



Early Number Fun Grade R Teacher Development Programme

Session Six Teacher Handbook

Name

School

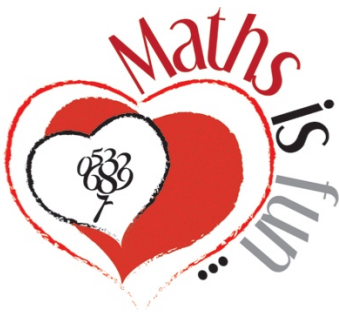
DECLARATION

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Introduction to session

In the first part of this session we focus on teacher experiences of using the activities from session 5.

These included activities based on:

1. “I can work with numbers in different ways” growth mindset poster
2. Bead strings



Year-end re-assessment

- Re-administer the assessment given in April with your learners. Additional copies of these are at the end of this booklet.
- Complete the sheets and compare them to learner performance in April.
- Do you notice any changes in the learners?
- Make notes of the changes.

Bead strings and structured number lines (linear representations of number)

Educators believe that regular use of a number line can develop learners' ability to form a *mental number line*, which can assist learners in doing mental computations. However, research has found that many learners are unsuccessful in using a number line effectively which could be attributed to their inexperience with number lines. It is important to introduce number lines to learners early in their mathematical learning. A transition can be made from a bead string to a counting line and then onto a number line.

Counting lines or number tracks

The first way that children encounter “number lines” is as a line or row of numbers or labelled objects for counting. This is known as a “counting line” and is an excellent to support learning to count and learning to add and subtract small numbers.

In the diagram below there is an example of a counting line laid alongside a bead string. The counting line is made of numbered unifix blocks. The first block is labelled with 1 which indicates that we are counting the objects.



A transition can be made from physical objects to a more abstract one, which can be called a numeral (number) track. i.e. a printed set of objects that can be counted.



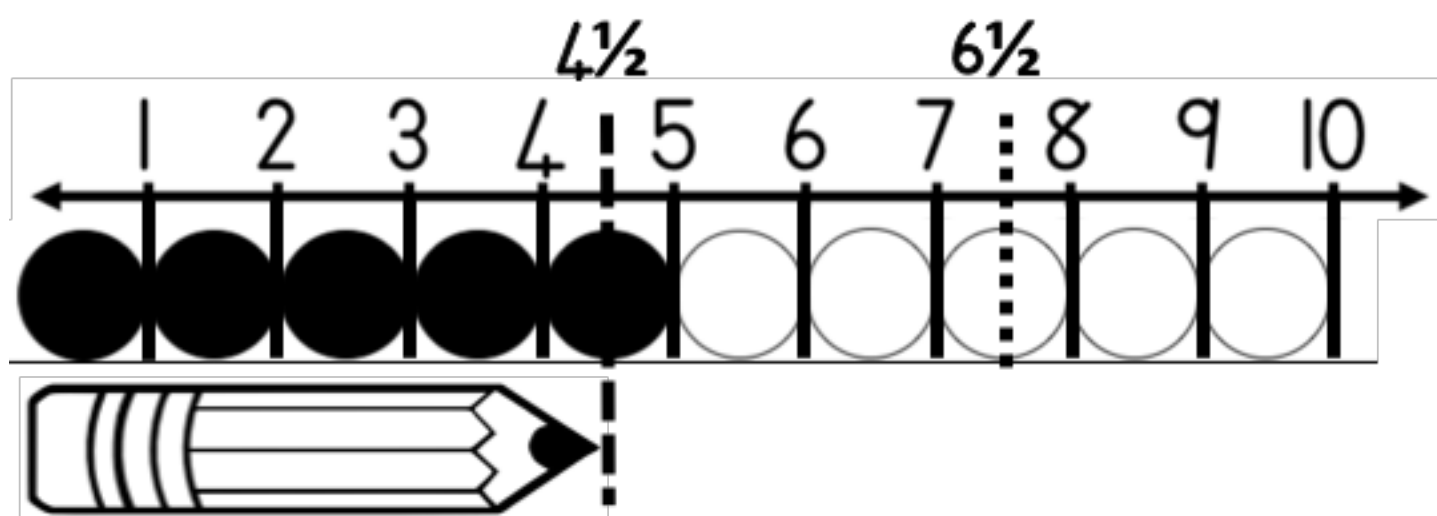
From counting lines to structured number lines

The counting lines above are very useful, but they are NOT number lines. Making a careful transition from bead strings or counting lines to number lines is important, because it can be the source of many learner errors when using number lines.

