

An Analytical Study on the Elementary Concepts of Area

Research Article

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Abstract: In this paper, some attempts have been made to present the 21 identified elementary concepts of the major concept area sequentially. This work was done by text book scanning process and incorporating experts opinions. This study will help the curriculum development of school mathematics.

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1. Introduction

It is known that the mathematics is the root of all sciences and technologies that advocate the happy and prosperous life of each citizen of each nation in the modern civilization for which it has been made a compulsory subject in present day school curriculum in almost all countries in the world including our country. But it is a matter that the presentation of the content of the subject should be logical on account of it is a logical science. Researcher has some contributions for identification and sequencing the elementary concepts of different major concepts up to secondary level using the 'text book scanning process' and 'experts' opinions' [25, 26, 27]. In this regard, he has also identified 21 elementary concepts of area but not presented in [26]. In this paper, an attempt has been made for presentation of the elementary concepts and their sequential order of major concept: area.

2. Objective of the Study

The objective of the study is to present the identified different elementary concepts of area sequentially.

3. Definitions

3.1. Major Concept and Sub-concepts

A Major concept is an idea which is complete in itself and is comprehended through a sequential process of step-by-step partial comprehension of its related concepts. These related concepts are called sub-concepts which are not complete in itself but are parts of the major concept. Examples of major concepts are 'addition of whole numbers including the familiarity of

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the numbers', 'subtraction of whole numbers', 'measurement of mass', 'fraction', 'decimal', 'rational number' etc. For the major concept such as 'Addition of whole numbers including the familiarity of the numbers', its sub-concepts are 'addition of one-digit numbers including zero where the sum is one-digit number', 'addition of one-digit numbers where the sum is two-digit number' etc.

3.2. First Level Sub-concepts

The sub-concepts which are obtained after immediate derivation of a major concept are called first level sub-concepts.

3.3. Second Level Sub-concepts and Others

When the derivation of first level sub-concepts are continued, the other sub-concepts so obtained stage by stage are called second level, third level etc.

3.4. Elementary Concept

A sub-concept which can not be split further will be called an 'elementary concept'.

4. Materials and Methods

Procedure adopted has been discussed below:

4.1. Collection of Text Books

The prescribed text books of mathematics from Class-1 to 10 of West Bengal Board of Primary Education (WBBPE), West Bengal Board of Secondary Education (WBBSE), National Council of Educational Research and Training (NCERT) and other available books from the market were collected in the first stage (1 to 24).

4.2. Analysis of Text Books

These books were analyzed to identify 'area' as a major concept and their elementary concepts of arithmetic mainly. This major concept has been considered up to class-V standard in Indian context in my study.

4.3. Sequencing of Concepts

The identified major concept and their elementary concepts were sequenced keeping in view the logical order of the subject and the psychological order of learners.

4.4. Experts' Opinions

The major concept and their elementary concepts with examples were given to experts for their comments. The experts were requested to add or omit or alter the sequence of concepts as they felt necessary.

Finally, the sequential form of elementary concepts of the major concept 'area' incorporating the experts' opinion was developed.

5. Salient Point of the Study

The major concept: area has been divided into six first level sub-concepts which are expressed in tabular form in Table-1. Each first level sub-concept has been divided into different sub-concepts except first level sub-concept serial nos. 2 of Table-1. Total 21 elementary concepts have been identified. The splitting of sub-concepts is continued through different levels until elementary concepts are reached. In this investigation each sub-concept is numbered with a position value of different levels i.e. when a sub-concept is denoted by i.j.k..., then i indicates the first level sub-concept no., j indicates the second level sub-concept no., k indicates the third level sub-concept no. etc. The numbers of different elementary concepts of the each first level sub-concept are shown in Table-2.

1	2
Sl. No.	First level sub-concept
1.	Meaning of area
2.	Area by counting squares on a square paper / geo-board
3.	Problems on area of rectangle
4.	Problems on area of square
5.	Problems involving area of rectangle and square
6.	Miscellaneous

Table 1. List of first level sub-concept of Area

1	2	3	4
First level sub-concept sl. Nos.	Number of second level sub-concept	Number of third level sub-concept	Total number of elementary concepts
1	2	-	2
2	1	-	1
3	6	1+2+2+2+2+2	11
4	2	1+2	3
5	2	-	2
6	2	-	2
		Grand Total	21

Table 2. Detailed list of different levels of sub-concepts of Area

The process of detailing out of first level sub-concepts has been done. Some of the elementary concepts of the sub-concepts have been elaborated giving question (Q) and answer (A) for better clarification and rest of the elementary concepts have only been presented giving question (Q) only for due to economy of space. Here

‘*’ represent the concepts which had been introduced in the prescribed text books of W.B.B.S.E. & N.C.E.R.T. both

‘**’ represent the concepts which had been introduced in the prescribed text books of N.C.E.R.T. only but not in W.B.B.S.E.

