
UNIT 9 DEVELOPMENT OF TEACHING MATERIAL AND THEIR USE IN MATHEMATICS TEACHING

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9.1 INTRODUCTION

Teaching is a complex activity in which an attempt is made to ensure learning among pupils. Pupils learn things through their senses. Teachers can also find means to have effective interaction with pupils' senses in order to help them learn better. The materials which supplement teachers' efforts and facilitate teaching-learning are known as teaching materials. These teaching aids may include audio, visual and audio-visual materials. Such materials, if presented properly at the appropriate time, may prove to be of great help in clarifying difficult concepts, making abstract things understandable and arousing and maintaining pupils interest in mathematical learning.

It is not always desirable to employ very costly things as teaching aids. There are many materials available in our immediate environment which may be either used as such or in a modified form to generate low-cost or no-cost teaching materials.

In the present unit an attempt has been made to clarify the role and importance of teaching materials. Various illustrations are provided with a view to giving you an idea of how to develop no-cost or low-cost teaching aids and their judicious use in classrooms for enhancing learners' competence in mathematics.

9.2 OBJECTIVES

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

- understand the role and importance of teaching material as an audio-visual aid for concept clarification and retention;
- develop no-cost or low-cost teaching aids in mathematics from locally available material, yourself or involving your pupils;
- make use of the teaching materials in your class effectively for enhancing learners' competence in mathematics.

9.3 ROLE AND IMPORTANCE OF TEACHING MATERIAL

Good teaching should result in good learning. There has to be a great deal of interaction between teacher and pupils. The interaction may be fruitful if pupils attentively participate in the teaching-learning process. The usual chalk-talk method has limited significance and may encourage rote learning, since it is not always possible for teachers to make things clear to the students by this method alone. Hence there is a need to create an environment within the classroom which may be interesting to learners. Once learners are made interested in learning, they become attentive and take advantage of teachers' efforts. For this purpose some audio-visual materials may be helpful in drawing pupils' attention and arousing interest in mathematics. Before this interest is sidetracked, children need to be made participants in learning. Certain materials can effectively be used to seek pupils' participation and making them understand difficult and abstract things in a much simpler way. The learning acquired through active participation of both the teachers and learners needs to be reinforced to ensure better retention. Again, well planned materials, equipment and activities can assist the teacher in doing so.

While teaching, a teacher has to cater to the needs and requirements of learners quite different from each other in their abilities, interests and motivations. Also, all learners do not possess the same pace of learning. Thus a teacher has to teach the fast learners, the average pupils and the weaker ones for which he has to employ different strategies. In these strategies teachers can also make use of various kinds of teaching-learning materials. Thus we can say teaching-learning materials are the arms and ammunition of teachers, which they use to deal with various types of challenges which they are supposed to face.

But teachers have to be resourceful in arranging or developing suitable types of teaching-learning materials and also have to be skilful enough to use each one of them at the most appropriate point of time, as indiscriminate use of these materials may be counter-productive.

The above discussion leads to highlight the role and importance of teaching materials as follows:

Teaching-learning materials are:

- the materials which have audio, visual or audio-visual appeal for children
- the materials which serve as the device to make the task of the teacher easy
- the materials which are helpful in making children attentive and interested in learning
- the materials to fill the gaps of classroom teaching
- the materials which encourage self-learning
- the materials which can be used for dealing with weaker students (remedial-teaching)
- the materials which provide real conceptualization of abstract principles
- the materials which help learning to become a permanent asset of pupils
- the materials which provide for the creativity of children and an opportunity for learning by doing etc.

Thus teaching-learning materials are of great value to teachers. Mathematics teachers do require them more, as they deal with concepts generally considered difficult for children.

9.4 DEVELOPING NO-COST OR LOW-COST TEACHING MATERIALS FOR MATHEMATICS TEACHING

In order to make the concepts comprehensible to pupils and making teaching-learning interesting, teachers require some materials. Certain materials like the mathematics kit are supplied by the department, and training is provided to the teachers in the use of the items, included in the kit. It is not advisable to depend on the department for the supply of all types of aids. It is the teacher who can develop certain teaching-learning materials as per his needs. Also no foolproof prescription or advice may be offered to the teachers. It is the training, experience, foresight and creativity of teachers which will help them innovate, redesign or develop new types of materials for use in their own classrooms.

