Closing Bracket

This time we feature an innovative Teaching Learning Material SOGOL (सौ गोले) **(S**tudents **O**wn **G**adget for **O**utstanding **L**earning) designed and developed by Sunil Bajaj, Head of the Mathematics department SCERT, Haryana. (See Figure 1.)

Figure 1

SOGOL is an approximately one metre long strip, made of flex sheet, with dots arranged in colour blocks of ten. The partition containing one dot is about 1cm which further divided in 10 mm.

SOGOL for Measurement



Measurement is one of the important concepts used in daily life and in almost all occupations. SOGOL strip that is easy to handle, would help in developing estimation skills, with experiential learning, also quantifying from the non -standard units dots to standard units- metre, centimetre and millimetre.



Estimate and Measure

First estimate any length, such as that of a notebook, finger, waist, arm, height of child, side of bench or window or blackboard and then verify it with SOGOL. Further, being flexible, it can also be used to measure the curved edges. Students can find out area, perimeter and circumference of the real objects by measuring using SOGOL strip.



Making shapes with fixed perimeter

Children may be asked to make different shapes (squares/rectangles/triangles/circles etc.) with fixed perimeter or area using Sogol strip. E.g. students may be asked to form different shapes with fixed perimeter 80 cm. In the fig. below, it is quite challenging to fold the strip in such a way to make a square with side 20 cm. Here internal edges of the square measure 20 cm.



Square with Perimeter 80cm

SOGOL in Number sense

SOGOL may be used to develop number sense and an understanding of place value.

Rolling Strip

This game can be played in pairs and one player from each pair would start rolling SOGOL strip from a corner in a given time (e.g. till other would recite numbers 1 to 10). One who folds more will be the winner by counting dots or colours or 10 partitions in one dot according to age group . initially they may count 1,2,3,4... but later in groups of 10.



Extension activity: Divide the class in groups of 4 or 5. Students would start rolling the strip turn wise from a corner (just like above activity), after two rounds (2 readings) by each player, the member

whose sum is largest would be the winner. For one digit addition, students may count the number of colours they rolled. They may do it by add on.

Further, for place value, players will roll two times and use numbers of colors as the unit and tens digits to form two-digit number. Similarly, roll three times for forming three-digit numbers. E.g. in the above two pics, 5 colours and 3 colours are rolled. numbers may be 35 or 53 according to the desired target of getting maximum or minimum. Do it two times to make two digit number and add or subtract ,one whose sum or difference is largest or smallest will be winner .

Also, for directly two-digit addition, dots may be counted two times after rolling two time e.g. in both the pics, dots in rolled part are 56 and 32, So the sum is 88 and addition of three-digits numbers, further partition (mm) may be counted e.g. in above pic 564 and 322. Same activity can be done for Subtraction.

Reach to 20

Divide the whole class into two groups. The group which reaches 20 (or any other pre-decided target as 50 or 100) will be the winner.

The groups take turns to call out a random number less than 4. As each number is called, it is added on to the previous total. By using SOGOL as an aid to addition, students will be able to understand the pattern required to reach the target number and hence the rule to win. (Students may write the numbers on the strips using sketch pen which can be erased later on)

This can also be played by subtracting numbers starting from 20 with the winner being the one who reaches 0 first.

At a glance (estimation)

Show a part of strip for 3-4 seconds to students and hide it, ask them how many dots were there. It would help in developing conceptual subitizing using grouping of 10 and also the estimation skills.



Adding Dots

Announce a number in the class say 8, and think of an addition fact of 8. ask students what addition fact I have thought of, they need to show it through two different coloured dots that sums to 8. Students may come up with different combinations such as 6 orange dots and 2 blue dots ; 3 blue and 5 orange 4 orange and 4 blue and so on .Teacher may say you are right but it is not what she thought.



Teacher may reveal after words what she had thought of and then students may take the lead to play this game.

Mark any number and ask to write preceding and succeeding number

Hiding Dots

To introduce subtraction, show 9 (initially take 5 or 4) dots and ask to count



then hide some dots by folding without showing how much hidden. Now ask to tell hidden dots. two children can play or with parents at home.



Hold the strip in the fist and leave some of the part of the strip out. Show it to the children for 3 seconds and ask them to estimate the number of dots out of fist and then number of dots in the fist.



SOGOL for Fractions as wonderful tool

We usually represent a given fraction say, $\frac{1}{4}$ by colouring of 1 box out of 4 equal boxes

In the Sogol strip, try to visualise fraction using any two- colour dots.

e.g. 1 blue dots out of 4 dots $\frac{1}{4}$; 3 orange dots out of 4 dots $\frac{3}{4}$



Think, what are the other ways to represent the above fractions on the Sogol strip?

Visualising fraction using two colours



Developing understanding of Equivalent fractions





Show $\frac{1}{2}$ on the strip and justify it.

 $\frac{1}{2}$ can be observed by showing 5 colours out of 10 colours (Note: one colour used for 10 dots).

What can be the other ways to show $\frac{1}{2}$ on the strip? Also give justification.

To show $\frac{1}{3}$ comfortably and justify, whole can be considered as 90 or 60 by folding the 10 or 40 dots at the back using cello tape.

