

# Assessing learner levels of numeracy proficiency to enable remediation of foundational knowledge

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# Introduction

- 🌐 In SA, our schools, teachers and learners are judged on their performance in the Annual National Assessments.
- 🌐 Yet, the ANAs do not provide sufficient **DIAGNOSTIC** information for our teachers, rather just that their learners are not at the grade level they should be.
- 🌐 Problematic that there is no way to do this
- 🌐 Through this presentation, we present one way that we have used with in our SANC Project research and development work

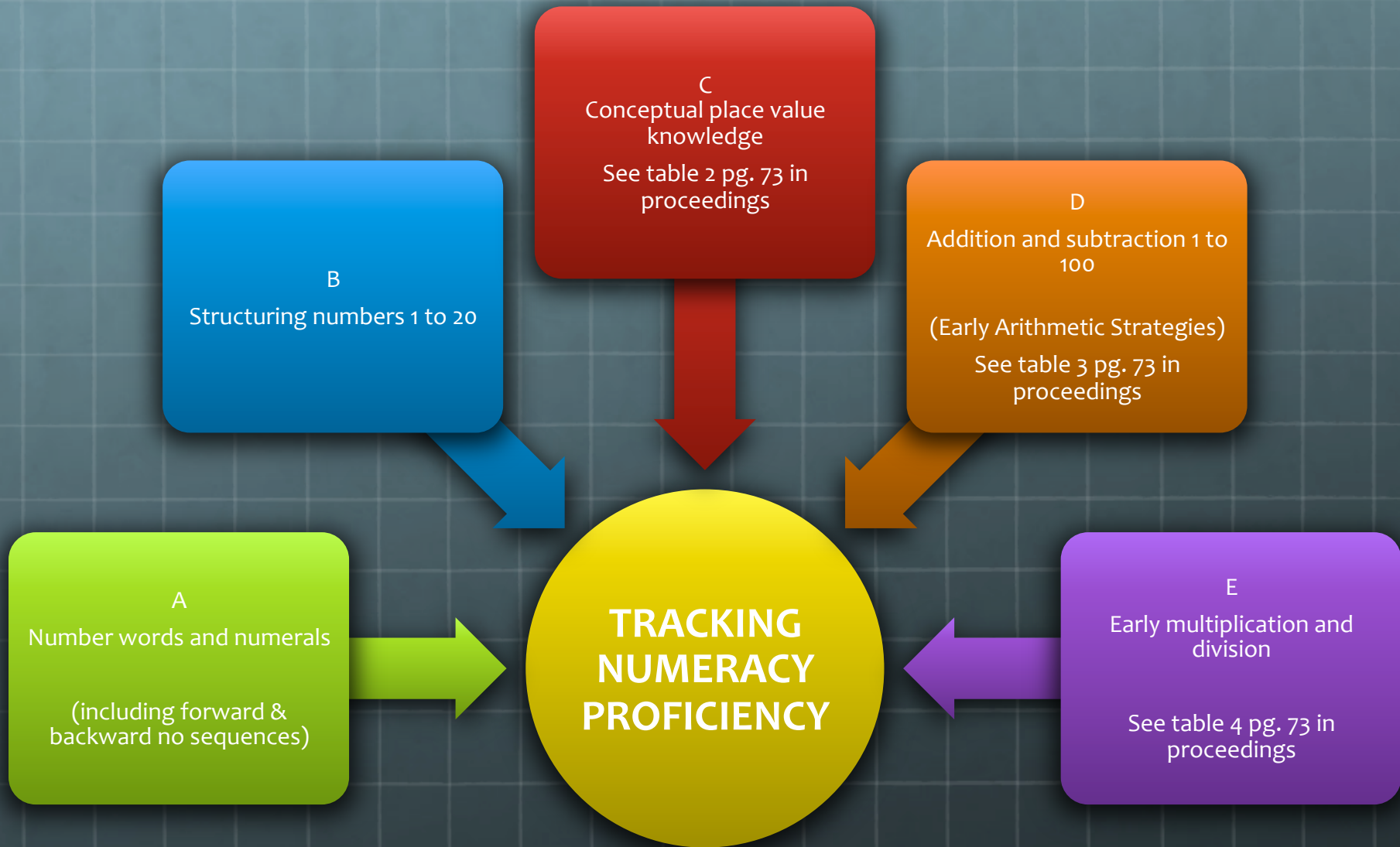
# Maths recovery programme

## KEY ASPECTS:

- 🌐 Interview-based assessment schedules
- 🌐 Learning framework
- 🌐 Instructional framework
- 🌐 Instructional procedures and sequences

## COVERS BASIC WHOLE NUMBER ARITHMETIC:

- 🌐 Numbers in 100s and 1000s
- 🌐 Multi-digit addition and subtraction
- 🌐 Early multiplication and division



*Learning Framework in Number (Wright, Martland, Stafford & Stanger, 2006)*

# Learning Framework in Number (LFIN)

- 🌐 Each of the key aspects of the LFIN elaborated into a progression of up to six levels or stages.
- 🌐 Each aspect has a model describing the characteristics of the levels or stages
- 🌐 powerful tool for profiling an individual learner's mathematical proficiency across the range of the key aspects.
- 🌐 Also allows one to see if there is progression from one level (stage) to another, over time for individual learners

- 🌐 **4 research projects**
- 🌐 **Each drew on Wright et al.'s MR programme**
  - 🌐 **Specifically the LFIN as both an analytical and a developmental tool for informing teaching practice**
