# Access, equity and knowledge-in-use

## Reflections from a research-based teacher professional development project in post-Apartheid South Africa


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# Access, equity and knowledge-in-use

- Teaching and learning in multilingual settings
  - Language as a resource
  - The 'power' of English and of mathematics
- Teacher education – social practice theory
  - Resources as a verb (in use)
  - Resources social, cultural and material
  - ***Knowledge resources – knowledge in use in teaching***
- ***Focus on knowledge-in-use in teaching***

# What does it mean to have an equity agenda in post apartheid education?

- The access/achievement ***and*** identity and power
  - Powerful knowledge knowledge of the powerful
  - Curriculum prescription teacher professionalism and agency

- Strategies ***and*** principles
  - How to move from ‘some’ to ‘all’, in conditions with the ‘some’ is so small?
  - How to manage teacher morale in a highly inequitable education system?

The South African post apartheid education system is a telling case of how the rhetoric of ‘transformation’ or ‘emancipation’ meets an inequitable playing field, and the struggle for access to resources simultaneously fosters and impedes the democratic project.

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# The South African Education Context

- 18 years of constitutional democracy
  – Unravelling of apartheid architecture
  – Setting up, and developing, the post apartheid state

- Significant demographic shift
  – Into cities from rural areas
  – Into South Africa from neighbouring states

- Changing class formations
  – Emergence of ‘black’ middle class
  – Greater levels of inequality – Gini coefficient of .65

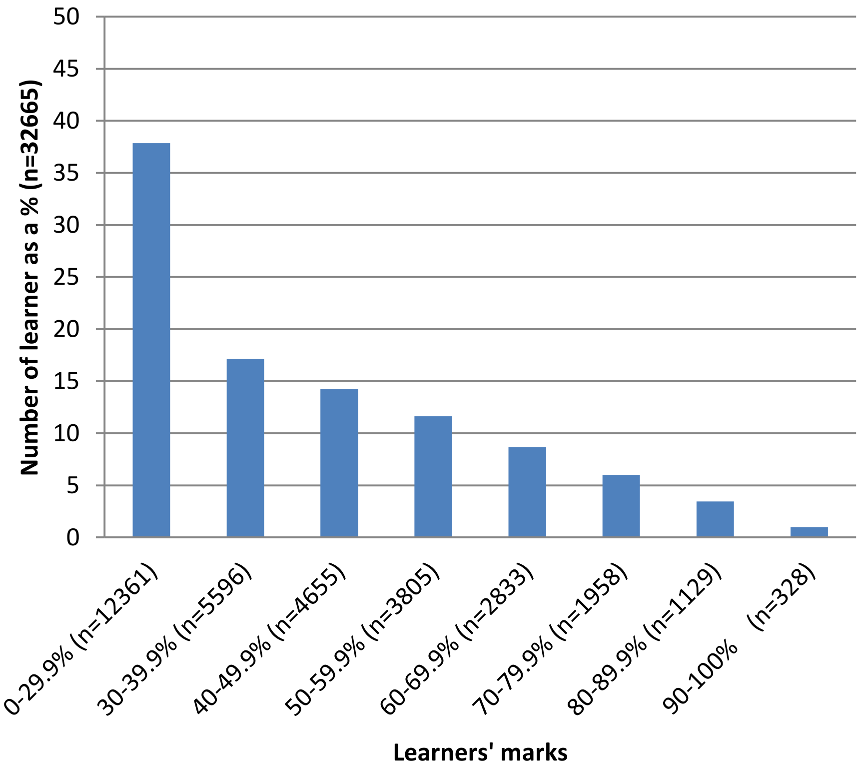
# So where are we now?

