Mathematics education behind the dykes, search for an opening

LEARN! Learning sciences
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Peter Langerak
External PhD-candidate, Vrije Universiteit Amsterdam
Educator, Netherlands Mathematatal Institute

VU VRIJE UNIVERSITEIT AMSTERDAM

LEARN!

External PhD-candidate
Educational Sciences

Nederlands Mathematisch Instituut

+ − × : FOUTLOOS REKENEN

Peter Langerak
p.l.langerak@vu.nl

OUTLINE

1. Is there something wrong with maths education in The Netherlands?

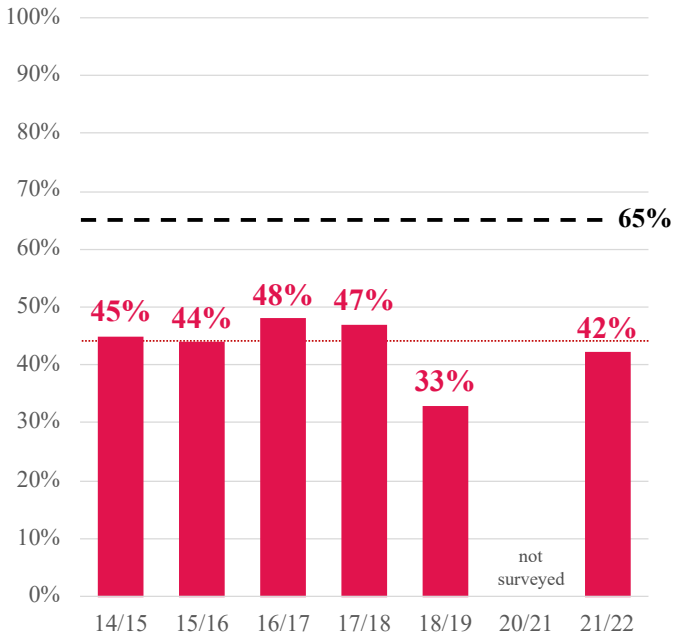
2. What is (wrong with) maths education in The Netherlands?

3. An alternative approach: Excellent Maths (Foutloos Rekenen)

Is there something wrong with maths education in The Netherlands?

National ambition has never been met

Inspectorate of education, PEIL onderzoeken



National research

Inspectorate of Education:

“ Mastery of target-level maths falls short” (2019)

“ Insufficient number of pupils reach target-level in maths” (2020)

“ We need to renovate and not just fix” (2021)

“ Concrete targets are unambitious and often derived from the minimum requirements” (2022)

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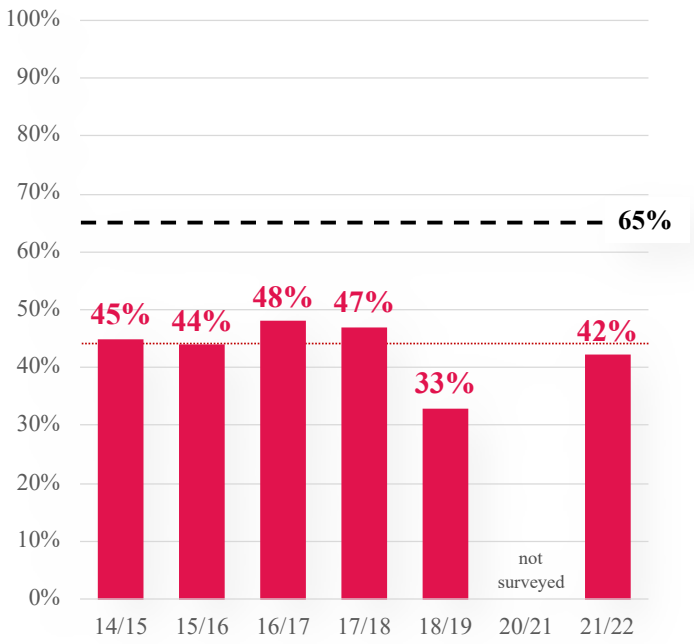
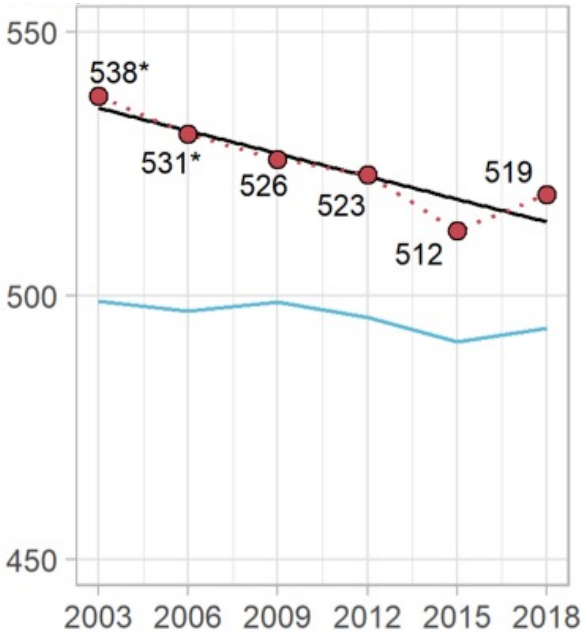