‘***’ represent the concepts which had been introduced in the prescribed text books of W.B.B.S.E. only but not in N.C.E.R.T.

‘****’ represent the concepts which had not been introduced in the prescribed text books of W.B.B.S.E. & N.C.E.R.T.

The second level sub-concepts of sub-concept no. 1: Meaning of area.

1.1 Concept of area. (*)

Q. Fill in the blank.

The nature of the region enclosed by a closed figure is called its _____. (A: area)

1.2 Units of area. (*)

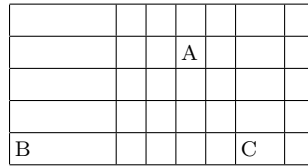
Q. Fill in the blank.

If we take a square of side 1mm as a unit of area, then the area is expressed as_____ mm. (A: square/sq)

The second level sub-concepts of sub-concept no. 2: Area by counting squares on a square paper / geo-board.

2.1 Finding the area of the figure by counting squares on a square paper / geo-board. (**)

Q. Find the area of the triangular figure ABC drawn on a square paper by counting squares.



The second level sub-concepts of sub-concept no. 3: Problems on area of rectangle.

3.1 Formula of the area of rectangle. (*)

Q. What is the formula of the area of a rectangle?

(A: The area of a rectangular=length × breadth.)

3.2 Finding the area of a rectangle when its length and breadth are given.

3.3 Finding the length of a rectangle when its area and breadth are given.

3.4 Finding the breadth of a rectangle when its area and length are given.

3.5 Finding the area of a rectangle when its length or breadth and relationship between length and breadth or perimeter are given.

3.6 Finding the length or breadth of a rectangle when its breadth or length and area are given.

The third level sub-concepts of sub-concept no. 3.2: Finding the area of a rectangle when its length and breadth are given.

3.2.1 Solution of the given problem and writing proper answer. (*)

Q. Solve the problem and write the answer properly.

The floor of a room is 5.5 m long and 4.5m wide. How much carpet is required to cover the floor?

$$\left(\begin{array}{l} \text{A : Area of the room} = \text{length} \times \text{breadth} \\ \qquad \qquad \qquad = 5.5 \times 4.5 \text{ sq m} \\ \qquad \qquad \qquad = 24.75 \text{ sq m} \\ \therefore 24.75 \text{ sq cm carpet is required to cover the floor.} \end{array} \right)$$

3.2.2 Formation of the problem and working out its solution. (****)

Q. Make a problem involving finding the area of a rectangle when its length and breadth are given and then solve it.

The third level sub-concepts of sub-concept no. 3.3: Finding the length of a rectangle when its area and breadth are given.

3.3.1 Solution of the given problem and writing proper answer. (****)

Q. Solve the problem and write the answer properly.

The area of a rectangular garden is 288 sq m and its breadth is 12 m. Find its length.

$$\left(\begin{array}{l} \text{A : length} = \frac{\text{area}}{\text{breadth}} = \frac{288}{12} \text{ m} = 24 \text{ m} \\ \therefore \text{Its length is 24 m.} \end{array} \right)$$

3.3.2 Formation of the problem and working out its solution. (****)

Q. Make a problem involving finding the length of a rectangle when its area and breadth are given and then solve it.

The third level sub-concepts of sub-concept no. 3.4: Finding the breadth of a rectangle when its area and length are given.

3.4.1 Solution of the given problem and writing proper answer. (****)

Q. Solve the problem and write the answer properly.

The area of a rectangular garden is 77 sq m. If the length of the garden is 11 m. Find its breadth.

$$\left(\begin{array}{l} \text{A : breadth of the garden} = \frac{\text{area}}{\text{length}} = \frac{77}{11} \text{ m} = 7 \text{ m} \\ \therefore \text{The breadth of the garden is 7 m.} \end{array} \right)$$

3.4.2 Formation of the problem and working out its solution. (****)

Q. Make a problem involving finding the breadth of a rectangle when its area and length are given and then solve it.

The third level sub-concepts of sub-concept no. 3.5: Finding the area of a rectangle when its length or breadth and relationship between length and breadth or perimeter are given.