- 🌐 **Each author used one, some or all of the LFIN aspects as an analysis tool for their study**

# The projects



## Graven



How the analysis of two learner's interview responses and assessed levels of numeracy proficiency influenced their opportunity to learn and participate in subsequent club activities



## Stott



Used the LFIN as an analytic tool to track progress between March and November 2012 for 17 club learners in all five LFIN aspect



Her study contributed an extension of the LFIN:



Quantifiable score data in the form of scores



to analyse progression of the club cohort of learners & individual learners.



## Mofu



aimed to inform mathematics teaching in her own school and to find ways to support primary school teachers at large in developing the strategies to teach and remediate multiplication reasoning



## Ndongeni



focused on the relationship between '*conceptual understanding*' and '*productive dispositions*' (Kilpatrick et al., 2001) in the context of multiplication



All



Addition & subtraction to 100  
Conceptual place value

B  
Structuring numbers 1 to 20

C  
Conceptual place value knowledge

D  
Addition and subtraction 1 to 100  
(Early Arithmetic Strategies)

A  
Number words and numerals  
(including forward & backward no sequences)

TRACKING NUMERACY PROFICIENCY

E  
Early multiplication and division



Early Multiplication and Division



Early Multiplication and Division





# Empirical fields

- After school maths clubs

- All

- part of SANC project

- Ran a club in 2012/2013

- Conducted research in these clubs

- Using Wright et al.s' work to assess learners level of numeracy proficiency over time

