

University of Johannesburg Institute for Childhood Education (UJICE)

The Nobel Prize-winner for economics, James Heckman, writes that “it is a rare public policy initiative that promotes fairness and social justice and at the same time promotes productivity in the economy and in society at large. Investing in disadvantaged young children is such a policy”.



Research Conference: Department of Basic Education

Elizabeth Henning and Lara Ragpot

Mathematical Competence of Young Children: A Model of Conceptual Development

Outline

- Background: slides 4 – 8. Quick overview. (Five minutes.)
- Model of conceptual development: slides 10 – 13. (10 minutes.)
- Fundamental measures: slides 14 – 17. (Five minutes.)
- Discussion >

Background to the research

- In a globally connected world the success of children (and adults) in all parts of the globe are bound to affect one another
- Finding an effective way to assess young children's competence in maths in the early grades has been a challenge
- Gesell Institute's critique of the Common Core curriculum in the US and its assessment practices? An example.

The South African curriculum takes note of conceptual development - in the US, however, there are complaints:

“The core standards being proposed by the National Governors Association and the Council of Chief State School Officers are off the mark for our youngest learners.

We at Gesell Institute call for a new set of standards for Kindergarten through Grade 3 that adhere to solid principles of child development based on what research says about how and what young children learn during the early years, birth to age eight”.



Where to find it?

**A reliable test-
from which valid
inferences can be
made**

Based on solid
theory

For fundamental
measurement??

With fine-
grained
diagnostic
capability?

Begin with a strong
theory – configured
in conceptual
model?

Andreas Schleicher [#OECDPISA](#)

“All assessments are subject to some uncertainty, but the OECD programme provides robust comparisons of nations’ performance

Imagine you were looking at a picture through the myopic lens of Kreiner and Christensen, which shows you just one pixel at a time. Of course, every time you look at the picture in that way you are going to see a different pixel that tells you a different story. But the point of Pisa is to portray the whole picture....



MARKO across two countries?

“...In other words, the approach taken by Pisa - and most other high-quality international surveys - is to craft and design the tests around an assessment framework, in which the different aspects of a subject matter and their **relative emphases** are internationally agreed”.

MARKO and the Meerkats > The right of a child to early, reliable diagnostic testing for effective learning support

