to real life context of their experience.
- Develop student's reasoning and communication skill when those are discussed in the classroom.
- Develop student's self-confidence for higher achievement. Since, such items have several possible correct responses, every student, even the poor performers; can provide at least one correct response. The better performing students can give several correct responses. All categories of students can aspire to perform in the subsequent occasions.



ACTIVITY -3

Construct **ten** open ended test items in mathematics for class- V children. Administer those open ended items to the class V students of your school. Analyze their responses. How many students have given more number of answers to an item?

.....

.....

.....



Notes

11.4 DEVELOPING QUESTION BANKS IN MATHEMATICS

Preparing objective based test items of different types in mathematics are quite important on the part of a teacher and at the same time, it is also not an easy task. But if you have a stock of quite a large number of items (questions) at your hand, you will have little difficulty in using appropriate test for your students at different times.

Now, the question may arise, “What are the *sources from which you can get variety of questions other than those available in the textbooks?*”

There are different possibilities:

- You can prepare questions by yourself,
- You can collect the questions prepared by the students during the course of teaching,
- You can bring some questions from different reference materials and
- Collect questions developed by other teachers of your schools or teachers in other schools.

Collecting questions from various sources, arranging and keeping (storing) them properly and using them as and when required are the purposes for which you need a question bank in each class of your school.

Purposes of question bank: The question bank is useful for the teachers in bringing reform in the traditional evaluation system. The National Curriculum Framework (2005) rightly observed that, the present evaluation system can be described as “one-exam-fits-all”, as one question paper is employed to all students during the examination. This is because the teacher has no other options but to use some questions which are



Notes

available with him. But, if the teacher has a variety of questions in the question bank then he can prepare different question papers and use them for different learners as per their requirement. The other purposes of question bank are:

- Question bank is useful to prepare a test for instant testing of the learners
- Though the test items in a question bank are objective based, those are helpful for the teachers to evaluate the learning progress with respect to learning objectives.
- The learners can prepare themselves in the questions available in the question bank.
- The learners can also self-evaluate themselves by using the question bank.
- Questions not only help in assessment of learning, but also aid in classroom transactions for helping the students to learn better. Therefore, variety of items on different learning outcomes should be available to you and your students in the classroom. Question bank in the classroom serves this purpose effectively.

E2. State any four utilities of question bank in mathematics. Write two more utilities which have not been stated here.

Every school should prepare question banks on their own. This brings ownership of the materials by the teachers and students of that school (*why?*). While preparing question bank in mathematics and their proper use the following points should be taken into consideration.

- Both oral and written items on each chapter should be prepared. Oral items in mathematics are quite useful in measuring the skills of speed and accurate calculation. Those oral items can be used in assessing the child's ability in mental arithmetic.
- In each chapter, test items from knowledge, understanding, application and skill objectives may be developed. Besides, project activities and practical activities should be there.
- After preparation and collection of questions those should be edited by the experts. Teachers from different schools or a cluster may sit and discuss on each item and finalize them.
- It is better to write one or two questions on an **item card** - a post card size paper, instead of a register. Cards have several advantages in developing, sorting, using and storing. Sometimes different cards containing questions may be supplied to different students in the class to engage everyone in learning. (*If a register will be maintained. then what will be the consequences?*)
- Different color cards may be used for questions on different objectives and subjects. It will help the teachers to select and use the questions as per the purpose.



For example- red color cards may be used for knowledge type of items while blue and yellow color cards may be used for comprehension and application objectives. The teacher may use different color of cards for different purposes, like- different color of cards may be used for extended response type of items (essay type of items), restricted response type of items (short answer type and objective type) and open ended items.

<p>Class V Topic: <i>Fraction</i></p> <p>Objective: <i>Demonstrates fractions as part of a figure (Understanding)</i></p> <p>Problem: Shade $\frac{2}{3}$ of the square given below:</p> <div style="text-align: center; margin: 10px 0;"> </div>	<p>Type of Task: <i>Performance</i> Difficulty Level: <i>Medium</i></p>
--	---

Answer on the overleaf

Fig. 11.2 Sample of an Item Card



ACTIVITY-4

Take any chapter from class-V mathematics textbook. Write down the expected learning outcomes of chapter. Develop items based on those learning outcomes. Prepare item cards on that chapter. Write a short report how you developed the question bank.