# Theoretical frames

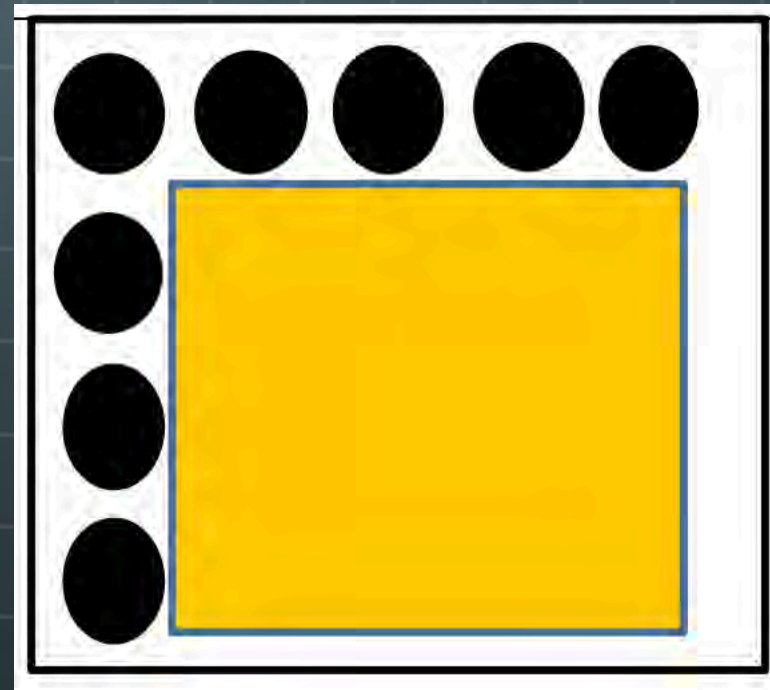
- 🌐 **Broad socio-cultural perspective**
  - 🌐 **Active learning through social interaction with others**
- 🌐 **MR programme based on sense-making and mathematical activity**

# Methodologies

- 🌐 Qualitative case studies
- 🌐 Primary data collection method for all projects:
  - 🌐 1-1 (individual) learner interviews
  - 🌐 Using standard items from Wright et al. interview schedules in their books
  - 🌐 Each focused on particular areas of interest
  - 🌐 Prior and post learning intervention

## Example multiplicative thinking interview question

- How many dots altogether?
- Explain how you got your answer



# Example conceptual place value interview question

## Counting with incrementing tens

[Use pink strip cards. Show strip (a) then add others for steps b to e. Ask] *How many dots are there altogether?*

Note Answer & How Answered








|  |   |   |   |   |   |   |   |   |
|--|---|---|---|---|---|---|---|---|
| (a) The 'four dot' strip               |   |   |   |   |   |   |   |   |
| (b) Add a 'ten dot' strip to the right |   | ● | ● | ● | ● | ● | ● | ● |
| (c) Add another 10 to make 24          |   | ● | ● | ● | ● | ● | ● | ● |
| (d) Add another 20 to make 44          |   | ● | ● | ● | ● | ● | ● | ● |
| (e) Add another 30 to make 74          | ● | ● | ● | ● | ● | ● | ● | ● |