3.5.1 Solution of the given problem and writing proper answer. (***)

Q. Solve the problem and write the answer properly.

The length of a rectangular park is twice of its breadth. If the length of the park is 84 m. Find its area.

$$\left(\begin{array}{l} \text{A : Length of the rectangular park} = 84 \text{ m} \\ \qquad \qquad \qquad \text{and breadth} = \frac{84}{2} \text{ m} \\ \qquad \qquad \qquad \qquad \qquad = 42 \text{ m} \\ \therefore \text{Area} = 84 \times 42 \text{ sq m} = 3528 \text{ sq m} \\ \therefore \text{Its area is 3528 sq m.} \end{array} \right)$$

3.5.2 Formation of the problem and working out its solution. (****)

Q. Make a problem involving finding the area of a rectangle when its length or breadth and relationship between length and breadth or perimeter are given and then solve it.

The third level sub-concepts of sub-concept no. 3.6: Finding the length or breadth of a rectangle when its breadth or length and area are given.

3.6.1 Solution of the given problem and writing proper answer. (***)

Q. Solve the problem and write the answer properly.

The area of a land is 459 sq m. If the length of the land is 27 m. Find its breadth.

3.6.2 Formation of the problem and working out its solution. (****)

Q. Make a problem involving finding the length or breadth of a rectangle when its breadth or length and area are given and then solve it.

The second level sub-concepts of sub-concept no. 4: Problems on area of square.

4.1 Formula of the area of square. (*)

Q. What is the formula of area of square?

$$[\text{A: Area of square} = (\text{length})^2]$$

4.2 Finding the area of a square when its length is given.

The third level sub-concepts of sub-concept no. 4.2: Finding the area of a square when its length is given.

4.2.1 Solution of the given problem and writing proper answer. (*)

Q. Solve the problem and write the answer properly.

If the length of a square is 4 cm. Find its area.

$$\left(\begin{array}{l} \text{A : Length of the square} = 4 \text{ cm} \\ \therefore \text{Area} = (4)^2 \text{ sq m} = 16 \text{ sq m} \\ \therefore \text{Its area is } 16 \text{ sq m.} \end{array} \right)$$

4.2.2 Formation of the problem and working out its solution. (****)

Q. Make a problem involving finding the area of a square when its length is given and then solve it.

The second level sub-concepts of sub-concept no. 5: Problems involving area of rectangle and square.

5.1 Solution of the given problem and writing proper answer. (*)

Q. Solve the problem and write the answer properly.

A wall of length 8.4 m and width 2.5 m is to be covered by squared stone slabs each of side 10 cm. How many slabs are needed to cover the whole wall?

5.2 Formation of the problem and working out its solution. (****)

Q. Make a problem involving area of rectangle and square and then solve it.

The second level sub-concepts of sub-concept no. 6: Miscellaneous.

6.1 Solution of the given problem and writing proper answer. (*)

Q. Solve the problem and write the answer properly.

The perimeter of a square is equal to the perimeter of a rectangle. The length and breadth of the rectangle are 48 m and 32 m respectively. Find the area of the square.

6.2 Formation of the problem and working out its solution. (****)

Q. Make a miscellaneous problem involving area and then solve it.

6. Conclusion

- (1). This methodology will help to mark different types of conceptual gaps of mathematics in the syllabus, text books and entire teaching learning process.
- (2). Total 21 elementary concepts of area have been identified and sequenced up to primary level. Only 10 elementary concepts have been introduced in the prescribed text books of WBBSE and NCERT has been considered 9 elementary concepts which are mentioned in the salient points of study. So, there is a conceptual gap of that major concept of our text books of mathematics.
- (3). It will also help to diagnose the particular areas of weakness of learners and also in planning for necessary remedial measures.
- (4). Backward learners can be detected easily and remedial method for them can be applied.
- (5). This study will help to develop sequentially the activities of area for better understanding of learners.
- (6). Special interest for mathematics can be enhanced which will be helpful for entire science education.

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