.....

.....

.....

E3. State any four uses of item cards.

11.5 ASSESSMENT FOR MATHEMATICS LEARNING

There are some techniques of assessment which also simultaneously help in enhancing learning. They are essentially used in formative assessment while the learning process is continuing. You can refer to discussion on assessment for learning in the Unit 12 of



Notes

Course 3 where the principles and techniques have been explained in detail. Here, we present some of those techniques which can be suitably applied to Mathematics learning.

11.5.1 Project

Here a situation is given. A teacher in a rural school conducted an activity to enable the learners to learn mathematical concepts as well as to enjoy mathematics.

*Dinesh is working as a primary school teacher in a rural school. He tries to create interest among the learners in learning mathematics. He plans different varieties of activities for his students to make mathematics learning more interesting and meaningful. One day he thought to give students a **project** on “Graphical presentation of occupational patterns of the community members”. He discussed with the students how to carry out the project. The following points were discussed:*

- *Why do we do this work? What benefit will we get from this work?*
- *How will we do it?*
- *What are the tasks involved?*
- *Who will do what work?*
- *What type of information we need to prepare the graph of different occupations?*
- *Estimated no of households to be visited to get required information*
- *Preparation and organization of different items of the work*
- *Keeping record*
- *Execution of different activities*
- *Preparing the report*
- *Evaluation of the entire work*

Then the students carried out the project.

This type of activity is known as a project, which is carried in a natural setting. Project creates scope for learning mathematical concepts in a real life situation. This involves the application of knowledge.

On the basis of the situation now try to answer the following questions.

- i. Is learning of mathematical concepts be possible in this approach?
- ii. Can the learning be meaningful?
- iii. Can the learning be a pleasurable activity for the students?



- iv. Can the project provide information about child's progress and learning?
- v. On the basis of this activity, is it possible to know the learning acquisition by the students?
- vi. What can be assessed through this type of activity?

Projects are undertaken over a period of time and generally involve collection and analysis of data. Those provide opportunities to explore, work with one's hands by undertaking projects the learners observe any situation/phenomena, collect data, analyse, organize and interpret data and draw generalizations. Project works provide opportunity to work in groups and real life situations. Projects help the learners to learn in an integrated approach i.e. from a mathematical project not only the mathematical concepts can be learnt, simultaneously knowledge in other curricular areas also developed.

Projects can be used as an effective tools and techniques of assessment in mathematics. Here the assessment becomes an integral part of the routine classroom activities and the teaching learning process. The teacher has to observe the behaviour of the child during the execution of the project, his interest towards the work, process of collection, recording, interpreting the data. Accordingly the teacher can assist the learner and helps in improving the learning.

E4. Enlist *three* projects you want to give learners at primary level. Indicate the mathematical concepts involve in each project.

11.5.2 Portfolio

We have already discussed in block III of this paper regarding various tools and techniques for assessment. Only the pencil-paper tests can not assess all dimensions of learner's development, rather other modes of assessment are quite useful both for assessment of learner's progress as well as to ascertain the needs of the learner for further learning. Portfolio is one of the modes which can be used in assessment for learning in mathematics. Here a case study is given, go through it.

*Rohini, teaching in primary classes uses different ways of learner assessment. She also uses portfolio as one of the way. While teaching the concept of "percentage" in the class, she discussed with the students different activities to be conducted collaboratively. Once the students and Rohini decided to collect and store different products prepared by the individual learner. The students were encouraged to write or collect essays, poems, stories, collect paper cutting and giving their own remarks on the articles/ issues, narrative or descriptive piece communicating a significant experience, riddles, mathematical puzzles, teaching-learning materials etc involving the concept of **percentage**. The students were engaged in creating and collecting different products. They were given a*



Notes

period of 10 days to complete the task. After 10 days all the students along with their teacher sat, the students displayed their creations and describe them in detail. The creations (portfolio) of some students are given below.