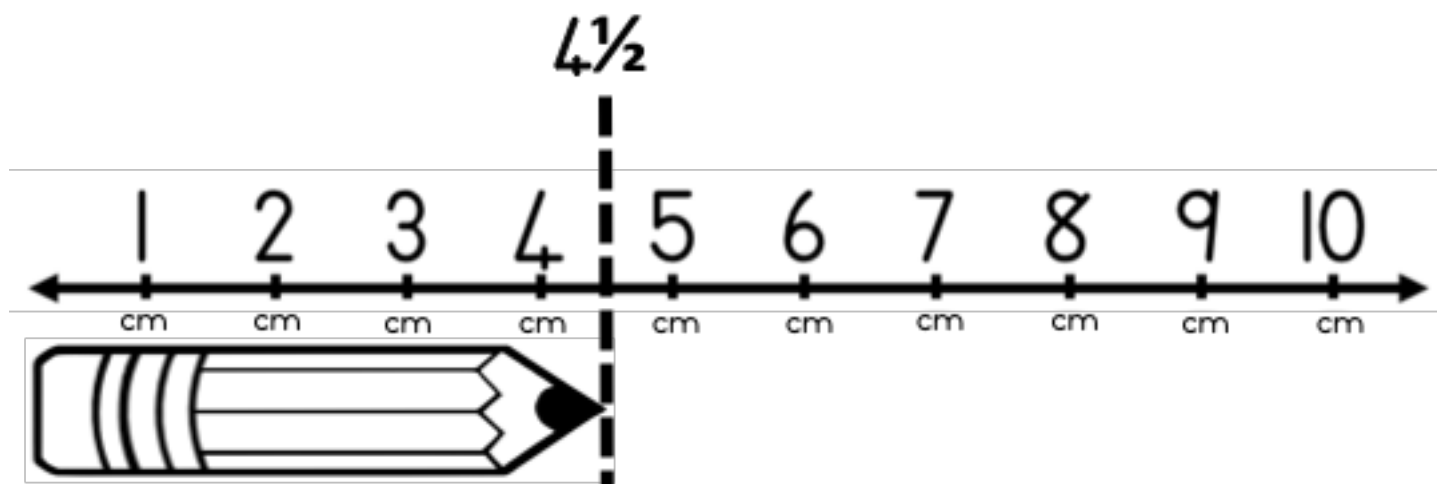
Number lines go beyond counting individual objects *counting*, to **measuring** from a fixed point.

A common mistake made by young learners when using the number line is to count on or back from a number is to count the **markers** rather than the **intervals** between the markers. So for example, 4 add on 3. Learners say 3 because they are counting 4; 5; 6 i.e. three markers.

So it is important to help the learners to understand this difference using the activities suggested in the pages that follow. So for example, the numeral 1 on the number line below, shows where bead one finishes. And we can find fractions and other rational numbers on the number line that we cannot when counting individual items.



The number line above shows the length of the pencil is $4\frac{1}{2}$ (beads in this case). The number line can therefore be connected to measuring tapes and rulers later as can be seen in the number line below, where the pencil is $4\frac{1}{2}$ cm.



1

¹ Note:: Number line not to scale, for demonstration purposes only.

Cognitive control activities: finger discrimination

Jo Boaler talks about the benefits of *visual mathematics* as seeing for understanding:

“when students learn through visual approaches, mathematics changes for them, and they are given access to deep and new understandings”

Jo points out that the use of our fingers in the early years is one of the key ways that we build visual mathematical understanding as fingers can be regarded as the link between numbers and their symbolic representation.