Some suggested activities are provided below :

1) Competency : Pupils differentiate between numbers and numerals

Activity I : Arrange candles, coins and books in the following pattern :

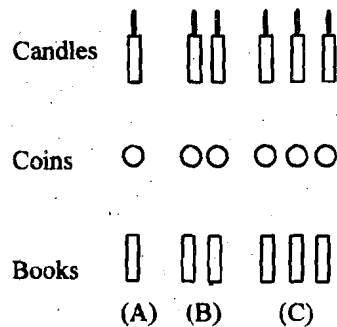


Fig. 9.1

Now draw the attention of pupils to collections A, B and C one by one. Let them recognize that there is one candle, one coin and one book in collection A, i.e., collection A has a common property which we call one and represent with the symbol 1. Repeat this for number and numerals 2 and 3. This activity may be repeated to give children adequate practice in recognizing number ideas up to nine and the symbols 1-9.

Activity II : Write numerals 1 to 9 on flash cards and put them in a box. Keep some objects like matchsticks, pencils, chalks, sticks etc. on the table. Ask one child at a time to pick up a flash card and, from the objects on the table, put aside as many objects as are represented by the numeral on the flash card. After due practice the process may be reversed, that is ask him/her to pick up a collection of objects (up to 9) from the table and let him/her identify the relevant flash card bearing the numeral corresponding to the number of objects in hand.

2) Some charts related to number system

a) Digit Chart

1	2	3	4	5	6	7	8	9	0
---	---	---	---	---	---	---	---	---	---

Fig. 9.2

b) Digit and Number chart

(for forming numbers from given digits)

Digits	Numbers
1	7
7	7
2, 3	23, 32
0, 4	40
2, 5, 7	257, 275, 527, 572, 725, 752

Fig. 9.3

c) Place Value Charts

Indian System

Lakhs	Ten Thousands	Thousands	Hundreds	Tens	Ones/Units
	3	5	4	7	3

International System

Millions	Hundred Thousands	Ten Thousands	Thousands	Hundreds	Tens	One Units
	2	5	3	9	6	4

Fig. 9.4

- Read the digits with place values.
- Express the number as a sum of place values of digit.
- Give children the idea of periods/place value of digits/expanded notation etc.

3) Sieve of Prime Numbers

You can get sieve of prime numbers developed through children and also prepare a chart of the sieve using the following instructions.

1	②	③	4	⑤	6	⑦	8	9	⑩
⑪	12	⑬	14	15	16	⑰	18	⑱	20
21	22	⑳	24	25	26	27	28	㉑	30
③①	32	33	34	35	36	③⑦	38	39	40
④①	42	④③	44	45	46	④⑦	48	49	50
51	52	⑤③	54	55	56	57	58	⑤⑨	60
⑥①	62	63	64	65	66	⑥⑦	68	69	70
⑦①	72	⑦③	74	75	76	77	78	⑦⑨	80
81	82	⑧③	84	85	86	87	88	⑧⑨	90
91	92	93	94	95	96	⑨⑦	98	99	100

Fig. 9.5

1. Draw 10 rows and 10 columns and write numbers from 1 to 100, one number in each cell and ten numbers in each row.
2. Cross 1 which is not a prime number of definition.
3. Encircle 2 which is the only even prime number.
4. Cross all multiples of 2 (multiples of a prime number can't be a prime).
5. Encircle the next prime number 3 and cross all its multiples.
6. Encircle the next prime number 5 and cross all its multiples.
7. Encircle the next prime number 7 and cross all its multiples.
8. Encircle the remaining numbers. All the encircled numbers are prime numbers.
9. The prime numbers from 1 to 100 are:
2, 3, 5, 7, 11, 13, 17, 23, 29, 31, 37, 41, 43
47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97
10. Ask the pupils to identify the common properties of these prime numbers.

