SA NUMERACY CHAIR PROJECT

Early Number Fun
Grade R Teacher Development Programme

Session One Teacher Handbook

Name

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School

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www.ru.ac.za/sanc
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Summary of the key ideas behind the Early Number Fun Programme

- The programme is a partnership of teachers, teacher educators, researchers and specialists
- We plan to build an inquiry community that together finds ways to strengthen Grade R learning, particularly numeracy learning
- All ENF community members brings expertise which in active discussion will enable strengthening Grade R teaching and learning
- Networking between members is supported through platforms such as Facebook, WhatsApp, an SMS group and the SANC project website
- We share the learning of our community with others in various forums

The programme:

  - emphasises learning through play and use of language (and mother tongue) as a resource and learners actively construct knowledge through these social activities
  - emphasises use of research informed key representations for learning about number - supported by a resource kit
  - emphasises use of stories (interactive reading and story telling) for strengthening literacy and number sense reading
  - emphasises a growth mindset and development of productive learning dispositions
  - Is an integrated programme and is curriculum aligned
  - focuses on developing number sense which includes pattern, spatial, measurement and data handling activities
  - strengthens cognitive control with focused research informed activities including physical movement activities as part of the resource kit

- The programme acknowledges that:
  - Development is progressive. We build new knowledge on what learners already know and bring to the classroom. Activities are selected to be at the 'cutting edge' of learners development.
  - Assessment of each learner is key to monitoring and supporting progress. Assessment activities are included in programme
  - Parents are a key resource – we will find ways to support this resource through the programme.

Early Number Fun Programme: key ideas elaborated

Broad assumptions

Working with both Vygotskian theory and socio constructivism the programme is based on the following assumptions:

- Language is key to development and learning.
- Learners will learn number sense through actively constructing number knowledge through engaging with activities in social settings.
- Learning takes place in the Zone of proximal development (ZPD) defined as:

The distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers. (Vygotsky, 1978, p. 86)

This means that activities should be targeted to an appropriate level of learner development such that activities are neither too difficult nor too easy for the learners and activities should involve active engagement and encourage dialogue with learners. According to Wright, Martland, Stafford and Stanger (2006) activities should be at the 'cutting edge' of learner development. In this way learning stimulates development.

Integrated curriculum

The integrated nature of teaching in pre-primary classrooms means that learning about number takes place alongside other learning in everyday contexts, with connections to the children's lives in meaningful ways and builds on a child's natural curiosity. Treffers (in van den Heuvel-Panhuizen, 2008) talks of watching out for "golden moments" of opportunity" (p. 42) for teaching mathematics throughout the day.

While the focus of this programme is on supporting learners to work confidently and competently with numbers this focus is connected to activities that support language and literacy development. The inclusion of 'number' story books and story-boards emphasise integration across the curriculum.

Number sense

Dehaene (1997) defines "number sense" as our ability to quickly understand, approximate, and manipulate numerical quantities. According to Anghilieri (2006) a child with number sense has the ability to work flexibly with numbers, observe patterns and relationships and make connections to what they already know, to make generalisations about patterns and processes. Number sense also includes a positive attitude and confidence (Anghileri, 2006)

The goal is to begin the development of pre-primary learner's number sense – developing a feeling for numbers and to enjoy working with them, the ability to give meaning to numbers and numerical facts in everyday life and to deal with them appropriately (van den Heuvel-Panhuizen, 2008 p. 21).

In the context of early number sense in pre school learners the development of number sense primarily includes the ability to count both verbal number sequence (forwards and backwards) and sets of objects (up to ten), recognise numerals 1-10, and developing the capability to operate (adding and taking away) on small numbers (orally and through modelling). In this context we include work with patterns as well as spatial, measurement and data handling activities

Story (narrative) approaches to working with number

Number stories get learners to actively engage with and imagine ways of working flexibly with numbers and are a key part of the resource kit. Using stories is a widely promoted teaching strategy for language and literacy development across contexts. This programme emphasises a narrative (story) approach for developing number sense. Both these forms of reading are shown to improve learner cognitive control discussed below. The resource therefore includes:

- 'Number' stories, which encourage learners to do imitative reading and provide resources for acting out and telling the stories (such as acting out with bundles of sticks or showing the story unfolding on a story board with moveable characters e.g. 5 people, 5 cows).
- Dialogic reading is a method of reading to children, which allows them numerous opportunities to engage in conversation with the reader (Blair & Raver, 2014). Our story books will also allow for opportunities for paired imitative reading (Bodrova & Leong, 2016).