Jobo and Lona



A thinking tool that is based on developmental progression of maths competence

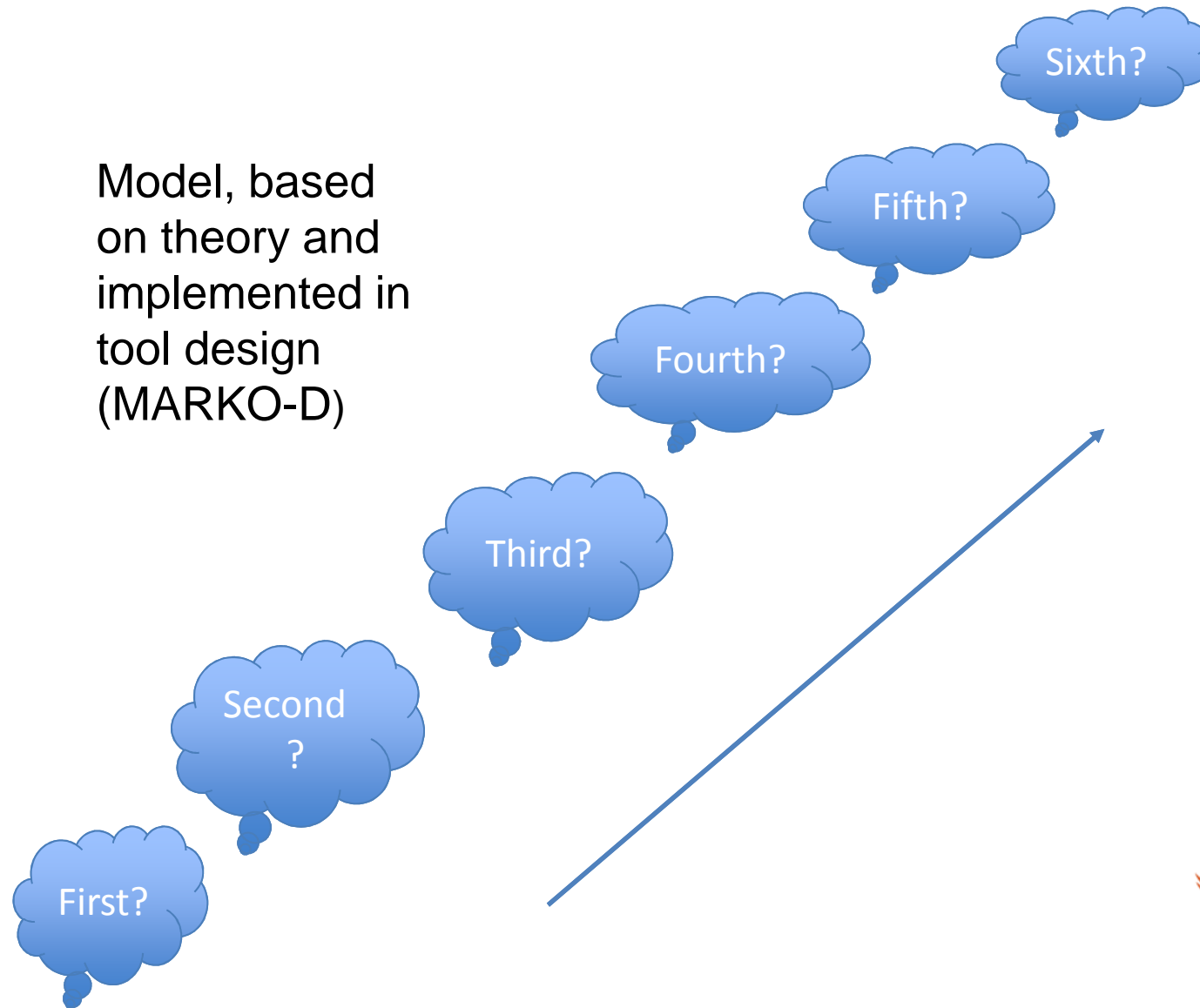
The hierarchical model of concept development used in the MARKO-D (also D1 and D2)