## Education for all
## Learning for some

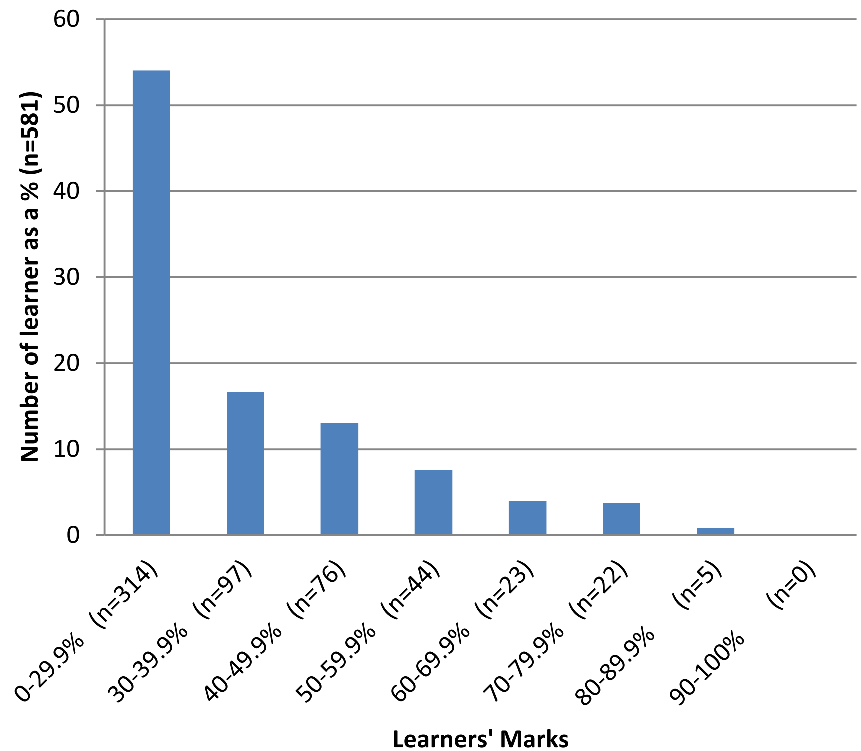
The pattern in South Africa is similar to the developing world overall - educational access has improved; distribution of quality education highly inequitable

# Learning for some: Epistemic access

Gauteng Province (752 Schools)
Learners attainment Mathematics
2011 Gr 12 National Exam




WMC Project Schools (10 Schools)
Learners attainment Mathematics
2011 Gr 12 National Exam

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# Research – Policy (learning for some)

- 20% of schools dysfunctional
  - Predominantly in poverty areas – rural, informal settlements

- 60% underperforming
  - Distributed across urban and rural, cities and townships
    - migration to cities
    - instability
    - skills shortages

Project schools

- 20% high achieving
  - Predominantly middle class, urban, economic centres of the country, racially mixed

# Research: Sociological
# Parallel economies of schooling in S. Africa

**Teachers' work inequitable: depends on**

- **learners they teach**
  - Cognitively prepared
  - physically healthy
  - homes a second site of acquisition
- **resources in school**
  - Material
  - Cognitive
- **curriculum**
  - well-specified
- **functional school management**
  - mediates the bureaucratic demands

Shalem & Hoadley (2009) *The dual economy of schooling and teacher morale in South Africa*; International Studies in Sociology of Education, 19, 2, 119–134.

**Three groups of teachers**

- Teachers with access to all four in the top 20% schools
- Teacher with access to none – bottom 20%
- ***Teachers with access to some – the 60% in the middle***

**Project teachers**:
For many, teaching not first choice;

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One of four similar "R&D Chairs" across country

10+1 schools in Gauteng Province in one district

Quality of teaching and learning mathematics

Strengthening of the pipeline; reshaping the curve

- Research led, data driven professional development
- Epistemic access – "Developing mathematical judgment"

# The school contexts

- 5 no fee schools (township) and 5 low fee schools (‘suburban’)
  - Shifting demography in post Apartheid South Africa
- All in the ‘middle band’ (National exams)
  - Unstable (with six ‘underperforming in 2010)
  - Mathematics (pass rates and averages low)
- Learners predominantly from townships
- Teachers (most qualified) diverse training and education backgrounds

# Working with schools and teachers

- Understanding that teachers are in the middle schools, unstable, with differing levels of low morale and poor support in terms of conditions of work

- The professional development work with them must interact with this context

# WMCS assessments

## Diagnostic test – algebra

## Curriculum items in algebra and functions

Algebra is "powerful knowledge" (Young, 2008) in secondary mathematics learning, and further progress in mathematics

"Algebraic symbolic realisations … hallmark of literate mathematical discourse …. generative power … advantage over iconic and concrete [in] effectiveness and applicability … " (Sfard, 2008)

"School algebra is a meta-discourse of arithmetic" (Caspi & Sfard, 2012)