Learner cognitive control

Neurocognitive research shows that learners' cognitive control (also referred to as executive functioning (EF)) is more strongly associated with school readiness and has greater influence on learners' school performance than their IQ score (e.g. Diamond et. al, 2007), especially in mathematics (Roebers et al. 2012). Learners in poorer communities need early support to develop such cognitive control because many of these learners have had fewer opportunities for the development of such control. The ages 4-6 yrs have been identified as particularly important for focused support of cognitive control as this is the period when marked improvements tend to occur (Rothlisberger et al., 2011).

Learner executive functioning (or cognitive control) is also used to assess school readiness. This involves 3 main components of:

- **Working memory**: ability to maintain and manipulate information over a brief period of time
- **Inhibition** (interference control): ability to suppress a dominant or automatic response
- **Shifting attention** (flexibility): ability to shift attention from one aspect or mental state to another (so for example from sorting shapes according to colour to sorting according to shape or size – this also involves inhibition as one must suppress earlier mental state to work flexibly with a different state (Garon et al., 2008; Diamond et al., 2007)

In our programme we will use a series of short sharp focused activities (mainly games) to help learners develop each of these. These have been shown by researchers to support EF and cognitive control if used regularly.

Learner progression

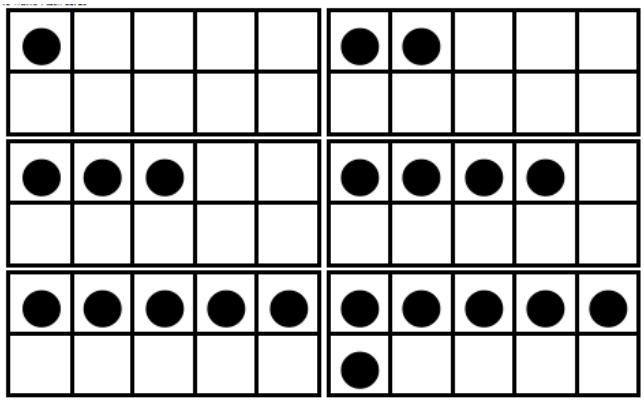
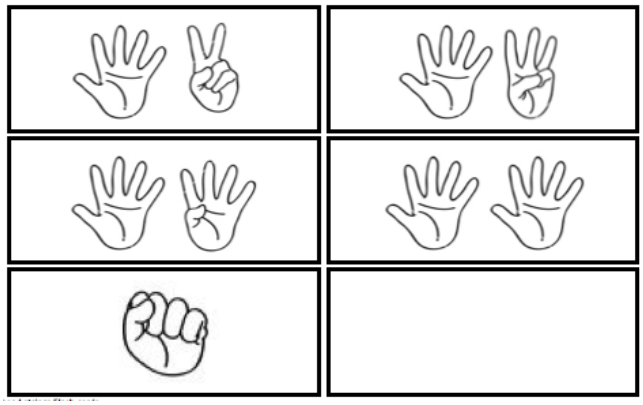
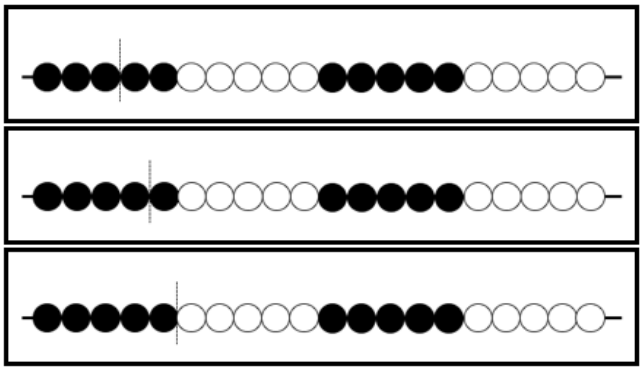
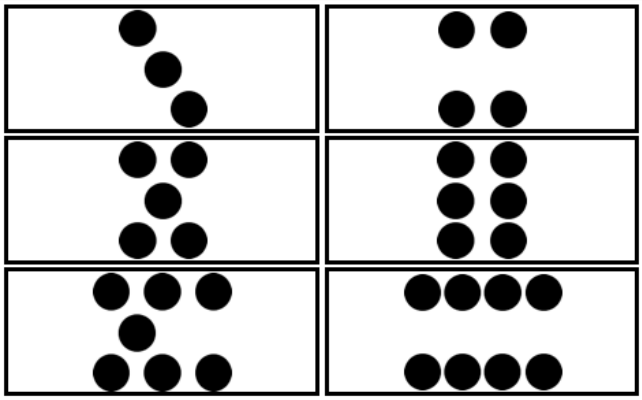
This programme draws on a wide range of numeracy research particularly the work of both Buys and Treffers (in van den Heuvel-Panhuizen, 2008) on learning-teaching trajectories related to whole number and the elements of number sense. Everyday life, and the world that the child lives in, provide meaningful contexts for learning. *Emergent numeracy* is the starting point with the anticipation that this will form the foundation knowledge for *growing number sense*.

