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ACTIVITIES ON VARIABLE AND CONSTANT

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Abstract– *'Variable and constant' are fundamental concepts and they are basis of the branch algebra of mathematics. Research has documented that learners, even a portion of teachers are weak in conceptualizing 'variable and constant'. So, the researcher has tried to develop some activities in such a way that the learners as well as teachers can be enriched about variable and constant. He has done this through the process of 'text book scanning' and followed by taking 'experts' opinions' on this work. In this paper, total 40 activities on 'variable and constant' have been developed and presented them sequentially. Among them, very few activities can be found in the prescribed text books of West Bengal Board of Secondary Education (W.B.B.S.E.) and in the text books of National Council of Educational Research and Training (N.C.E.R.T.), but these activities have not been presented like the illustrations of the developed activities of this paper. This study will help to develop the curriculum framing, writing text books and improving teaching-learning process which ultimately grows more interest among the target group of learners towards mathematics of different grade levels and ability levels.*

Keywords*:* developing the activities; algebra; variable; constant; school mathematics; secondary level; text book scanning process; curriculum development.

2010 AMS Mathematics Subject Classification: *97A99, 97B50, 97C70, 97D40, 97H20.*

I. INTRODUCTION:

Mathematics is an abstract subject in its nature whose concepts are extremely logical and sequentially developed. So for its proper understanding special care needs to be taken at its presentation. Because of smooth passage is to be developed from real life experience to abstract concept formation. This purpose will be served only if activity oriented learning is adopted properly in teaching learning system. In this respect it is worth mentioning that the National Focus Group on Teaching of Mathematics of National Council of Educational Research & Training (N.C.E.R.T.)-2006 has emphasized specially on activities in practical mathematics that helps the learners immensely in visualization. [25]

Donna, H. Henry & Chandler, Arizona (2007) said " …that my students will create their own math knowledge through activities that involve them in explorations and inquiry. It is also my intent that the knowledge gained through the manipulative activities can be applied in solving problems. Math that arises from real life situations is more relevant to the student's lives. I believe that a concept should grow out of a student's need to know, not just because it is the next chapter in the book. [8]"

Again, Deepak Dayal (2011) said, "It is useful to involve students as mentors in support systems, as teaching assistants in courses to facilitate student success. Results show that the peer support, coupled with active and cooperative learning methods improve the student learning processes. [6]"

T. Swarupa Rani recommended in her research study to the field of mathematics education, "Pupils should learn mathematics as far as possible through active practical experience and with the help of learning aids drawn from the environment. Therefore, most of the existing text books may be modified and re-written by considering the suitable daily life situations to explain the different mathematical concepts. [31]

The status of implementation of the activities based mathematics learning in India is poor. In this regard, Anandalakshmy & Bala Mandir Team (2007) said in 'A Report on an Innovative Method in Tamil Nadu' [14] on Activity Based Learning that innovative methods which engage the children and enable them to achieve mastery over school-related competencies and skills can be located here and there. However, they are small in scale and number in India.

Now, algebra, an important branch of mathematics, is started from class VI, at the age level of 11-12 years of learners i.e. the beginning level of upper primary in our country. The branch is started with the concept of variable. But it is a matter of pity that a large number of learners who can not realize what is variable? They can not do the discrimination between variable and constant. It is not clear among them when x is treated as a variable or a constant or a letter of English alphabet. But it is a fact that the subject has been mainly developed based on variables. These variables are concerned with our real life problems. We provide/construct the mathematical frame of our real life problems and find their mathematical solutions using variables.

K. K. De (2014) said, "In algebra, the idea of ***variables*** and ***constants*** are hardly given in any secondary level algebra book or in any popular book on mathematics in our country. An example on the identification of variables and constants is given below:

Example: Utility of the equation y=ax+b

A problem is constructed below following the above equation:

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In a wedding ceremony the total rent of the marriage hall is Rs. 5000/-, the number of guests who attended the function is 200. The cost of food per plate was Rs. 150/-. If you like to calculate the total cost for the ceremony noted above using the algebraic equation, what are the value of x, a, b and y?[*In a UGC Seminar in mathematics in a Teachers' Training College, W Midnapore, the responses given to this question, by the serving mathematics teachers of secondary schools in 2011, were not very encouraging.*]'' [7]

On the other hand, as a secondary level teacher, I acted as a resource person in many teachers' orientation programme where many science teachers asked me how will they present the idea of variable? Their questions are like: how will they write the unknown quantity? Why will they write these? Is the unknown quantity variable? Possibly these questions arise because of the conceptualizing difficulty in grasping the idea 'variable' in the class room ambience.