# Algebra as generalised arithmetic

ICCAMs previously CSMS study – KCL, UK, Hart et al, 1981

- 33 questions; Levels 1 – 4 (adding in level 0)
- Learner responses enable us to assign them to a level and so track progress over time
- Learner errors can be identified, analysed
  - Work with teachers on what levels mean
  - Common errors

# Simplify where possible: *3x – (y + x)*

## ICCAMs codes + WMCS added

| | |
|---|---|
| Missing 0 | |
| Correct 1 | 2x-y |
| Ambiguous 2 | |
| Letter Evaluated 3 | |
| Letter as Object | |
| Letter not used | |
| Premature 8 Closure | a) xy b) 2x c) 2xy d) 3xyx |
| Additional 9 Wrong | a)4x-y b) $3x^2y$ c)$\pm 3x^2-3xy/3x^2+3xy$ d)$3x^2$-y e)3xy f) 4xy g) 2x+y h) Other |

## Prevalence in WMCS data

| | Grade 9 % | Grade 11 % |
|---|---|---|
| Missing | 8.4 | 7.1 |
| 2x-y | 3.5 | 24 |
| 0 | 0 | 0.2 |
| xy | 2 | 0.8 |
| 2x | 1.3 | 0.2 |
| 2xy | 2.6 | 1.5 |
| 3xyx | 2.8 | 0.2 |
| 4x-y | 6.5 | 6 |
| $3x^2y$ | 6.5 | 4.6 |
| $3x^2-3xy$ / $3x^2+3xy$ | 1 | 9.1 |
| $3x^2$-y | 2.1 | 5.3 |
| Other | 63.5 | 41 |

# Beyond “misconceptions”

- Misrecognition
  - More incorrect than missing
  - Confounded by integers/operations and brackets
- Non participation
- Participation in ‘another’ discourse (not ‘school mathematics discourse’)

# Engagement but non participation?

L:  I work hard, but not on my own, I don’t understand when I am on my own

T: They participate in class, yet fail

– “No learning without teaching”

– Low bar ??

# Contributing role of instruction?

- Attention to operational sequences that seem to lose sight of the object – coherence?

- Localised non mathematical discourse, or extensive rule-based discourse

# The lesson – example space

**1. Application of exponent law (Correction of homework and interactional routine)**

$ab^2$ x $a^3b$

$ab^2$ x $ac$ x $2a^3b$

$ab$ x $ab$ x $ab$

$a^2bc$ x $a^{-3}b^{-2}c$

**2. Multiplication of algebraic expression**

1) 4 ($x$ + 2)

2) 4$x$ ($x$ + 2)

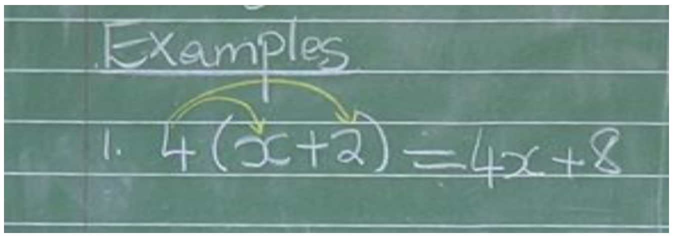
Compare 1) and 2)

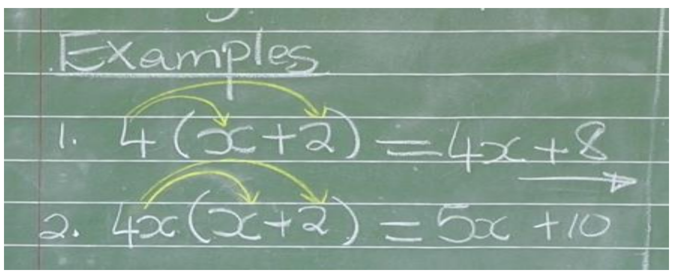
3) -4$x$ ($x$ + 2)

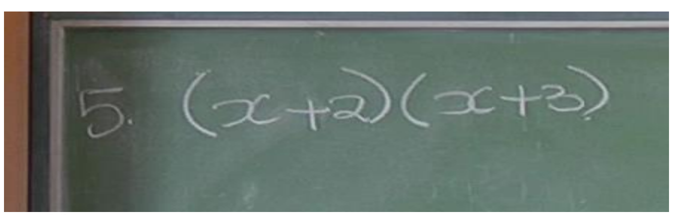
4) 2$x$ (3$x^2$ + 2$x$ - 4)

5) ($x$ + 2) ($x$ + 3)

# What is done


# What is said

T: We want to find the product of Algebraic expressions. That's another way of saying multiplying algebraic expressions. …

T: we want to multiply 4 into x plus 2 - remember brackets represent multiplication and that means we have to multiply whatever is in the brackets using the four.