4) Factors of natural numbers

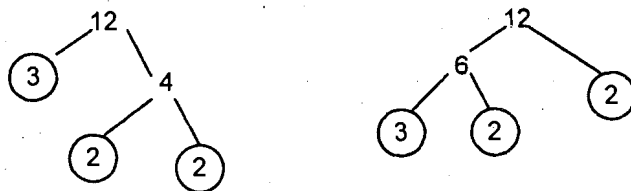
Factors of a natural number, say, 12 can be shown as in Fig. 6. Factors of 12 are 1, 2, 3, 4, 6, and 12.

$$\begin{aligned}
 12 &= \left(\begin{array}{l} 1 \times 12 \\ 2 \times 6 \\ 3 \times 4 \end{array} \right) \\
 &= \\
 &=
 \end{aligned}$$

Fig. 9.6

Now pupils may be asked to write the factors of 16, 24, 36 etc. starting from 1 and ending at the number to be factorized.

Factors tree for prime factors



5) Game related to concepts relating to numbers

Prepare with the help of class roll numbers badges for children using waste paper/cloth. Let children wear these badges on their chests. Divide the class into two groups/teams and make them stand in two rows facing each other. Keep ready a list of 20-30 oral questions based on even/odd numbers, prime numbers, factors, multiples etc. Address your question to team 1 and ask a child to reply and stand in front of the child wearing the badge of correct answer. If the child's answer is correct he earns two (2) points for his team. If the answer is wrong, the chance

is given to other members of the team. If the answer is correct the team gets one point, failing which the chance is given to team 2. Use the blackboard as the scoreboard for writing team points.

After 30 questions the game will be over and the team with the greater number of points will be the winner. Some specimen questions are mentioned below :

- which is the smallest prime number?
- which is the greatest factor of 12?
- which is the least multiple of 7?
- which represents number of primes between 1 and 100?

6) Finding the HCF and LCM of two numbers using strips

Take two strips of cardboard and mark the factors of a number, say 4, on edge and multiples of 4 on the other using some scale. Now mark multiples and factors of another number, say 6, on the edge of another strips using the same scale. Now put the strips in such a manner that their starting points coincide and factors edges of 4 and 6 lie against each other. Now read the common factors and the highest common factor (HCF).

Now put the strips in such a manner that their multiple edges lie against each other with their starting points coinciding. This arrangement will help you read the common multiples and the least common multiple (LCM).

Ask your students to prepare strips for numbers like 2, 3, 5, 7, 8, 9, 10 etc. and let them learn to show factors, HCF, multiples and LCM for a given pair of numbers.

Check Your Progress

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

b) Compare your answer with the one given at the end of this unit.

1. How can you make teaching of mathematics more interesting and joyful?

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2. How can you take care of fast learners, average learners and slow learners in the classroom?

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3. What type of teaching material a teacher can develop for teaching of mathematics?

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7) Visual for number systems

A visual showing mutual relationship among natural numbers, whole numbers, integers, rational and irrational numbers and real numbers may be developed as follows:

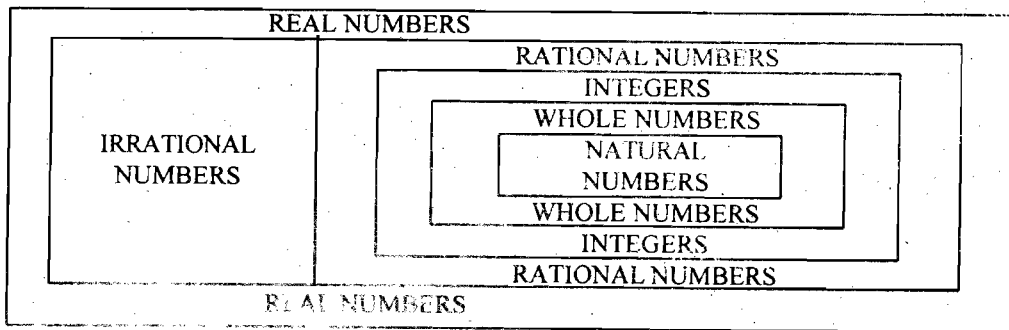


Fig. 9.7

Natural numbers	N	1, 2, 3,
Whole Numbers	W	0, 1, 2, 3,
Integers	I	..., -3, -2, -1, 0, 1, 2, 3,
Rational Numbers	Q	a/b : a and b are integers and $b \neq 0$
Irrational Numbers	S	which are not rationals e.g. $\sqrt{2}$, $\sqrt{5}$, $\sqrt{7}$,.....
Real Numbers	R	rational and irrational numbers taken together

8. Teaching-learning Material on Measurement and Mensuration Activity

Set up a play way shopping center in your class/school compound. Let there be shops dealing with cloth, grocery, fruits and vegetables, stationary and milk, etc. The school staff may arrange a metre rod, a measuring tape, a set of weights, a set of measuring utensils, a balance and improvised articles of daily use (e.g. sand can stand for sugar), coupons as currency notes and coins may be used. For doing so community participation may be sought.