So, it is clear from the above discussion that learners are also confronted the same feelings/queries. Hence, there is a special need to develop different activities on variable and constant for providing the concrete idea of variable and constant. This study will not help only learners, but teachers also. Therefore, I take an attempt to develop different activities on variable and constant for concretization of the concepts to target group i.e. the learners considering their ages, grades and ability levels. The researcher has some contributions in this direction [26, 27, 28, 29].

In this paper, 40 illustrations of activities on 'variable and constant' have been developed and presented sequentially which will help the learners to get the relish for learning variable.

II. OBJECTIVE OF THE STUDY:

The objective of this study is to develop various learning activities for acquaintance with 'variable and constant' with the help of the learning aids drawn from environment.

III. MATERIALS AND METHODS:

Materials and methods have been discussed below:

1. **Collection of text books:**
   The prescribed text books of mathematics from class-I to class-X standard of West Bengal Board of Primary Education (W.B.B.P.E.), W.B.B.S.E. and N.C.E.R.T. and other available books from the market were collected at first (from [1] to [5], [9] to [13], [15] to [24], [30]).

2. **Analysis of Text books/Text book scanning:**
   The books were analysed to identify the activities of the 'variable and constant' in algebra.

3. **Developing the activities:**
   The activities for verifying the 'variable and constant' were developed considering the psychological order of learners and the learners' ability level.

4. **Sequencing of activities:**
   The developed activities were sequenced keeping in view the logical order of the subject matter and the psychological order of learners. The gaps in activities if any detected by the researcher were filled in by him at the initial stage.

5. **Experts' opinions:**
   Experts' opinions were taken on the developed activities.
   Finally, the sequential form of the activities 'variable and constant' incorporating the experts' opinion was developed.

IV. SALIENT POINTS OF THE STUDY:

Here, forty activities for acquaintance with 'variable and constant' have been developed by the researcher and are presented below sequentially. Only two activities (2.1 & 2.2.1) out of forty have been presented in detail and just the names of all other activities have been mentioned due to economy of space. Learners will acquire knowledge about the above mentioned ideas through their active participation with the real life problems in this process. Here, the teacher will play a role as a facilitator. This work has been done through the help of the different mathematical concepts.

Different activities for acquaintance with variable and constant have been presented in the following ways.

1. Acquaintance with variable and constant with respect to static and motion.

Activity-1.1: Acquaintance with variable and constant in an ambience of home/ class room of a school.

Requirements: Chart of school environment, chart of home environment, pen/pencil, exercise book.

Mode: Pair group.

Strategy: Learning through activities.

Objective of the development: Cognitive development.

Activity Follows:

Stage-I: The facilitator will do the following activity involving the learners.

1. After showing the scenery of home or school, the learners will be asked about variable and fixed object.

Stage-II: The learners will do the following activities with help of the facilitator, if needed.

Each pair group:

1. Reads the following statement:

Two out of three electric fans were moving in the house of Malay on Sunday at noon.

2. Writes from the above statement which objects are in variable mode.

3. Writes then from the above statement which is in fixed mode.

The work is illustrated below:

Through the proper involvement of the learners in the activities, they will write: Two moving fans are variables. One non-moving fan is fixed, Malay's home is also fixed.

Activity-1.2: Acquaintance with variable and constant in a rural environment.

Activity-1.3: Acquaintance with variable and constant in an urban environment.

Activity-1.4: Acquaintance with variable and constant in transport system

2. Acquaintance with variable and constant using the concept of multiplication.

2.1 Activity using matchsticks and English alphabet/shapes.

Activity-2.1.1: Acquaintance with variable and constant by making pattern I using matchsticks.

Activity-2.1.2: Acquaintance with variable and constant by making pattern L/V using matchsticks.

Activity-2.1.3: Acquaintance with variable and constant by making pattern Z/C/shapes (Δ) using matchsticks.

Activity-2.1.4: Acquaintance with variable and constant by making pattern E/shapes ( ) using matchsticks.

2.2 Activity other than using matchsticks and English alphabet/shapes.

Activity-2.2.1: Acquaintance with variable and constant by any one relationship between exercise books and cost, balls-cost, balls-learners, marbles-learners, cycle-wheel, rikshaw-wheel, car-wheel etc.

Requirements: A chart of natural numbers, a chart of English alphabet, plastic balls, picture notes of Rs 5, Rs 10 etc, pen/pencil, exercise book. **Mode:** Pair group.

Strategy: Learning through activities.

Objective of the development: Cognitive development.

Activity Follows:

Stage-I: The facilitator will do the following activity involving the learners.