- Our brain uses representations of fingers, well beyond the time and age that people use their fingers to count. We “see” a representation of fingers in our brains, even when we do not use fingers in a calculation
- Counting numbers on fingers in the early years is important for brain development and future mathematics success.
- It is important that schools help learners **discriminate** between their fingers through the use of finger-based activities.

The *finger discrimination* activities in this session encourage development of:

- **Inhibition:** in terms of learner ability to suppress an automatic response of using a dominant hand or finger
- **Shifting attention:** ability to shift attention flexibly to using different fingers and different paths (among many)

NOTES:

Reflection Activity



Get into groups of 3-5 teachers who are from a different school to you.
Reflect on your use of the following activities from the last session.

Thinking about numbers relationally and bead strings

1. Reflect on your experiences of the use of **bead strings in class**.
2. Did you make any adaptations to the activities? If so, show / explain to the members of your group.
3. What were the learner experiences of the activities?

NOTES:

This section provides details of the activities that are be presented in this workshop.
Every workshop will have a similar section so you know where to look in the handbook.

Resources

Cognitive control activities
Page: 8

Bead strings, numerals and words
Page: 9

Bead strings and ordinal numbers
Page: 10

Connecting bead strings and unifix blocks
Page: 11

**Connecting the number line to bead
strings and unifix blocks**
Page: 12

Cognitive control activities



Finger Maze 1

The finger maze² you receive today is the first in a set that focuses on finger discrimination and encourages finger use for your learners.

Mathematical object of learning:

Build finger differentiation, which is important for developing numerical and visual mathematical understanding

Skills:

- Inhibition and shifting attention
- Colour differentiation
- Descriptive vocabulary such as *up, down, left, right, curved, straight, around*

You need:

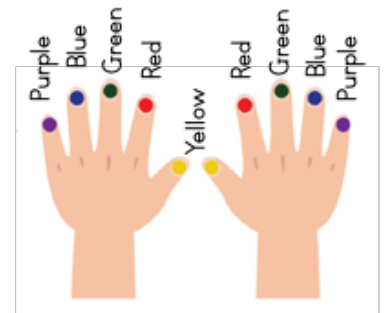
- Small coloured stickers for children's fingers in blue, green and red
- Finger Maze 1 (laminated)

For extension

- Crayons (red, blue and green)
- Scrap paper

Directions:

1. Use the laminated mazes to work in small groups on the mat.
2. Put a coloured dot on each child's fingernail as shown in the diagram.
3. Have the child match their red index finger to the red path in the maze and **slowly** trace the path to the end. Help the child focus on the path and not speed along.
4. Each path should be traced slowly and take several seconds.
5. Next trace the green path with the matching finger.
6. After a child uses their dominant hand to trace all of the paths in the maze ask them to use their other hand.



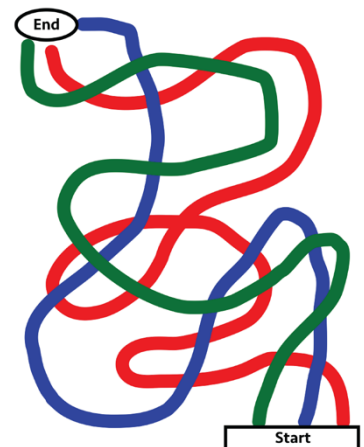
youcubed
at Stanford University

Finger Maze 1

Observe if learners struggle with any particular finger or hand. Let them practice more with the fingers and hands they struggle with.

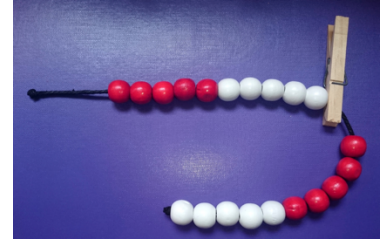
Extension ideas:

1. After children have used both hands and all fingers, get them to re-trace each coloured path. This time encourage them to try and describe how their finger moves along the path using words like *up, down, left, right, curved, straight, around* and so on.
2. Learners can also draw their own paths from a common start and end point in blue, green and red. Mark the common start and end points for them on their pieces of scrap paper. They can then trace their own paths and swop their paths with other learners.