**Tests published in Germany (Hogrefe Verlag)
Mathematical and Arithmetical Competence Diagnostic**

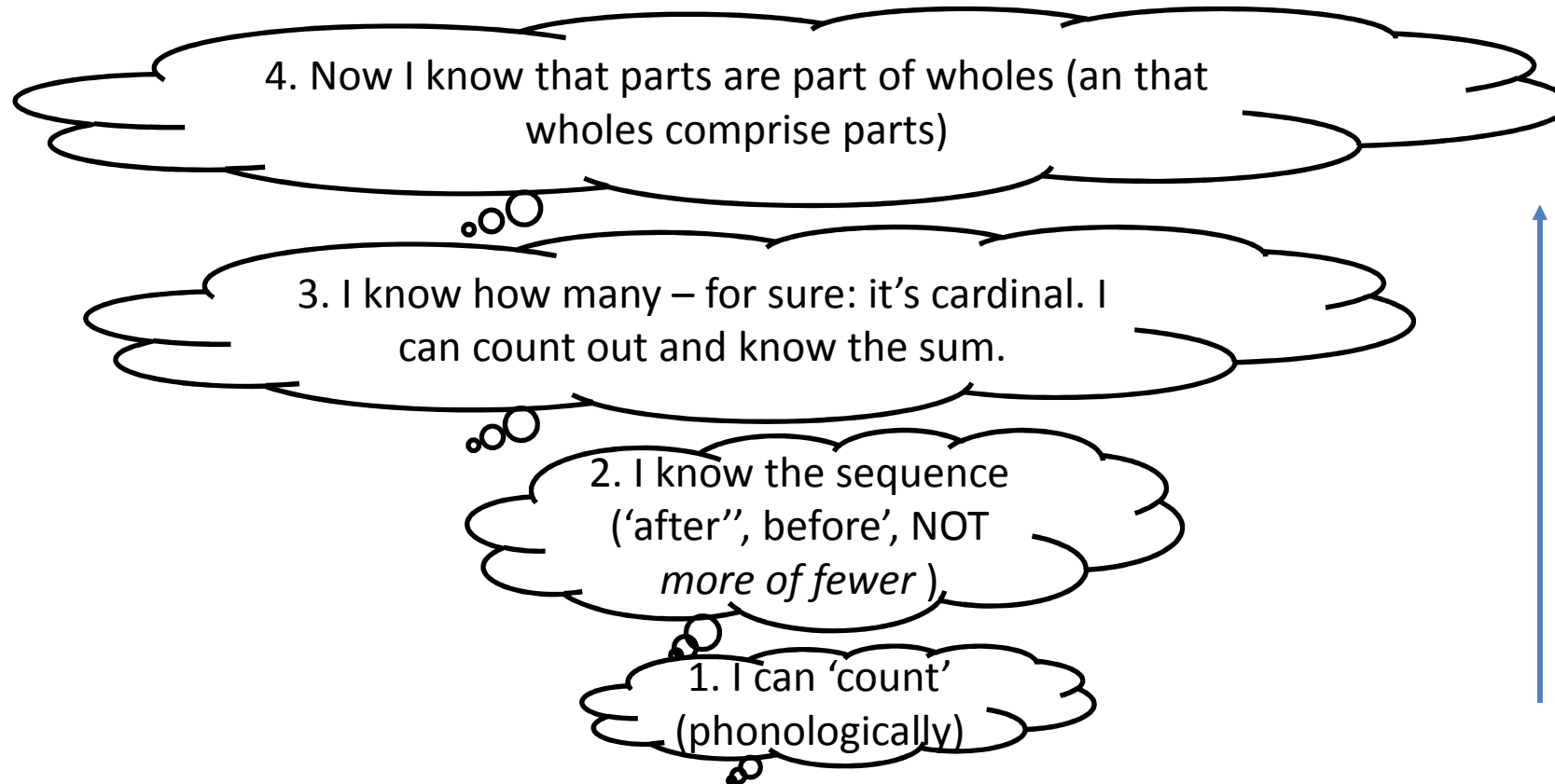
SA standardisation in progress



Initial levels of conceptual development of number (magnitude)



‘Levels’ of conceptual development (1 – 4)