- *Dinesh wrote a story involving the concept of percentage.*
- *Madhabi discussed with her father who is a bank employee and collected the interest rates given by various banks on fixed deposits and saving deposits. She also prepared a chart on this.*
- *Shyama has gone through textbooks and reference books of other schools of their locality and collected 10 different types of examples to understand the concept of percentage.*
- *Sudhir collected some news from the newspaper and pasted on a chart paper. He also wrote his own views on some of the articles.*
- *Anjan visited some of the households in his habitation, collected data on number of school going age children in each family. Calculated the percentage of the school going children to the no of persons and prepared a chart etc.*

All the students enjoyed the activity.

“Portfolio is a purposeful collection of students work that exhibit the students’ efforts, progress, or achievement in (a) given area(s). This collection must include:

- Students participation in selection of portfolio content,
- The criteria of selection,
- The criteria of judging merit, and
- The evidence of student self-reflection.”(Reckase, 1995).

Thus, portfolio provides an opportunity to the child to express his/her feelings and for the teacher to understand what is happening to the child outside the class. It is a collection of children’s work over a period of time. It could be a day to day work or selection of the child’s work. It provides a cumulative record. In the process, a picture of how a skill or knowledge develops emerges. It encourages the child to show and tell what they know and think about what they have included in their portfolio. The child becomes an active participant in learning and assessment (*how?*).

-
- E5. Prepare a list of different materials that can be put together while preparing a portfolio.
- E6. State two ways of using portfolio for assessment of learning mathematical concepts or skills.
-



Notes

On the basis of the discussion try to reflect on the following points relating to portfolio:

1. Can a portfolio help a teacher to assess the learners?
2. Whether such activity helps the learners to enjoy mathematics?
3. Can the performance of the children be assessed by his/her peers?
4. Can the learners assess their own performance?
5. Can the portfolio act as a tool for learning?



ACTIVITY -5

Select a concept from the mathematics syllabus. Discuss with your students on that concept. Encourage them to prepare and collect materials on that concept within 10 days. Ask the children to show and tell what they know and think about the material they have included in their portfolio. Ask the students to assess their own collection and collection of other students.

.....
.....
.....

11.5.3 Participation in Exhibition

We can also use exhibitions in mathematics to share and assess student’s learning. Mathematics exhibition creates opportunities for the learners to show their talent in mathematics outside the formal classroom activities. Such type of activity not only fosters mathematical awareness among the learners but helps in skill building, developing positive attitudes among the learners.

In the mathematics exhibition, the students learn certain concepts using concrete objects and verify many mathematical facts and properties using models, measurements and other activities. Thus, Spenser and Angus(1998) point out that student exhibition involve complex cognitive skills as they must “collaboratively synthesize and evaluate information, and effectively communicate their ideas to others.”

How to organize exhibition

Before organizing a mathematical exhibition, the teacher should discuss the time and venue of the exhibition. The children should be intimated well in advance the exhibition so that they will get sufficient time to share among themselves, teachers and their guardians regarding their materials to be demonstrated in the exhibition. The children may prepare different models, materials, charts and interesting facts, puzzles etc. in the exhibition the parents may also give scope to participate. Different types of activities may be organized during the exhibition. Those are:



Notes

- Demonstration of models, charts by the students and teachers
- Photo exhibition (photograph of mathematicians reflecting their contribution)
- Teaching-learning material (TLM) preparation
- Popular talk on different mathematical concepts by the teacher or invited experts
- Demonstration of reference books in mathematics
- Activities for parents to show their talents and participate in different activities
- Different recreational activities in mathematics for the students

Now the question may arise, how this exhibition acts as a tool in assessment *for* learning and assessment *of* learning? This clearly indicates that, exhibition can be helpful in formative assessment as well as in assessing the learner's ability to apply the acquired knowledge in different situations. Observing the nature of learners' participation during different activities of the exhibition the teacher can assess the learner's understanding on a particular concept, his/her attitude towards mathematical learning. Further the teacher has to plan for further learning of the individual learner on the basis of the assessment findings. Further, it creates scope for learning from each other in an informal situation as well as peer assessment.

Look at the table given below. You will find that the information given in the box below will help you to assess the learners during the exhibition:

What are to be observed during the exhibition for assessing a learner?