# Some results

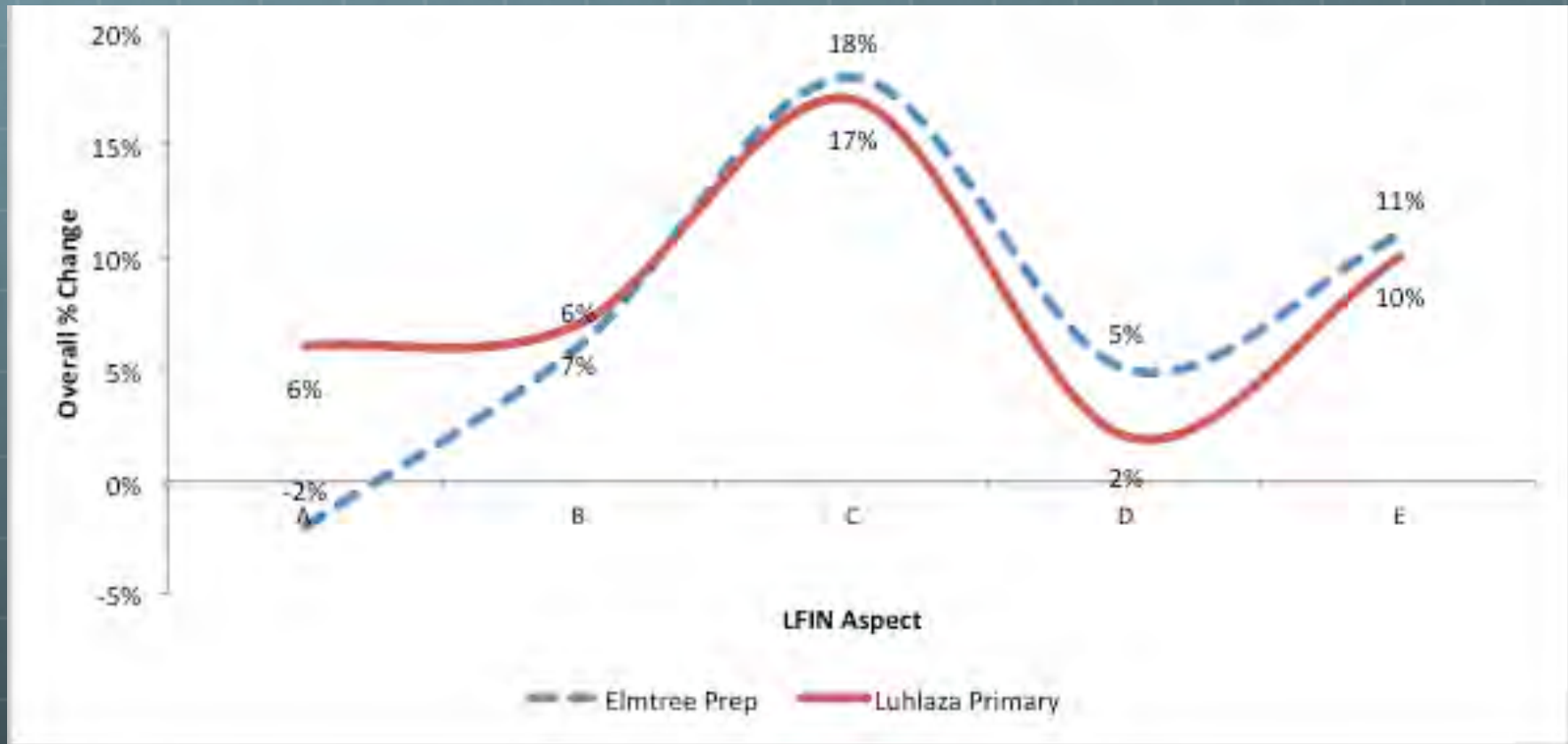
-  Will share some of the different results and findings from each project

# STOTT

## Overview:

-  All LFIN aspects
-  Multiple clubs (2 research clubs) over entire year (Feb to Nov)
-  17 learners
-  LFIN profiling for each learner
-  But additionally **Mathematical Proficiency scores**
  -  Quantifiable percentage scores for each learner and club
  -  Allowing comparisons

# STOTT




Percentage scores to draw comparisons between research clubs. These results show the similarities in improvements across the 2 clubs





# GRAVEN

## Overview




-  Early Arithmetic Strategies
-  Conceptual Place Value
-  One club over entire year (Feb to Nov)
-  2 case study learners

## Realisation ..



-  Learners profiled at different levels of proficiency according to the LFIN need differentiated activities in order to offer opportunities to learn even in small group situations
-  Ongoing research here with other researchers

# MOFU

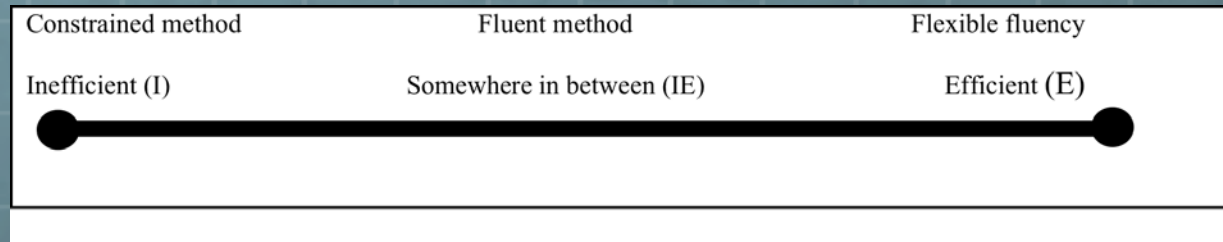
## Overview:

-  Early Multiplication and Division
-  Masters study of 6 purposively selected learners
-  After school intervention for 5 weeks aimed at supporting multiplicative reasoning

## Results

-  Progression over the short space of time for all learners
-  Elaborated an efficiency spectrum (Graven & Stott, 2013) for multiplicative thinking to help understand learner progress

# MOFU



Mofu quantified the qualitative data to track possible progress using the spectrum

Value show the number of tasks where the learners showed the usage of different methods.

Example, Learner A progressed from using mostly constrained methods in the pre interview (in 5 questions) to more flexible methods in the post interview (in 5 questions)

|                  | I<br>Constrained | IE<br>Fluent | E<br>Flexible fluency |
|------------------|------------------|--------------|-----------------------|
| <b>LEARNER A</b> |                  |              |                       |
| PRE              | 5                | 1            | 1                     |
| POST             | 2                | 0            | 5                     |
| <b>LEARNER B</b> |                  |              |                       |
| PRE              | 4                | 3            | 0                     |
| POST             | 2                | 0            | 5                     |
| <b>LEARNER C</b> |                  |              |                       |
| PRE              | 6                | 1            | 0                     |
| POST             | 2                | 2            | 3                     |
| <b>LEARNER D</b> |                  |              |                       |
| PRE              | 3                | 1            | 3                     |
| POST             | 0                | 1            | 6                     |
| <b>LEARNER E</b> |                  |              |                       |
| PRE              | 1                | 2            | 4                     |
| POST             | 0                | 0            | 7                     |




# MOFU

- Mofu found that
  - the Maths Recovery (MR) Programme made it possible for the learners in her case study to progress in terms of multiplicative reasoning.
  - The MR programme highlighted that teachers need to understand the levels that the learners are operating at so as to assist them in their learning trajectory.
  - As a teacher she learnt the importance of providing learning tasks that allow collaboration with peers, having access to concrete materials like arrays for multiplication and division.
  - She found that the MR programme offered rich learning activities for teachers to use in interventions.
  - She learnt from the interview as an educator and saw it as a useful developmental tool.


# NDONGENI

Exploring relationships between levels of numeracy reasoning, CU and productive disposition

## Overview:

-  Early Multiplication and Division
-  Masters study of 6 purposively selected Grade 4 learners
-  After school intervention for 5 weeks aimed at supporting multiplicative reasoning

## Results

-  By combining analysis of the learner levels in LFIN and productive disposition indicators, able to see the relationship between these

# NDONGENI

- The key findings indicate that
  - for conceptual understanding: most of the learners depended on using concrete materials in solving multiplication and they also used basic strategies and methods.
  - for productive disposition: most of the learners saw themselves as competent in doing multiplication but the aspect of sense making and steady effort was less developed
  - the relationship between conceptual understanding and productive disposition: both strands have a mutual relationship in which one helped the other to develop
    - If a learner possesses conceptual understanding in the concepts of multiplication, they are able to see sense and give sensible explanations for getting particular answers

# CONCLUDING REMARKS

- **LFIN. Useful tool for**
  - **Assessing learner levels of understanding in one, many or all of the aspects**
  - **Planning subsequent interventions and activities**
  - **Such a tool can be used to help teachers supplement ANA results by knowing exactly where they are in numeracy trajectories**
  - **Ndongeni (doctoral study) on how to implement instrument in whole class situations**
- **Stott, Mofu and Ndongeni theses are available on SANC project website [www.ru.ac.za/sanc/people](http://www.ru.ac.za/sanc/people)**