Students should play shopkeepers and buyers turn by turn. The rates of articles are displayed in each shop. Teachers will prepare shopping lists in sufficient numbers indicating the quantity of items to be purchased. A student customer is given a list for buying the articles mentioned. Only the seller will get marks 5 ; marks may be awarded for each correct deal (one mark each for correct counting, weighting/measuring, calculation, returning the balance and preparing the bill). Every student will get a chance to act as seller and buyer and every deal will take place in the presence of the teacher who would award marks. The game will begin with the singing of a rhyme jointly by the teacher and students with the showing of the measuring instruments; the rhyme is noted below:

Cloth we measure with a metre,
 Milk we measure with a litre,
 Sugar in grams you must weigh,
 How much a dozen banana? Hey
 Twenty toffees make a score,
 A quire has leaves twenty four,
 Clock and watches tick the time,

Seconds, minutes and hours chime.

A hundred paise make a rupee,

All the dealings with a rupee.

9) Teaching-learning materials on Fractions

The concept of fraction can be classified through activities such as folding a sheet of paper, cutting an apple into (say) four equal parts and then taking only one (write as $1/4$); taking 3 pencils out of a box containing 10 ($3/10$); selecting a team of 11 players from a class of 30 ($11/30$); etc.

A) Fraction Discs

- i) Take a chart paper and cut a circular disc and two semi circular discs of the same diameter. Make four equal parts on the circular disc and two equal parts on each of the semi circular discs. Fix a circular disc and a semi circular disc on a plywood strip permanently and keep the other semi circular disc free to rotate. Use one nail at the coinciding centre.
- ii) Prepare another set of similar discs. Mark six equal parts on the circular disc and three equal parts on the semi circular one. Fix them on a plywood strip in the same manner.
- iii) Cut out a circular disc and two discs of which $1/3$ part has been cut out. Mark six equal parts on the circular disc and four equal parts on the partial discs. Fix them on a plywood strip as done in other cases.

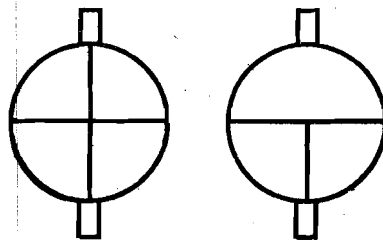


Fig. 9.8

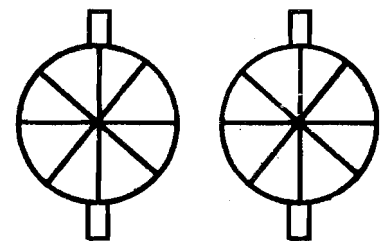


Fig. 9.9

Activity — Rotate the semi circle half a turn. What do you notice? It covers disc top portion completely. Bring it back to its original position by rotating another half a turn. So in how many parts is the disc divided? (Two) Each part is half of the whole. (Write it as $1/2$ and read as one by two.) Numbers like $1/2$ are called fractions.

Similarly by moving a quarter turn give the concept of $1/4$. Various things can be shown through these discs such as $1/4 + 1/4 = 1/2$; Equivalent fractions can be demonstrated as $1/2 = 2/4$; $1/3 = 2/6$ etc.

Now ask the students to show the following:

Can you show that $1/3 + 1/3 = 2/3$?

Can you show that $1/4 = 2/8$?

Can You show that $3/4 = 6/8$?

B) Comparison of Fractions

Let us take the example of comparing two fractions $5/8$ and $1/2$. Take a square or rectangular sheet of paper. Fold and press the paper four times i.e., divide it

16 equal parts as shown here in Fig. 9.10. You can show $1/2$ part along EF (either ADFE or EFCB) comprising eight parts out of sixteen. Now show $5/8$ taking 10 parts out of 16 (as in the shaded portion ADCGHE). Now compare with ADFE.