Emergent Numeracy (p. 25)	Growing Number Sense (p. 31)
Recognising "two-ness", "three-ness" and "many-ness" as a property of a group of objects	Recognising different functions of number in everyday life and learn to distinguish and connect them. Magnitude, order, measure, label and calculate
Learning to recall the number sequence	Counting: Know the counting sequence at least up to 10 (**magnitude** and **label**)
Imitating resultative counting	Arrange numbers in the correct order, make reasonable estimates and compare quantities as being more, less or equal (**magnitude** and **order**)
Symbolising by using fingers	Represent physical numbers up to 10 on their fingers and with lines and dots Elementary calculation: Select a suitable strategy for simple addition and subtraction situations for up to 10 objects using these skills (**calculate**)

<table>
<tr><th></th><th></th><th>Grade R</th><th>Gr R → 1</th><th>Gr 1 & 2</th><th>Gr 3 & 4</th><th>Gr 4 →</th></tr>
<tr><td>Cranfield et al.</td><td></td><td>Emergent numeracy
Number sequences to 10</td><td>Learning to count and calculate
+ & - to 10/ number sequences to 20</td><td>Calculate by structuring
+ & - to 20/ number sequences to 20</td><td>Formal calculating</td><td>Counting and calculating up to 100
+ & - to 100/ number sequences to 100</td></tr>
<tr><td rowspan="3">Wright et al. (LFIN)</td><td>EAS</td><td>0, 1, 2</td><td>3, 4</td><td>5</td><td></td><td></td></tr>
<tr><td>Structuring nos. 1 - 20</td><td colspan="2">1, 2, 3</td><td></td><td></td><td></td></tr>
<tr><td>CPV</td><td></td><td></td><td></td><td>3</td><td>3</td></tr>
<tr><td>Buys & Treffers</td><td></td><td>Stages 1 to 4
Context bound – up to 4 objects
Object bound – up to 10 objects
Via symbolisation – unseen items/fingers</td><td>Stages 5 & 6
Count all
Count on
Count up to
Count down</td><td colspan="2">Stages 7 & 8
Stringing & splitting
Doubles/halves
Combining with 5 & 10
Partitions of 5 & 10</td><td>Stages 9 & 10
2-digit + and -</td></tr>
<tr><td>Buuys, Treffers Visual progression</td><td></td><td colspan="4">1 Learning to count; 2 Context bound; 3 Object bound; 4 Pure calculating; 5 Calculation by counting; 6 - 7 Counting by structuring; 8 Formal calculating; 9 Count to 100; 10 Calculate to 100</td></tr>
<tr><td>Representations</td><td></td><td colspan="2">Tallies, finger patterns, dot patterns</td><td colspan="2">Models of...
Line, group, combination, part-part-whole</td><td></td></tr>
</table>

Key representations

The programme focuses on key representations from the broader research literature (particularly prevalent in the work of Buys and Treffers and in Wright et al.'s work), such as fingers, dot patterns, linear model (bead string), 10-frame, concrete items (counters, blocks etc.)