1. The facilitator will ask the learners about the natural numbers, letters after showing the list of natural numbers, English alphabet.

Stage-II: The learners will do the following activities with help of the facilitator, if needed.

Each pair group:

1. Buys one ball with Rs. 5.
2. Buys two balls.
3. Buys three balls.
4. Does so on.
5. Fills up the following table.

									…	…
Number of balls bought										
Total cost in price									…	…

6. Finds the rule/relationship between the number of balls bought and total cost in price.
7. Writes ‘n’ for the number of balls for convenience.
8. Writes the total cost in price.
9. Writes 5n instead of 5 × n (since, 5n is same as 5 × n)
10. Tells here what are called n and 5.

The work is illustrated below:

Figure: Ball and Currency

The each pair group will fill up the following table such as

Number of balls bought	1	2	3	4	5	6	7	8	…	…
Total cost in price	5	10	15	20	25	30	21	24	…	…

Each pair group realizes while writing the table that

Total cost of the balls= Rs. 5 × Number of balls bought

This is the relationship between the total cost of the balls and the number of balls bought.

∴ Total cost of the balls = Rs. 5 × n (∵ Putting n for number of balls bought)

= Rs. 5n (∵ 5 × n and 5n are same)

Here, n is variable and 4 is constant.

(**Remarks-1:** Here n is an example of a variable. The word ‘variable’ means something that can vary, i.e. change. Its value is not fixed. It can take any value 1, 2,3, ……

Rule for total cost of balls has been written using the variable n.

Again, 5 is a number and its value is fixed.

So, the number 5 before n is called constant.

Remarks-2: For example, an activity on balls-cost is presented here. The similar other activities like that the relationship between exercise books and cost, balls-learners, marbles-learners, cycle-wheel, rikshaw-wheel, car-wheel etc can be done easily.)

Activity-2.2.2: Acquaintance with variable and constants by arranging the learners/balls/different objects etc. in a rectangular/square form.

3. Acquaintance with variable and constant using the concept of addition

Activity-3.1: Acquaintance with variable and constant using concept of addition.

4. Acquaintance with variable and constant using the concept of subtraction

Activity-4.1: Acquaintance with variables and constants using concept of subtraction.

5. Acquaintance with variable and constant using the concept of division.

Activity-5.1: Acquaintance with variable and constant using the concept of division when divisor is variable.

Activity 5.2: Acquaintance with variable and constant using the concept of division when dividend is variable.

6. Using variable and constant or variable in common rules for the two dimensional geometrical figure i.e. the

perimeter of triangle, square, rectangle, quadrilateral, pentagon, hexagon, polygon, circle etc.

6.1 Using variable and constant in the rule for the perimeter, area etc. of a triangle.

6.1.1 When the triangle is scalene triangle.
Activity-6.1.1.1: Acquaintance with variable and constant in the rules for the perimeter, area etc. of a scalene triangle.

6.1.2 When the triangle is isosceles triangle.
Activity 6.1.2.1: Acquaintance with variable and constant in the rules for the perimeter, area etc. of an isosceles triangle.

6.1.3 When the triangle is equilateral triangle.
Activity-6.1.3.1: Acquaintance with variable and constant in the rules for the perimeter, area etc. of an equilateral triangle.

6.1.4 When the triangle is right-angled triangle.
Activity-6.1.4.1: Acquaintance with variable and constant in the rules for the perimeter, area etc. of a right-angled triangle.

6.2 Using variable and constant in the rule for the perimeter, area etc. of a quadrilateral.

6.2.1 Quadrilateral whose sides are unequal.
Activity-6.2.1.1: Acquaintance with variable and constant in the rules for the perimeter, area etc. of a quadrilateral whose sides are unequal.

6.2.2 When quadrilateral is rectangle.
Activity-6.2.2.1: Acquaintance with variable and constant in the rules for the perimeter, area etc. of a rectangle.

6.2.3 When quadrilateral is square.
Activity-6.2.3.1: Acquaintance with variable and constant in the rules for the perimeter, area etc. of a square.

6.2.4 When quadrilateral is parallelogram.
Activity-6.2.4.1: Acquaintance with variable and constant in the rules for the perimeter, area etc. of a parallelogram.

6.2.5 When quadrilateral is trapezium.
Activity-6.2.5.1: Acquaintance with variable and constant in the rules for the perimeter, area etc. of a trapezium.

6.2.6 When quadrilateral is rhombus.
Activity-6.2.6.1: Acquaintance with variable and constant in the rules for the perimeter, area etc. of a rhombus.

6.3 Using variable and constant in the rule for the perimeter, area of a regular pentagon.
Activity-6.3.1: Acquaintance with variable and constant in the rules for the perimeter, area of a regular pentagon.