- Rationale taken for the text and lesson demonstrated in the exhibition (whether it provides a clear sense of purpose and drew the understanding of learner?)
- Whether the main teaching and learning activities were appropriate, well designed and properly linked?
- Are the activities showed variety, flexibility, creativity and innovation?
- Whether the activities taken by the learners are likely to develop their understanding of mathematical principles?
- Whether the demonstration and description of the activity was informative and interesting?
- Whether the lessons and resources were user-friendly and realistic for the classroom?
- Whether the learner's demonstration and exhibition be able to communicate his/her ideas effectively to others?

E 7. Write some of the usefulness of an exhibition in mathematics for the learners?



11.5.4 Mathematical Quizzes and Games

Students learn mathematics when they were engaged in meaningful mathematical tasks.

Such tasks provide the learners to think mathematically. Tasks like mathematical quizzes, puzzles and games provide situations to learn mathematics without fear and anxiety. While participating in those activities, the teacher should observe the learners and assess their performance. On the basis of the observation, the teacher should find out the areas where further inputs can be provided to the learners. Let us discuss the procedures of assessment through these activities.

Quiz:

The dictionary meaning of the term quiz is ‘series of questions testing people’s general knowledge especially as a form of entertainment’. You might have seen the quiz competition either in your school or in any other place. Normally in the quiz programme oral questions were asked to the participants and those were responded orally. But sometimes the respondents were allowed to use paper-pencil to get the answer. The question may be asked to an individual participant or to a group of participants (preferably 2 or 3). such techniques may be applied to conduct mathematical quizzes. While conducting mathematical quiz the following points may be kept in mind:

- After teaching some concepts the quiz programme may be arranged, this will enable the learners to practice the concept and apply those in different situations.
- Questions based on real life situations may be asked to the learners
- Different round of answering like-answering using paper pencil, answering without paper-pencil, answering with clue and quick answer round may be conducted.
- Questions based on audio-visual support may be used to arouse interest among the learners.
- Questions prepared by the learners during the course of teaching-learning process may also be used during quiz programme.
- All the children may be allowed to participate in the quiz programme.

Quiz programme enable the teacher to understand the student’s progress in learning. It helps the teacher to know the learners interest towards mathematics learning. The teacher will observe how the students choose the answer and how they respond to the questions.

Games:

Game is a spontaneous activity for the children in which they participate naturally without any fear. Normally mathematics is associated with fear and failure. But participation of the child in different types of games and interesting puzzles removes the fear from the child. Such games and puzzles enable the child to understand the



Notes

basic mathematical process without memorizing the facts and formulae. Also, the teacher creates situation to link the bookish knowledge to the real life situations.

Let us go through the game conducted by a teacher:

Rajeeb a teacher in an elementary school while teaching the concept of inside, outside, between, regions, across and boundary faced problems to enable his students to understand. He thought to conduct a game as follows:

Two groups of children are selected: those who attempt to change from the red base to the green base, when the whistle is blown, and those who begin at the “catchers region”. As the children are changing from the red to green base, the catchers run from their region and tag those who are changing, as long as they are outside either the red or green bases. The game is over whenever there are no more children to run between the red and green bases.

During the game each child was active and all the children discussed among each other to develop the strategies.

On the basis of the game described in the box, try to give answer to the following questions:

1. Can this game help the children to learn mathematical concepts? How?
2. Can this game help the teacher to assess the learners? How?
3. Can this game enable the teacher to plan for further learning of the children?
4. How the games are useful for the children to learn mathematics?

No doubt, the mathematical games create interest among the learners than the traditional teaching inside the classroom. But the teacher should plan carefully how the mathematical understanding is developed among the children through the game. Observing the children during the game (i.e. how they are planning & performing, communicating with each other, building strategies) helps the teacher to assess whether they are able to apply the mathematical ideas in other situations.

Like games mathematical puzzles (problem designed to assess knowledge or ingenuity) create interest among the learners to participate in it and enjoy mathematics. Here is an old riddle:

Three travelers stopped at an inn and asked for supper. The inn-keeper could offer only baked potatoes. While the potatoes were baking, the travelers feel asleep. Soon one of them woke up, saw the dish of potatoes, and took a third of them without waking the others. Later the second one woke up, saw the dish, and ate a third of the remaining potatoes. Later the third one did the same. When all three were sleeping once again, the inn keeper cleared the table and found 8 potatoes left. How many were there to start with?



Notes

Similarly a lot of games and puzzles can be used to teach different mathematical concepts. The teacher has either to prepare them or collect them. But using them at right time in right way will definitely motivate the learners to the mathematics class.