² Youcubed finger mazes adapted from Gracia-Bafalluy, M., & Noël, M. P. (2008). Does finger training increase young children's numerical performance? *Cortex*, 44(4), 368-375.

Bead strings, numerals and words



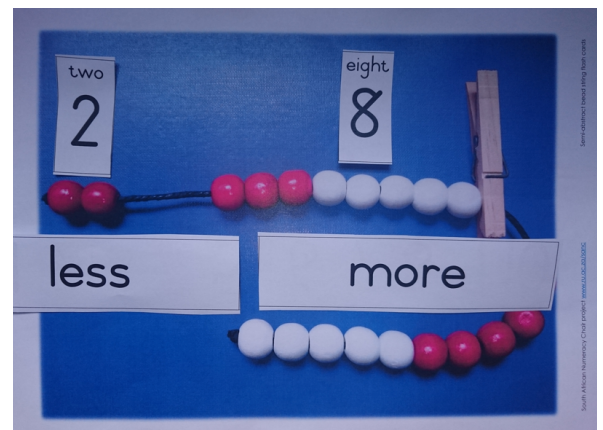
Using the colour bead string boards

As with all activities, these are best done a few times over many days.

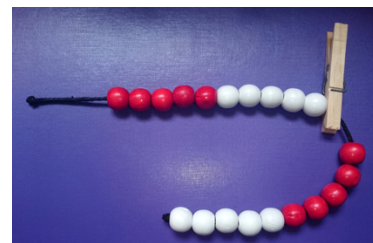
Mathematical object of learning: • Making combinations to 10 • Transition from physical bead string to semi-abstract representation • Recognition of number symbols and words • Recognition of 'more' and 'less' words	You need: SMALL NUMERAL AND NUMBER WORD CARDS TO STICK ONTO BEAD STRING CARDS – CUT OUT ALONG LINES <table><tr><td>zero</td><td>one</td><td>two</td><td>three</td><td>four</td><td>five</td><td>six</td><td>seven</td><td>eight</td><td>nine</td><td>ten</td></tr><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr></table> <table><tr><td>nul</td><td>een</td><td>twee</td><td>drie</td><td>vier</td><td>vyf</td><td>ses</td><td>sewe</td><td>agt</td><td>negie</td><td>tien</td></tr><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr></table> <table><tr><td>roks</td><td>nye</td><td>tet</td><td>tshelhi</td><td>ne</td><td>Nene</td><td>shandhu</td><td>shane</td><td>shane</td><td>shane</td><td>shane</td></tr><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr></table> SMALL WORD CARDS TO STICK ONTO BEAD STRING CARDS – CUT OUT ALONG LINES <table><tr><td>less</td><td>more</td></tr><tr><td>minder</td><td>meer</td></tr><tr><td>zimbalwa</td><td>ongeza</td></tr></table>  • Small numeral and number word cards. Cut these out first. • Small more/less cards. Cut these out first • Colour bead string cards • Peg and bead string for yourself • Prestick	zero	one	two	three	four	five	six	seven	eight	nine	ten	0	1	2	3	4	5	6	7	8	9	10	nul	een	twee	drie	vier	vyf	ses	sewe	agt	negie	tien	0	1	2	3	4	5	6	7	8	9	10	roks	nye	tet	tshelhi	ne	Nene	shandhu	shane	shane	shane	shane	0	1	2	3	4	5	6	7	8	9	10	less	more	minder	meer	zimbalwa	ongeza	Work with: We suggest working with smaller groups on the mat
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Preparation: Select 5 bead string boards and use Prestick to attach them to the wall or board. Have the number cards and more/less cards accessible for the learners to use.

- With the red beads on the left, use your *physical bead string* to mark off 10 with a peg. Then make a combination to 10 such as 2 and 8 to match one of the boards.
- Show the learners your bead string
- Ask a learner to find the matching bead string board from those displayed.
- Then ask a learner to find the matching numerals. Attach these to the card.
- Then ask a learner to attach the less/more cards accordingly.
- An example is shown using 2 and 8
- Ask the group if they agree.
- Ask selected learners to explain why.
- Repeat with a different combination to 10: i.e. 1 & 9; 2 & 8; 3 & 7; 4 & 6 or 5 & 5...