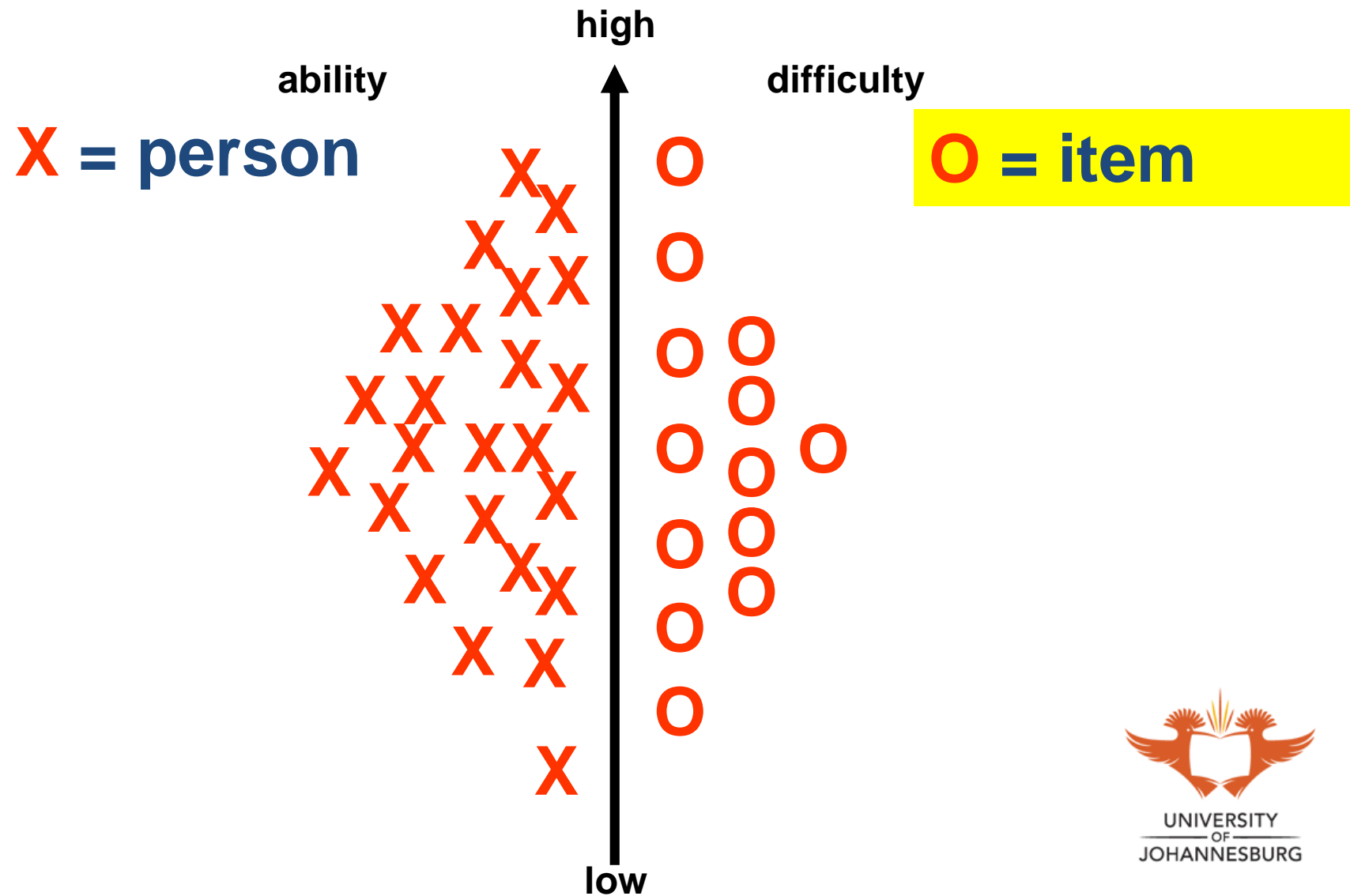


'Levels' of conceptual development (5 & 6)

6. I recognize units/groups in numbers

5. I see relationships between (cardinal)
numbers – some are fixed

Levels of concepts (item difficulty)



The MARKO-D test and the Fritz & Ricken model

“Scientific measurement requires (the) allocations to be carried out according to a set of rules that will produce, at a minimum, a resultant scale with a unit value that will maintain its value alongside the scale”. (Bond & Fox, 2007:5)

The Fritz & Ricken (2008) model of early mathematical concept development can be used as a developmental “set of rules”.



One thinking tool selected (there are others)

The Fritz & Ricken model is aligned to contemporary knowledge from:

1. Cognitive developmental psychology
2. The neuroscience of “the number sense”
3. Theory of learning to read
4. Theory of executive functions
5. Language development theory

Modeling and measuring developmental discontinuity?

The Saltus model

More panel research

Is development step-like or gradual?

Relation between stages assessed with different data collection instruments

..... What teachers say.. “We think about concepts and constructs as well as operations and skills”?



It's the teachers who can do things

The teachers with whom we work find a way of using the curriculum to talk and teach conceptually – more than operationally.

They are trained to use the tests and to do some modelling. **Fourth-year students as well.**

They design ways of talking in (and out of) the classroom, foregrounding conceptual knowledge. They use the Fritz & Ricken model as tool for talk and lesson planning and **learning support provision.**



Footnotes:

- Mathematics is learned. It needs to be taught. Systematically. According to what we know about the (gradual, or step-like) development of young minds.
- The move from innate number knowledge to symbolic learning is huge (See Henning and Ragpot, in press.).
- There is a whole lot to be said for and about sociocultural learning. A good teacher is a cultural agent. She/he performs the semiotic mediation that initiates the young into the culture. Foundation phase education is foundational an many ways.