5 and 10-frames	Finger patters
	
Bead strings	Dot patterns
	

Growth mindsets

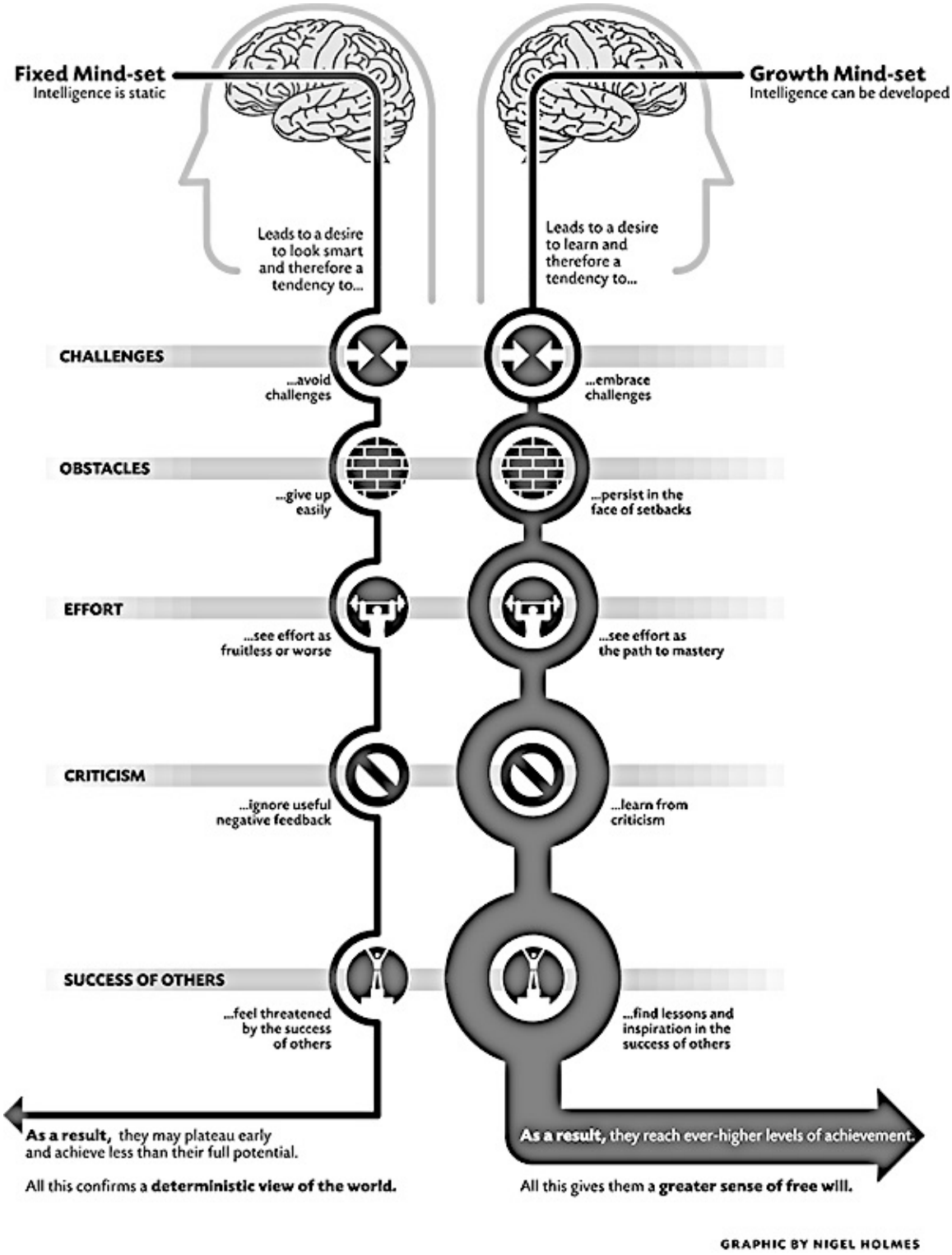
A mindset is a belief about yourself and your most fundamental qualities like ability, faith, personality, political views, talents etc. People with *fixed mindsets* believe that fundamental qualities like intelligence are stable: they don't change much over time. People with *growth mindsets* believe that these qualities are growable: they can change and flourish or wither depending on how one engages with learning opportunities (Hymer & Gershon, 2014).