The conclusion will be $ADC\ GHE > ADFE$ or $5/8 > 1/2$, also compare with EFCB. The conclusion will be $ADC\ GHE > EFCB$ or $5/8 > 1/2$.

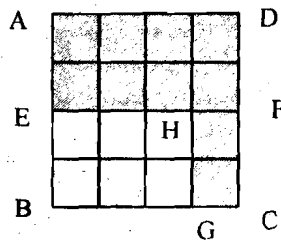


Fig. 9.10

C) Product of Fractions

To illustrate the product of two fractions, let us take the example of $3/4$ of $5/9$. Take a rectangular paper and divide it into 9 equal parts vertically and take 5 out of them. In Fig. 9.11, ABCD is the rectangular sheet of paper. Its $5/9$ is shown through shading by horizontal lines as AEFD. Now divide the paper into 4 equal parts horizontally. $3/4$ of $5/9$ would be AEHG out of AEFD (shown by double lines shading). You may clarify that the whole figure is divided in 36 equal parts 20 parts represent $5/9$ and 15 parts represent $3/4$ of $5/9$.

$$3/4 \text{ of } 5/9 = 3/4 \times 5/9 = 15/36$$

Students may generalize that

$$a/b \times c/d = ac/bd$$

Students may be given similar exercises to demonstrate such as $3/8$ of $3/5$ etc.

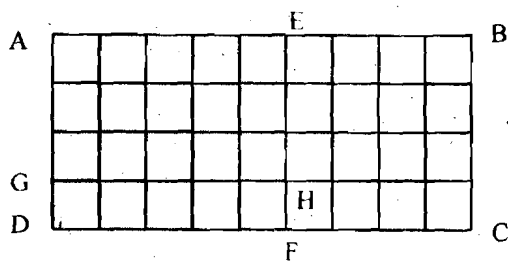
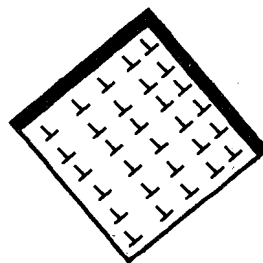


Fig. 9.11

10) Geo-Board and its Use

The Geo-Board may serve as a very good teaching aid for clarifying various important concepts and operations in mathematics. For preparing a Geo-Board you should take a rectangular plyboard of convenient size and fix cobbler's nails on its surface in rows. The nails must be at a distance of 1 cm (preferably) to each other. Now taking large size rubber bands of different colours, various geometrical shapes can be formed by covering two or more than two nails at a time, such as line segments, triangles, quadrilaterals, rectangles, squares, etc. The Geo-Board may be used for finding out area, perimeter, etc. The Geo-Board is shown in Fig. 9.12.



GEO-BOARD

Fig. 9.12

A) Measurement of Area/Perimeter

- i) Students can use Geo-Boards to form a rectangular/square shape by using rubber bands. It will be in Geo-Board units. If Geo-Board nails are at a distance of 1 cm each, then perimeter will be in cm and area in sq. cm.
- ii) Another activity suggested is to tell the children to ask each other to take 4 thin jute strings each of 16 cm length and make 4 different rectangles including a square as shown in the figure. Get them secured by fixing drawing pins on their corners.