Bead strings and ordinal numbers



Activities 1, 2 and 3 should be done a few times over many days. They can also be followed up with some whole class or small group flashcard work (bead flashcards 1-10) in which learners say out loud or show on fingers or on their unifix blocks how many on each card.

Activity 1: Bead strings

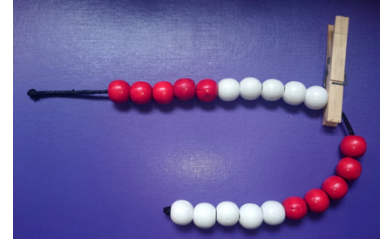
Mathematical object of learning:	You need:	Work with:
Working with ordinal numbers on the bead string	Teacher and learner bead strings	We suggest working with smaller groups on the mat

We suggest that this activity is best done in smaller groups as 'mat work' where learners show you the following on their own bead strings. For those learners who have begun using the structure of 5 and 10 in answering these questions shift to the 10 to 20 range – i.e. show me 15; 20; 14; 16; 19 etc.

- How many red beads are there here? *[show the first red group of 5]*
 - How many white beads are there? *[show the first white group of 5]*
 - Hold your bead string with the red beads starting in your left hand.
- Using a pattern of prompts, first ask the group a question, followed by asking individual learners "how they know" type questions. We suggest working from left to right on the string. Possible prompts are shown below.

- T to group: Show me the 2nd bead - T to a learner: How do you know that's the 2nd bead?	- T to group: Show me the 5th bead - T to a learner: How do you know that's the 5th bead? - T to group: any other ways you know that is the 5th?
- T to group: Show me the 3rd bead - T to a learner: How do you know that's the 3rd bead?	- T to group: Show me the 6th bead - T to a learner: How do you know that's the 6th bead? - T to group: any other ways you know that is the 6th?
- T to group: Show me the 4th bead - T to a learner: How do you know that's the 4th bead? - T to group: any other ways you know that is the 4th?	- T to group: Show me the 7th bead - T to a learner: How do you know that's the 7th bead? - T to group: any other ways you know?
- T to group: Show me the 10th bead - T to a learner: How do you know that's the 10th bead? - T to group: any other ways you know? (can relate 5 & 5 fingers on our hands being 10 fingers)	- T to group: Show me the 9th bead - T to a learner: How do you know that's the 9th bead? - T to group: any other ways you know?
- T to group: Show me the 8th bead - T to a learner: How do you know that's the 8th bead? - T to group: any other ways you know?	T to group: Show me the 11th bead - T to a learner: How do you know that's the 11th bead? T to group: any other ways you know?

Connecting bead strings and unifix blocks



Activity 2: Unifix blocks

Mathematical object of learning: Connecting bead strings with unifix blocks as another linear representation	You need: Unifix blocks in 2 colours e.g. white and red	Work with: We suggest working with smaller groups on the mat
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Use the same questioning sequence from the previous page with a row of connected unifix blocks such as 5 red, 5 white, 5 red, 5 white.

Activity 3: Relating the above activities to our hands

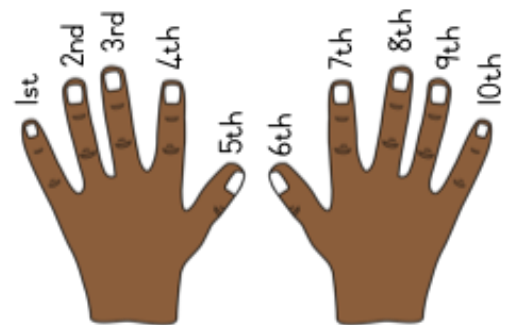
Mathematical object of learning: - Working with ordinal numbers - Asking learners to explain their thinking with "how do you know" questions	You need: Ordinal number chart (laminated)	Work with: We suggest working with smaller groups on the mat
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Put up the ordinal number finger wall chart. Learners can place both hands in front of them as shown on the chart.