ACTIVITY-6

Prepare or collect at least 2 games. Write down the rules to conduct each game. Which concepts will you teach through the games you have selected? How will you assess the learners?

.....
.....
.....

E 8. A mathematical game is described below. Read it and answer the questions given below the game.

Play the “large to mouse but small to an elephant” game. Ask questions such as: “what objects in the room seem small to you but would seem large to a mouse? What objects in the room would seem small to a mouse? What objects that seem large to you would seem small to an elephant? Are there any objects that seem small to you that would seem large to an elephant? Why?” continue asking questions until all of the possibilities have been exhausted.

- With the help of this game acquisition of which concepts can be measured?
- Can this game help the students to learn that concept? How?
- Assessing the learning progress of the learner through this activity differs from the paper-pencil test. - Is it true?

11.5.5 Observing Children During Mathematics Activities

Observing the children during mathematics activities (during the course of teaching) is a technique of *assessment for learning* or formative assessment. Through observation information can be gathered about children in natural settings. Some observations can be done in course of teaching from the behaviours like: how the child is answering the questions asked to him/ her, how he is describing the facts, how he is responding to the answers of other children, what type of questions he is asking the teacher, how he is presenting the group reports, how he is participating in the discussions etc. The teacher could record number of questions asked by distinct students during the activity. The will be a valuable information indicating whether a learning was taking place.



Notes

Through observation various aspects of the child's personality development can be assessed. It can be used to assess individuals and groups. If a task is assigned to different groups then you can assess the performance of a group. Through observation, the teacher can get evidence of child's performance based 'on-the-spot' record. Over time, detailed observations of behaviour as well as interests, challenges-patterns/trends emerge which allow teachers to create a comprehensive picture/view of the child. So observations are to be made by the teacher over a period of time, across different activities and settings. When the child is engaged in a number of tasks/activities, it will be easier on the part of the teacher to observe the child and assess him. So teaching based on the *lecture method* cannot create scope for the child to do much works. Thus, the child may be engaged in a lot of activities (individual/group) which will help the teacher to assess the child's learning as well as enable the child to identify his own weaknesses and rectify them.

Some of the examples are given below:

Example 1:

Divide class into small groups and tell them that they are going to use measurement to find some secret objects inside the school campus. Provide each group the name of a set of objects including the secret objects. The measurement of the secret objects may also be given to the children such as- the length of the object is 2 m 15 cm and its width is 1 m 10 cm etc. Each group must measure objects provided to them until they identify the objects described by the measurement.

Example 2:

Ask the children to draw many 4 by 4 squares, and shade half of each, in as many different ways they can think of.

(This activity can be extended to have children draw different shapes on the squared sheet, and shade exactly half of each. A child should be able to justify why the part she has shaded exactly half.)

While the child is busy in the activity you can observe him/her from a very close quarter without disturbing their attention on the activity. This would provide information on the children's style of learning and their learning difficulties.

- You can observe the level of participation of students in the activities in the classroom. Many students are afraid of mathematics and do not like to get involved in group activities in mathematics. Detecting their reservations, you can take appropriate actions to improve their participation in mathematics activities.
- Observation provides better opportunity to detect the degree of involvement of each child in the activities, several personality characteristics, the strengths and weaknesses of students on the topics of concern.



- Observing students in mathematics class, you may gain insight into several aspects of their learning of mathematical concepts like interest for mathematics activity, aesthetic sense of mathematics, symptoms of mathematical anxiety and phobia, typical errors committed, alternative methods applied for solution of problems, specific points of difficulty etc.

11.6 LET US SUM UP

- The progress and achievement of learners in mathematics can be known by assessment, as well as the effectiveness of the teaching-learning process, materials can also be ascertained by assessment.
- Assessment should not be a onetime event, rather be a continuous one. Use of unit tests, giving assignment, observing the child during teaching-learning process and preparation of TLM, project work and portfolio makes the assessment process continuous.
- Comprehensive assessment means assessment of both scholastic and co-scholastic areas of the curriculum. To assess both the areas the teacher has to use a variety of tools and techniques.
- The objective based test items in mathematics are supposed to measure a specific objective of instruction (learning outcomes). Such types of items describe the learner's achievement more accurately. Particularly in mathematics the teacher should prepare and use knowledge, comprehension, application and skill based questions.
- Question bank in mathematics help the teacher to conduct a test instantly and also enables the learners for self study and self evaluation.
- Participation of the learners in activities like project, portfolio, mathematical exhibition, quiz, mathematical games helps the learner to learn in an informal way. Such activities help the teacher to assess the learner in an informal situation.
- The teacher has to observe the learners during activity and assess to what extent the learner has acquired the knowledge in a particular concept. Through those activities the assessment process can be made child friendly.