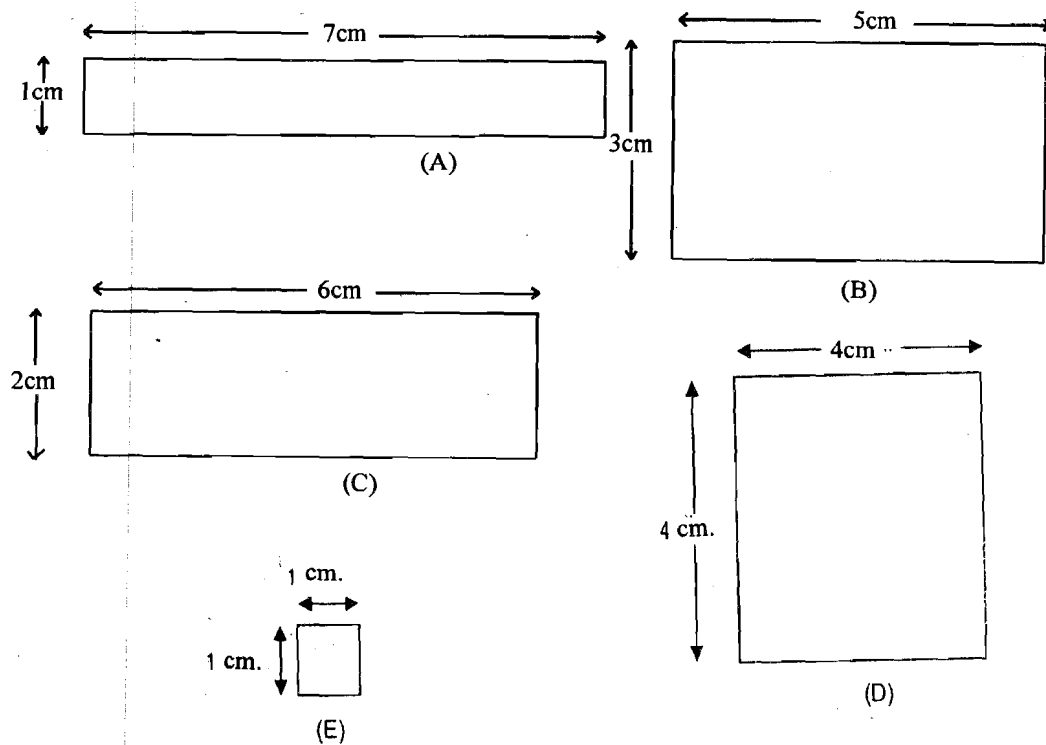


Fig. 9.13

All these figures enclose some plane surfaces which are called their areas. These areas can be measured with the help of a unit square, i.e., a square each of whose sides is of 1 cm length (Fig. 9.13E). The children may be made to discover that the perimeter of all these figures from A to D is 16 cm but the areas are different.

Fig. A Area = 7 sq. cm. = 7×1 sq. cm.

Fig. B Area = 15 sq. cm. = 5×3 sq. cm.

Fig. C Area = 12 sq. cm. = 6×2 sq. cm.

Fig. D Area = 16 sq. cm. = 4×4 sq. cm. Teaching

The above observation may lead to the generalization that the area of a rectangle = length \times breadth units; the area of a square = length \times length units.

11) Geometry

Various geometrical concepts may be got understood through certain activities. Some suggested activities are described below:

Activity I

Concepts related to Circle

Take a rope and lime powder and draw a circle in your school compound big enough to accommodate the whole class on its boundary. Mark the centre of the circle.

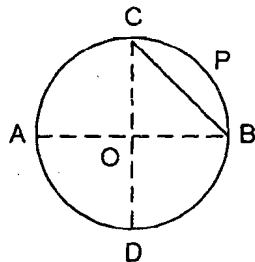


Fig. 9.14

Now ask the children to stand as per instructions and speak as follows:

- i) The student standing at O speak, "I am the centre of the circle".
- ii) The chains of students standing along AB and CD speak, "I am the diameter".
- iii) The chain of students on either OA, OB, OC or OD speak, "I am the radius".
- iv) The human chain of students standing on the circumferences ACBD speak "I am on a circle". "I am at a fixed distance from the centre", "We all are at the same distance from the centre", "Together we form the circumference of the circle".
- v) The chain of students along CPB say: "I am on an arc".
- vi) The chain of students along BC speak, "I am on a chord".
- vii) Chain of students along arc ADB speak, "We form a semi-circle".

Activity II

Triangles, Rectangles and Squares

Take some matchsticks. These matchsticks may then be joined with the help of 1 cm long pieces of cycle valve tube and then bent to form any closed rectilinear figure such as triangle, rectangle and square.

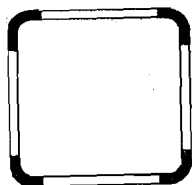


Fig. 9.15

Activity III

Cuting Out Figures

From a given rectangular sheets of paper ask the children to cut out the following


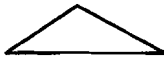
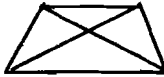
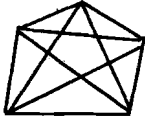
- i) Cut out a square whose side is equal to the breadth of the paper, without measuring.
- ii) Cut out a triangle whose area is half that of this square.
- iii) Guess the angles of this triangle in degrees and verify it by actual measurement.