Get children to read the order of the fingers from left to right as the 1st finger; 2nd finger; 3rd finger; 4th finger etc. up to the 10th finger.

For learners that really struggle: To start with, they can use coloured stickers with the numbers 1 to 10 on them. Try to progress them from relying on the numbers after a time.

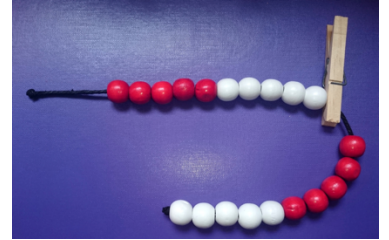
Use the same questioning sequence from the previous page but end at 10 (if you want to go onto 11, 15 etc. they could include their toes)



Example adapted questioning sequence

- T to group:* Wiggle your 2nd finger
T to a learner: How do you know that's your 2nd finger?
- T to group:* Wiggle your 5th finger (yes it's a thumb but a thumb is also a finger)
T to a learner: How do you know that's your 5th finger?
- T to group:* any other ways you know that's the 5th finger? (e.g. answer because there are 5 fingers on each hand and this is the last finger on my left hand)
- And so on

Connecting bead strings and unifix blocks continued



“How do you know” questions

The question “*how do you know*” focuses on the learners’ development of mathematical language (in ordinal terms) and reasoning language. Learners must describe why they think that it is for example the 6th bead/unifix block or finger.

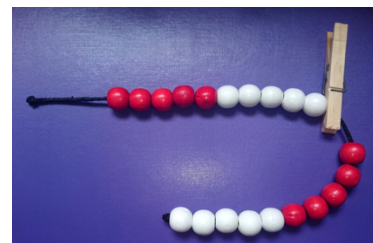
While many learners might just point to their blocks by counting in ones and say: ‘*because look one, two, three, four, five, six*’, other learners might begin to see the structure of 6 as $5 + 1$ and reason in various ways. For example: ‘*because 6 is 5 red and 1 white*’ or ‘*because the 6th is the one after the 5th and I know the last red one is the 5th*’

Of course learners don’t always explain their thinking this clearly but you can revoice their contributions and thus share this ‘noticing’ with others to show how noticing and using the structure it is quicker than counting by ones.

If no learner comes up with a ‘*non-counting by ones*’ way of finding the 6th; 7th; 4th; 10th etc. then you can prompt them by encouraging them to find quicker ways to know without counting and emphasizing which beads are the 5th and 10th.

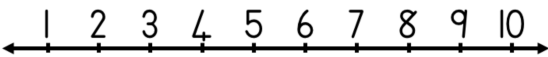
NOTES:

Connecting the number line to bead strings and unifix blocks

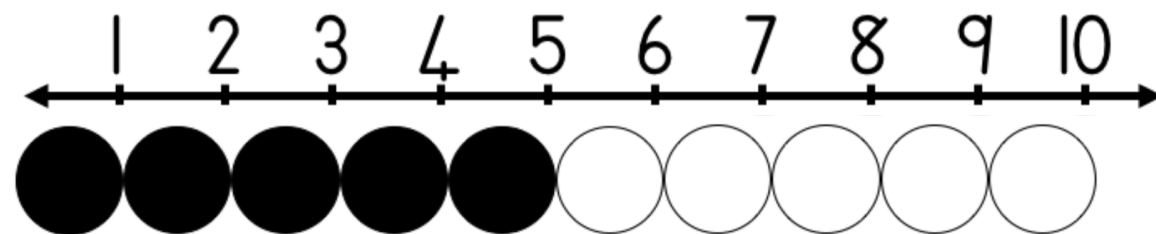


As with earlier activities, it is useful to ask learners questions about numbers out of sequence, so that they don't fall into the habit of knowing what the pattern is. So mix it up each time you do it.