T: Is that the final answer? … Can we leave our answer like that?

L: we cannot add these because the 8 does not have a variable of x

T: She said we cannot add these two because 4x has a variable of x and 8 does not have a variable. So those two are not like terms therefore we leave our answer as 4x + 8.

Example 2:

L: 5x + 10

L: 6x

L: $4x^2 + 8x$

L: why does 8 have an x, as 2 didn't have an x?

T: Is that the final answer?

L: disagree … $12x^{2+1}$

L: $4x^2 + 8x$ because $x^2$ and x are not the same

Multiplying these; adding those – referents unclear

Distributive law; 'totally different'

# Object of learning out of focus

$4(x + 2)$
$= 4.x + 4.2$
$= 4x + 8$

Operational activity

Four multiplied by the sum of $x$ and 2 (meta arithmetic)

$4x(x + 2)$
$= 4x.x + 4.2$
$= 4x^2 + 8x$

From iconic to full procedural explanation

Dependent on understanding $x + 2$ as distinct from $2x$

# Legitimating criteria

- What is made available is ‘localised’, immediate
- Errors proliferate, together with an invisible discourse of ‘guessing’ as mathematical practice
- Those that can answer correctly are confirmed; those who do not are not aided with why or how to proceed.

- This is the discourse in which learners participate – thus closing off epistemic access – access to powerful knowledge

# Challenge and disquiet

I have vacillated between a deficit discourse – an explicit rendering of what is 'lacking', and its re-description through notion of misrecognition (rather than 'wrong'), or 'participation in a different discourse'.

The tensions of working simultaneously with what is 'lacking' in instructional practice and in learners' discourses, and how this is best engaged so that these become more mathematical, and doing so respectfully, are profound.

# Developing mathematical judgment

Pedagogy proceeds through the operation of judgment

Judgment epistemological and *related* pedagogical entailments

*Object* of *learning*

# Professional development work

- ‘Specialised’ mathematical knowledge
- Working with teachers – key concepts and their teaching/learning – *objects of learning (Marton et al)*
- Key features – mathematical with explicit attention to discursive demands and why use of new words and ‘legitimate’ ways of talking matters

# Professional ‘courses’

- 20 days
- Release from school on 10 days; 4 days in school
- Incentives – school and teachers – on basis of participation and achievement
- Two teachers per schools (Gr 9 and 10)
- In partnership with three schools and their teachers neighbouring the university

# From “they can’t” to “maybe I can”

1. Shifts in levels of teaching within school

2. Teachers working together
   – On mathematics
   – On mathematics teaching

3. Teachers willing to ‘look’ at their practice
   – Visibilising teaching as part of the complex terrain
   – Talk about ‘what’ they want learners to learn and then ‘how’ they might enable this

# Concluding comments …

The focus on knowledge(s) in use is necessary for building democracy – communities of practice, professional learning communities background the knowledge question

*Epistemic access as principle and strategy*

*Research led professional development led research complicates both*

*Eyes wide open, revisiting theory, revisioning practice*

# Access, equity and knowledge in use

What does it mean to have an equity agenda?

- The access/achievement ***and*** identity and power
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- Strategies ***and*** principles
  - How to move from ‘some’ to ‘all’, in conditions with the ‘some’ is so small?
  - How to manage teacher morale in a highly inequitable education system?
    - Raise the bar
    - Setting/streaming in large schools

The truth is that we are not yet free; we have merely achieved the freedom to be free, the right not to be oppressed. We have not taken the final step of our journey, but the first step on a longer and even more difficult road …. After climbing a great hill, one only finds that there are many more hills to climb.