6.4 Using variable and constant in the rule for the perimeter, area of a regular hexagon.
Activity-6.4.1: Acquaintance with variable and constant in the rules for the perimeter, area of a regular hexagon.

6.5 Using variable and constant in the rule for the perimeter, area etc. of a regular polygon.
Activity-6.5.1: Acquaintance with variable and constant in the rules for the perimeter, area of a regular polygon.

6.6 Acquaintance with variable and constant by constructing geometrical figures (open like I, V and closed like regular polygon) using matchsticks.
Activity-6.6.1: Activity of acquaintance with variable and constant by constructing geometrical figures (open like I, V and closed like regular polygon) using matchsticks.

6.7 Using variable and constant in the rule for the perimeter, area etc. of a circle.
Activity-6.7.1: Acquaintance with variable and constant in the rules for the perimeter, area of a circle.

7. Using variable and constant or variable in common rules for the three dimensional geometrical figure i.e parallelepiped, cube, right prism, right circular cylinder, right pyramid, right circular cone, sphere.

7.1 Rules for finding the diagonal, area, volume of parallelepiped.
Activity-7.1.1: Acquaintance with variable and constant in the rules for finding the diagonal, area, volume of a parallelepiped.

7.2 Rules for finding the diagonal, area, volume of cube.
Activity-7.2.1: Acquaintance with variable and constant in the rules for finding the diagonal, area, volume of a cube.

7.3 Rules for finding the area of lateral surface, total surface and volume of right-prism.
Activity-7.3.1: Acquaintance with variable and constant in the rules for finding the area of lateral surface, total surface and volume of a right-prism.

7.4 Rules for finding the area of lateral surface, total surface and volume of right-circular cylinder.
Activity-7.4.1: Acquaintance with variable and constant in the rules for finding the area of lateral surface, total surface and volume of a right-circular cylinder.

7.5 Rules for finding the area of lateral surface, total surface and volume of right-pyramid.
Activity-7.5.1: Acquaintance with variable and constant in the rules for finding the area of lateral surface, total surface and volume of a right-pyramid.

7.6 Rules for finding the area of lateral surface, total surface, volume and slant height of right-circular cone.
Activity-7.6.1: Acquaintance with variable and constant in the rules for finding the area of lateral surface, total surface, volume and slant height of a right-circular cone.

7.7 Rules for finding the area total surface and volume of sphere.
Activity-7.7.1: Acquaintance with variable and constant in the rules for finding the area total surface and volume both of a sphere and a hemisphere.

8. Using variables in commutativity of addition and multiplication of numbers; in distributivity of multiplication over addition of numbers; in associativity of addition of numbers.

8.1 Using variables in commutativity of addition of two numbers.
Activity-8.1.1: Activity on using variables in commutativity of addition of two numbers.

8.2 Using variables in commutativity of multiplication of two numbers.
Activity-8.2.1: Activity on using variables in commutativity of multiplication of two numbers.

8.3 Using variables in distributivity of multiplication over addition of numbers.

Activity-8.3.1: Activity on using variables in distributivity of multiplication over addition of numbers.

8.4 Using variables in associativity of addition of numbers.

Activity-8.4.1: Activity on using variables in associativity of addition of numbers.

V. IMPLEMENTATION:

This study may be implemented in text books of mathematics at school level. It could also be used in the teaching-learning process.

VI. CONCLUSION:

1. 40 illustrations of activities for acquaintance with variable and constant have been developed and presented sequentially in this paper.
2. Very few activities out of 40 for acquaintance with variable and constant have been introduced both in the prescribed text books of mathematics of W.B.B.S.E. and N.C.E.R.T. but they have not been presented like the illustrations of the developed activities of this paper. Therefore, it is a gap both in the syllabus and in the text books of school mathematics.
3. This study will help the facilitator and the learners to understand about variable and constant through activity oriented learning.
4. Collection of multiple numbers of activities for acquaintance with variable and constant will help the facilitator to choose the appropriate activity for the learners considering the learners' ability levels, time limits, availability of working materials and class room ambience etc.
5. This study will also help to prepare a proper syllabus, to develop a good text book and to improve the quality of teaching-learning process on variable and constant of mathematics.
6. These types of activities will help the children to enjoy learning mathematics so that the phobia in mathematics will be reduced and stop the drop out of learners who leave from institution on account of anxiety for mathematics learning.
7. Special interest towards mathematics can be enhanced which will be helpful for entire science education.
8. As these activities are presented step by step i.e. in an iterative sequential form. This can be appropriate in preparing text material through computer based learning.

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