A fixed mindset makes you concerned with how you'll be judged; the growth mindset makes you concerned with improving (Dweck, 2006 p.13). Kilpatrick et al. (2001) use the term productive disposition to describe a particular attitude towards learning mathematics:

> "Productive disposition refers to the tendency to see sense in mathematics, to perceive it as both useful and worthwhile, to believe that steady effort in learning mathematics pays off, and to see oneself as an effective learner and doer of mathematics" (p. 131).

Amazing new research shows that when learners make a mistake in maths, and grapple with how to solve it/ fix it, their brain grows, synapses fire, and connections are made; when they do the work correctly, there is brain activity but less growth. This finding suggests that seeing mistakes as useful opportunities for learning is important.

Our focus is on combing these ideas to help us to develop growth mindsets and productive dispositions in our learners by encouraging effort, perseverance, persistence, sending messages about process and growth and that making mistakes are opportunities to learn. 'Mistakes are our friend because we learn from them!'


Fixed Mind-set
Intelligence is static
Growth Mind-set
Intelligence can be developed
Leads to a desire to look smart and therefore a tendency to...
Leads to a desire to learn and therefore a tendency to...
CHALLENGES
...avoid challenges
...embrace challenges
OBSTACLES
...give up easily
...persist in the face of setbacks
EFFORT
...see effort as fruitless or worse
...see effort as the path to mastery
CRITICISM
...ignore useful negative feedback
...learn from criticism
SUCCESS OF OTHERS
...feel threatened by the success of others
...find lessons and inspiration in the success of others
As a result, they may plateau early and achieve less than their full potential.
All this confirms a deterministic view of the world.
As a result, they reach ever-higher levels of achievement.
All this gives them a greater sense of free will.
GRAPHIC BY NIGEL HOLMES

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

Mathematical 'Mascot says please…'

Played in the same way as "Simon says…" but with a mathematical basis. 'Simon says' is a traditional game where you give out statements such as 'sit down'. To do as the statement suggests, Simon must say it. If Simon doesn't say the statement and you move you are out. For example - 'Simon says sit down' – everyone has to sit or they are out. 'Stand up' – Simon didn't say it, so anyone who does stand up is out.

You can change the way it works for your classroom and the names. If you have a soft toy or a club mascot, give that toy a name (ask the kids for suggestions and vote on a name perhaps). Use that name to play the game. For the instructions below I will replace with a generic 'mascot'.

Once children are familiar with how the game works, you can give them the chance to be the leader. So it will become "Siya says please…"

Rules:

Learner will do what the mascot says if they hear the word "**please**" in the instruction "do this" otherwise they must ignore the instruction and stay still.

Mascot says "please do this" (show action) - learners must do what mascot says

Mascot says "do this" (show action) - learners must not ignore what it says and stay still

This game can be changed to a slightly more difficult version:

Mascot says "do this" (show action) - learners must do what mascot says

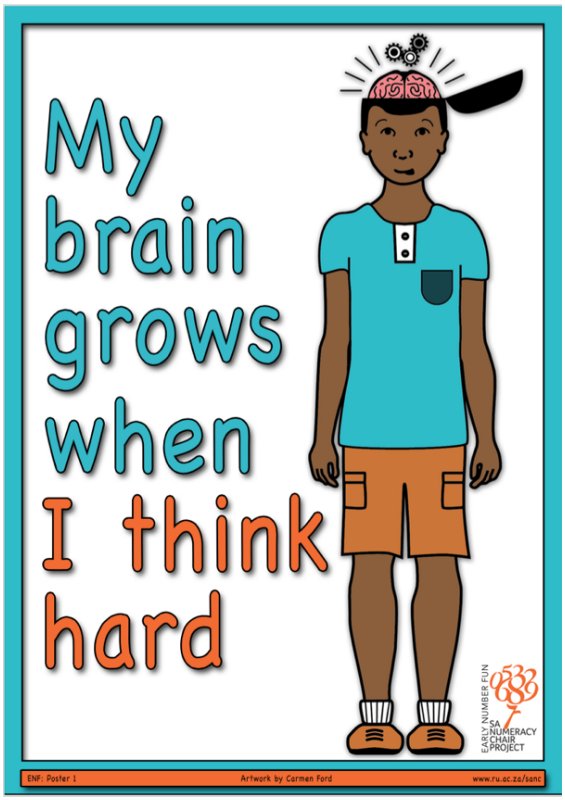
Mascot says "do that" (show action)- learners must not ignore what it says and stay still

Example things to do, remembering to change between saying 'please' and not.