The activity sequence below can also be done with unifix blocks and the number line

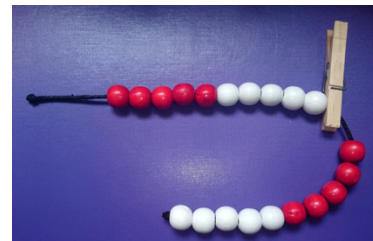
Mathematical object of learning: - Working with other linear representations - Making connections between bead strings (counting objects) and number lines (counting intervals)	You need: - Laminated number line board  - Laminated bead string board  - Two pieces of paper, long enough to cover 4 numbers on the line - Physical bead strings for yourself and learners if you want them - Unifix blocks - Prestick
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- Place the 2 boards on the floor in front of each learner.
- Lining up number lines with where each bead finishes stresses the idea of counting intervals rather than objects. That intervals have values in between can be related to learner ages. So at 6 months they were between 0 and 1-year-old.**
- Learners line up their two boards as shown in the example.

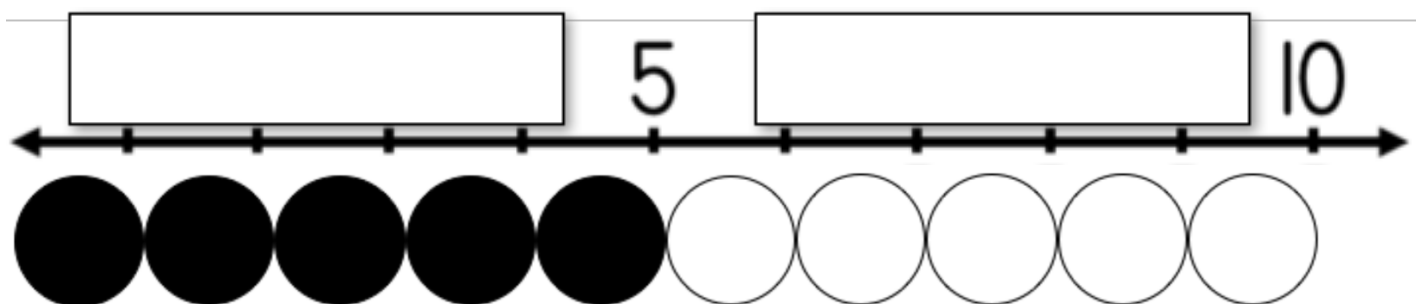


- Get learners to read each numeral on the number line as they *touch* each bead on the board.
- Now ask learners to show you these numbers on the number line:
2; 5; 3; 1; 6; 8; 10; 9
- Count the 5 black beads on the board using the number line.
Demonstrate touching each bead from 1 to 5, then emphasise *all five together* saying "there are five red ones".
Then count on the 5 white beads starting at 5, touching each bead and saying "six, seven ... ten".
You can then say "there are 5 red beads and 5 white beads".
"How many altogether?"
- Now get learners to touch each bead on the board but this time saying their order i.e.: 1st; second; third; fourth ... tenth.

Connecting the number line to bead strings and unifix blocks continued



- Now ask learners to show you these beads on the bead string board or on a physical bead string:
2nd; 5th; 3rd; 1st; 6th; 8th; 10th; 9th
Ask: "how do you know that?"
- You can also line up ten learners.
The first five with jerseys (or shoes, hats) off and the next five with jerseys (or shoes, hats) on.
Again, ask the learners to say where is 1st, 5th, 10th etc.
- Next cover the numbers from 1 to 4 and from 6 to 9 on each of the learners' number line boards with a piece of paper and Prestick as shown:



- Now ask the learners to show you where the following numbers are on the number line:
1; 5; 10; 2; 4; 3; 6; 8; 10; 7; 9
As each child shows you, ask "how did you know that?"
- Now ask them to point to the following beads (from left to right):
1st; 5th; 10th; 2nd; 4th; 3rd; 6th; 8th; 10th; 7th; 9th

NOTES:

Teacher's class assessment checklist 1 – counting, 2, 3-ness and many

[illegible]

Teacher's class assessment checklist 2 – fingers, dot patterns, numerals and 5-frames

[illegible]

Teacher's class assessment checklist 3 - Patterns

[illegible]