Activity IV

Drawing Segments

Ask the children to draw all possible segments by joining the given number of points.

Let them discover the pattern:

No. of Points		No. of Segments
2		1
3		3
4		6
5		10

Students may be assigned 6,7 points and so on to identify the pattern of 1, 3, 6, 10, 15, 21 segments.

9.5 USE OF TEACHING-LEARNING MATERIALS FOR ENHANCING LEARNERS' COMPETENCY IN MATHEMATICS

You would have now realized that use of teaching-learning materials may bring out a significant change in the quality of teaching and learning as compared to the mere chalk and talk approach or forcing the children to cram for the purpose of examination. There are three basic considerations involved in the use of teaching-learning materials which are stated below:

- i) **Genuine requirement of material:** You should be fully convinced that with a particular kind of teaching-learning material the concepts can be easily clarified and better learning may take place. So you should ask a question of yourself — what kind of teaching material may help develop competence among children?
- ii) **Procurement of the required teaching-learning material:** Now you have to find ways and means to arrange for such material. You may like to think of some low-cost or no-cost teaching aids and arrange them before discussing the particular topic.
- iii) **Use of teaching-learning material:** Feeling concerned about teaching-learning material and being able to arrange and prepare the appropriate teaching-

learning material is not enough. You have to be skilled in handling these materials at the appropriate moment and in a proper way. For this one should acquire experience through study, discussion with knowledgeable colleagues and experimentation.

You must note that teaching aids and activities should not be used for the sake of formality. But there should be a purpose behind the use of each of the teaching-learning materials and activities. Teaching-learning materials are conceived keeping in view the intelligence level of children. Since you are the right person to know about your students, this may help you to develop materials and activities in which all children will feel interested and participate with great joy. One most important thing is that children should not get lost in activities but should be encouraged to appreciate the mathematical principles/ concepts involved in them. It is therefore imperative that each activity should be followed by appropriate evaluative questions. Generalizations should be drawn wherever possible. Resourcefulness and concern for the development of competence among children is the key to success in the whole gamut of development of teaching-learning materials and activities and their use.

Check Your Progress

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

b) Compare your answer with the one given at the end of this unit.

4. What is important when preparing a teaching-learning material?

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9.6 LET US SUM UP

Teaching-learning is a purposeful activity which requires wholehearted participation of both the teacher and the learners. If you have to make teaching a joyful activity as well, it is desirable to make it interesting. Well-thought teaching-learning materials and activities, if, used skillfully, may help teachers like you achieve the desired goals of teaching-learning. No exhaustive list of such materials can be suggested or provided to you. It is the teachers who have to take their own decisions with regard to the selection, planning, developing, and conduct of various teaching-learning materials and activities keeping the local specific requirements and the requirements of mathematics teaching at the particular stage. In the present unit, the role and importance of teaching-learning materials have been discussed. Various suggestions have been made with regard to developing various types of visual materials (charts etc.) and other activities on selected competencies pertaining to different areas of learning mathematics at primary level.

Towards the end of this unit some suggestions and precautions with regard to preparation and use of teaching-learning materials have been provided. Now you should be able to generate such materials and use them effectively in your classrooms so as to help children acquire mathematical competencies at the level of mastery.

9.7 UNIT-END EXERCISES

1. Develop two teaching-learning materials on topics of your choice and not provided in this unit at 11.5.
2. Suggest two such activities which can be organized to clarify certain mathematical concepts with the involvement of almost all children in an interesting manner.
3. Develop an action plan for taking your students to visit some architectural monument and help them identify combinations of various geometrical designs.
4. List various objects around your school setting and mention their resemblance to geometrical shapes.
5. On the Geo-Board mark two different rectangles of area 12 sq. cms each. Find out their perimeters.

ANSWERS TO CHECK YOUR PROGRESS

1. Teaching-learning can be made more interesting and joyful by using the appropriate teaching materials.
2. Different categories of learners can be attended to by employing different strategies and making use of different types of teaching-learning material.
3. A teacher can develop "no-cost or low-cost teaching-learning material"
4. The use of material at the proper time and in a proper way is as important as its preparation.