Long walk to freedom, Nelson Mandela, 1994, p. 617

Thank you

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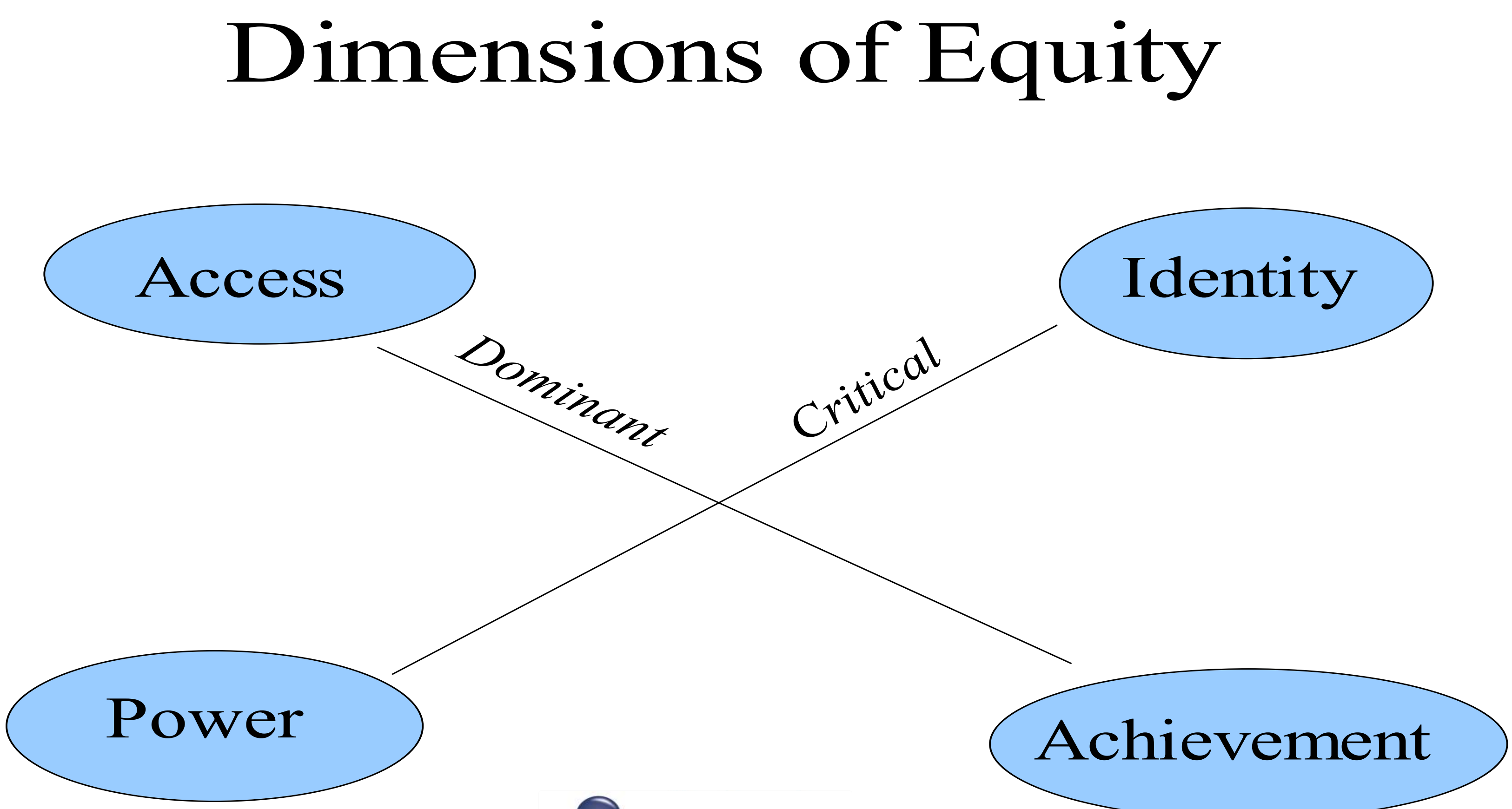
# Gutiérrez – play and change the game

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# Interdependent model (critical literacy) Janks (2011)

## Access, Power, Diversity and Design

- Access without power
- Access without diversity
- Access without design

- Power without access
- Diversity without power
- Design without power

**Gutiérrez**

- Access
- Power
- Identity/diversity

Achievement ? Design