Consider 60 dots as a whole

Here 30 dots i.e.
$$\frac{1}{2}$$
 $\frac{30}{60} = \frac{1}{2} = \frac{3}{6}$
 $\frac{20}{60} = \frac{1}{3} = \frac{2}{6}$
20 dots show $\frac{1}{3}$ rd of the whole
15 dots i.e. $\frac{1}{4}$

12 dots i.e. $\frac{1}{5}$

Compare by size of strips or number of dots in each strip $\frac{1}{2} > \frac{1}{3} > \frac{1}{4} > \frac{1}{5}$ (try by taking 90 or any number of dots as a whole)

To compare $\frac{2}{5}$ and $\frac{4}{9}$, use LCM 45 and write $\frac{2}{5} = \frac{18}{45}$ and $\frac{4}{9} = \frac{20}{45}$ by taking any 45 dots as whole and visualize



Decimal Fractions

are 0.1 = 0.10 equal?

0.1 = 1/10

One colour out of ten colours, represents 1/10 = 0.1



Now .10 = 10/100

Again, one colour has 10 dots and the whole strip has 100 dots.

It represents 10 dots out of 100 dots, i.e., 10/100 = .10

Now this 10/100 parts is equal to one colour out of 10 colours i.e. 1/10. Hence .10 = .1 similarly try for 0.2 = 0.20 (2 colours and 20 dots), 0.3 = 0.30 etc.



Locating decimal fractions

By changing the whole (e.g., considering one colour as one whole, or the whole strip as one whole) which part representing .1, .01 or .001 (1 colour, 1dot, 1 small partition(mm)). *Some challenging Questions-*

What would be the whole of the following decimal numbers if we want to represent it on the strip: 8.1, 13.5, 0.5 etc?

How would you represent 8.1cm, 13.5 cm or .5 cm or .54 m on the strip?

How to represent 0.548 on the strip?



Also check the difference between 54.8 cm and .548m.

If you take one strip as one whole then how would you represent 10.1 and take 10 dots as a whole then represent 3.24 or (use decimetre).



Addition & subtraction in decimals using SOGOL

.5+.04,



Try these using the Strip:

35-.03, 1.1+.23

Prompt: Think of changing the whole for representing desired decimal number.

SOGOL for Factors and Multiples

Folding Dots

Using folding dots activity, Multiplication facts (time tables) can be easily observed. Ask students to fold 3 dots each time. Where do they reach at every fold? Two folds of 3 would make it 6 and so on.







One fold

Two folds

Three folds

Micky and the Mouse

Students may develop the idea of factors and Multiples by playing the game (described in the NCERT Class – 5 Maths Textbook) using the strip. Stickers of Micky and Mouse or sticky notes or sketch pen may be used on the strip to play this game. Try various position





Cat at 3 Rat at 14. Hole at 27



Further, it can also be used to visualise HCF and LCM.

Here in the pic, LCM of 3 and 4 can be seen by marking at 3s on one side and 4s on other side.



Is the Number divisible by a given Number or not?

Students may use the strip to find whether a number is divisible by a given number or not e.g. to check 29 is divisible by 3 or not, 3 dots would be folded or marked each time and check weather 29th dot is the last dot of the last fold or not.

Measuring pi in the kitchen

Ask students to measure the circumference and diameter of the different circular utensils at their home. Using different measures, they may try out the ratio of circumference to the diameter and note their observations to find the approx. value of pi.

ltem	Circumference	Dia	Ratio	
Glass	20.4 cm	6.5 cm	3.138	
Plate	62.8 cm	20.1 cm	3.124	
Pen	24.3	7.7	3.155	
stand				

The SOGOL may be used as a rope or a string to do a number of things.

1. By holding it tight (possibly by fastening one end) one can draw a straight line, so it can perform the function of a straight edge.



2. By keeping one end fastened and moving the other end around, one can draw a circle or make two holes to keep a point fixed and other point moving as shown below.





- 3. At a later stage, it can be used to directly measure the length of the arc, hence an angle in radians: simply lay the Sogol vertically along the curve and note the reading.
- 4. Use as compass to draw angles 30 ,60 ,90 degrees as shown.



5. By marking two points on it a distance can be marked off and replicated, so it can perform the function of a divider.

Integers

You can play a game given in NCERT 7th class book. Write numbers on each dot by sketch pen 0 to 49 and -1 to -50 (as shown in figure) on each dot. Use two dice, one with numbers 1 to 6 and other with + or - sign. Throw both die and move according to + or - and number. One who reaches 50 first will be winner.



Paste the strip by cello tape on table top and play.

Addition and subtraction of integers can also be visualised on this.

In addition, SOGOL strip may also be used to enrich and assess spatial understanding by asking questions such as which colour is on right side of yellow? which colour dots are before/ after red and so on. For up and down hold strip vertically. Ordinality of numbers can also be dealt with the strip. Further, Numbers / Number names can be written on the strip and can be erased after use. E.g. teacher may announce a number and students are supposed to write the number on the strip on that position and vice versa. They may also asked to write preceding, succeeding numbers, missing numbers or position of a number on the strip.

Skip counting can also be written on strip.

1,3,5 ...

2,4,6.....

Further, locating the position of any number on the strip can be used for number sense assessment. Relationship with other numbers can also be observed using the strip e.g 48 it is near 50 or it is between 40 and 50 or it is near half of the strip.

Patterns



Eva tiles can be pasted with water on the strip.

Ordinality

Ask about 1st colour, 2nd colour and so on from each side.

Inclusive classroom

Strip may also be modified for Divyang students by making wholes in the dots or by putting small cuts as shown below .



SOGOL modified for Divyang Students

Undoubtedly, all the above features may be available using a tape measure, bead-chain, counters and so on. SOGOL scores because it is a relatively cheap, multi-purpose TLM which, if part of the student's school bag may be used as a handy tool by the student to measure, verify, visualise, represent and justify.

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