11.7 MODEL ANSWER TO CHECK YOUR PROGRESS

- E1. Statements in (ii) and (v) are true for understanding based items.
- E2. The question bank can help the learners to be acquainted with the answer pattern which will enable them to prepare for the examination. Further, the teacher who



Notes

are not able to prepare variety of test items on a particular concept, can be benefited and use variety of items for their students. *Similarly you can write down more utilities of question bank.*

- E3. Instant use by the teacher in the classroom for unit testing, using to prepare objective-based tests, selecting items according to difficulty level, helping students to prepare questions, etc.
- E4. The projects like the following can be undertaken at primary classes:
- Collection of rates of few commodities from the local market in an interval of 15 days. Compare the increase or decrease of the rate. Discussing with the seniors try to know the reasons of such increase or decrease of the rates. (helps to learn the concept of percentage of increase or decrease of the rate)
 - Understanding of a local cottage industry: the child has to collect information about nature and sources of raw materials, number of persons employed in the cottage industry, how much they are earning per month, the progress of industry from year to year etc. (helps the children to learn about the profit and loss, managing business and other concepts of commercial arithmetic).
 - Development of a profile of 10 households with respect to their number of family members, illiterate members, employed persons etc. Representing all the information in a tabular form and drawing inferences from the data. (Helps the children to learn the tabular and graphical representation of data, the concept of percentage and ratio can also be taught through this work).
- E5. The following materials can be included in portfolio:
- A collection of different items like pictures from magazines, newspaper clippings, photographs, poems, drawings, collection of stamps, coins, essays, stories, letters etc. Self-initiated works of the children with or without limited help of the teacher, items contributed by family and community members.
- E6. The teacher can evaluate the work of the students using rating scale or other techniques, the peers can evaluate through comparison of each others work, Self-evaluation by observing others' work. (any two).
- E7. The mathematics exhibition is useful for the learners due to the following reasons:
- It removes the phobia from the mind of the learners and motivate the learners to participate in the mathematical activities
 - Mathematics is learnt by *doing*, not only by *reading*
 - Teacher and the learners collaboratively plan for different activities.

- Learners got opportunity to verify and discover the properties and principles
- Enables the learner to go beyond the textbook and linking the bookish knowledge to the knowledge outside the school.

(You may add some more points to it)

E8. When the children will be engaged in this game they will learn the concept of 'measurement of volume'. This game is quite useful in learning the concept because of the following reasons:

- The children work in an informal environment free from fear and tension, which is a conducive environment for learning.
- The game is based on the day to day life experience of the child which causes learning
- There is scope for peer support for learning.

The teacher can assess the learner through this activity. He has to observe how the child is applying the mathematical principles in the game.



Notes

11.8 SUGGESTED READINGS AND REFERENCES

CBSE (2010). Continuous and comprehensive evaluation: Manual for teachers. New Delhi: CBSE.

Cruikshank, D. E., Fitzgerald, D. L. and Jensen, L. R. (1980). *Young children learning mathematics*. Boston: Allyn and Bacon.

Deale, R. N. (1975). *Assessment and testing in the secondary school*. London: Pearson Education

Gronlund, N.E. and Linn, R. L. (2000). *Measurement and assessment in teaching*. Singapore: Pearson Education

NCERT (2008). *Source book on assessment for classes I – V Mathematics*. New Delhi: NCERT.

11.9 UNIT-END EXERCISES

1. Take any unit from the mathematics test book of class-V. Prepare different types of objective based objective type of test items. Suggest some projects from that chapter.
2. How assessment through a project differs from the assessment through portfolio.
3. Prepare a list of activities for your students to be demonstrated in the mathematics exhibition.