Stand on one leg	Show me 3 fingers
Put your right hand behind your back	Touch your toes
Reach for the sky	Touch your nose
Show me two hands	Show me 4 fingers over your head with one hand
Show me one / two hand(s) in a fist	Give yourself a hug
Bend and touch your knees	Use one finger to touch your nose

My brain grows when I think hard

In this session, you will receive this poster to display in your classroom.



Learner discussion

As you put it up, you could have a discussion with the learners about this.

- It is helpful for learners to revisit a mistake and grapple with it because the brain grows from the **experience of struggle**. When learners struggle with mathematics, their brains grow. Being outside their comfort zone is important and learners must learn to resilience in the face of unfamiliar challenges.
- Mistakes are our friend because we learn from them!
- The harder you work at something, the deeper you think about it the better you will be at it.
- Discussing our thinking strategies with others helps us to reflect on and improve our thinking.

Game-based activities

Wolfie Wolfie Whats the Time? - Game Instructions

Location: Play outside, in a hall	**Resources required**: Mask for wolfie (or lion, tiger, leopard) Masks for learners (optional – could be zebra masks or any other) Plastic clock (optional)	Development of imaginative play, counting with physical actions (steps), understanding that numbers also represent time.

Initially, the teacher is Wolfie[1] (or the lion, leopard, crocodile or other scary predator).

Wolfie stands a distance away from the learners, facing away from them.

All learners except for Wolfie chant in unison

"Wolfie Wolfie What's the time, ? and Wolfie will answer in one of the two ways:

1) Wolfie may call a clock time (e.g., "3 o'clock"). The other players will then take that many steps forward towards wolfie counting as they go ("One, two, three").
   The question is asked again.
2) 2) Wolfie may call "Lunch Time". Then Wolfie will turn around and chase the other players back to their starting point. If Wolfie successfully touches a player, that player becomes the new Wolfie for the next round.

How to make the masks

1. Draw any scary predators face on a paper plate as shown in the pictures below.
2. Cut holes for the eyes
3. Punch holes on either side of the plate near the eyes
4. Thread the elastic through the punched holes and tie knots
5. Place mask over face.

[1] If you wish, you can change the name of the game from Wolfie to Lion to match your context and masks

Learner assessment activities

Preparation

- Photocopy the assessment sheets for yourself. You have master copies in your folders.
- Assemble the resources needed for the assessment onto a tray or into a box:
    - Pegs
    - Three paper plates
    - Two large dice
    - 5-frame flash cards
    - Numeral flash cards
    - Clipboard
    - Pen or pencil

Administering the assessments

- Find a spot in the classroom where you can work with one or two learners on the mat or at a desk.
- Bring your tray of assessment resources to that spot
- Place assessment schedule on clipboard and write learner names onto it.
- Bring learners to the spot where you will be asking them the questions.
- Fill in the assessment schedule according to learner responses.

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

Assessment resource		Pegs		Pegs on a paper plate			
Learner Name	Verbal counting to 10	Count objects to…		Recognise 2-ness	Recognise 3-ness	Recognise many	Comments
		5	10				

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

Assessment resources	Learner's fingers					Big dice with dots			Numeral flashcards				Show 5-frame flash cards from 1 to 6				Comments
Learner Name	Show me fingers					Recognise dot patterns			Recognise numerals				Recognise 5-frame numbers				
	2	3	5	6	10	4	5	6	2	3	5	8	4	5	Most	least	

Teacher's class assessment checklist 3 - Patterns

Assessment resources	Make pattern with 2 coloured pegs on paper plate e.g. Green and Red		Comments
Learner Name	Pattern 1 variable (GR/GR)	Pattern 2 variables (GRRR/GRRR)	

Key references informing the programme

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