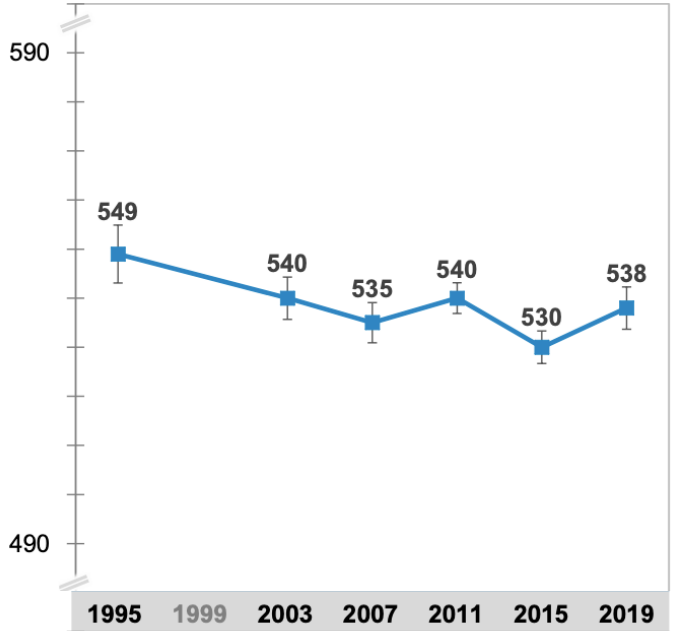
Declining trend is 'steadily negative'

PISA: Peña-López, 2019



High mathematics performance of the first measurement in 1995 has never been reached again

TIMSS: Meelissen, 2020



National research

International research

What is wrong with maths education in The Netherlands?

Realistic Mathematics Education (RME)

(oa. Freudenthal, 1973; Treffers, 1987; Gravemeijer, 1994; De Lange, 1998; Van den Heuvel-Panhuizen, 2010)

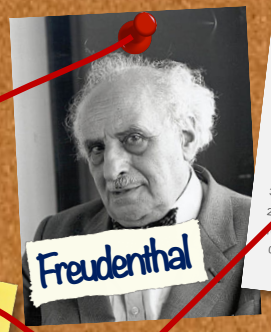
Mathematics is a human activity, teacher guides the reinvention of mathematics by pupils

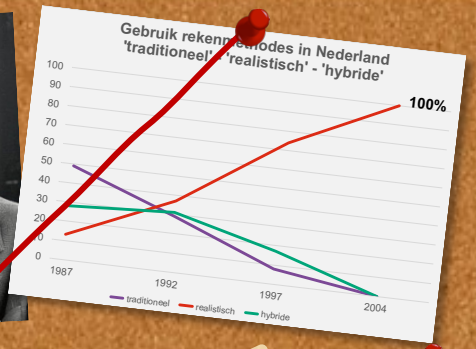
1. Mathematisation from realistic, meaningful contexts
2. From a concrete level to a more formal level
3. Own productions and informal solutions of pupils
4. Class interaction and reflection on solutions of problems
5. Intertwining of mathematical concepts

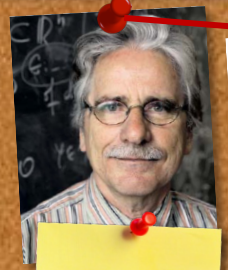
The combination of unstructured material and a meaningful question is the situation in which the student can develop the mathematics needed to structure the situation themselves (Gravemeijer, 1994).

VU

Tijdgeest:
gelijkheid
inspraak
democratisering
emancipatie
creativiteit







2007

2012
NMI

1961-73
Commissie Modernisering Wiskunde Onderwijs

1971
IOWO
Instituut Ontwikkeling Wiskunde Onderwijs

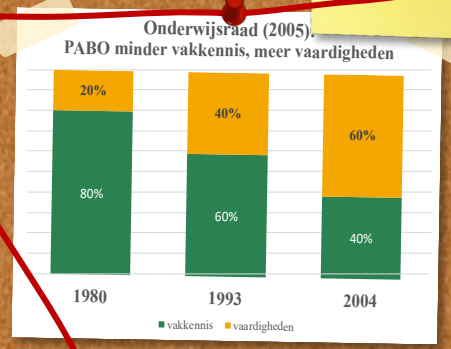
WISKOBAS

1981
OW&OC (UU)

1991
Freudenthal Instituut

1981-heden
Panama

1989-1996
Nationaal programma (1-4)

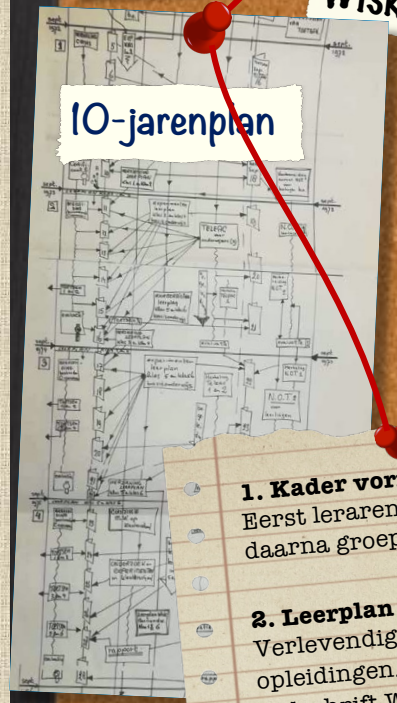


2009
Kennisbasis pabo

2009
Cie Meijerink

2011
Protocol ERWD

Nieuwe taal RR:
dyscalculie
handelingsmodel
drieslagmodel
vertaalcirkel
. . .



- [x] cijferend rekenen
- [x] schattend rekenen
- [x] handig rekenen
- [x] hoofdrekenen

2009
KNAW

1. Kader vormen:
Eerst lerarenopleidingen
daarna groep onderwijzers

2. Leerplan ontwikkelen:
Verlevendiging door leraren-opleidingen, SchoolTV en tijdschrift Wiskobas

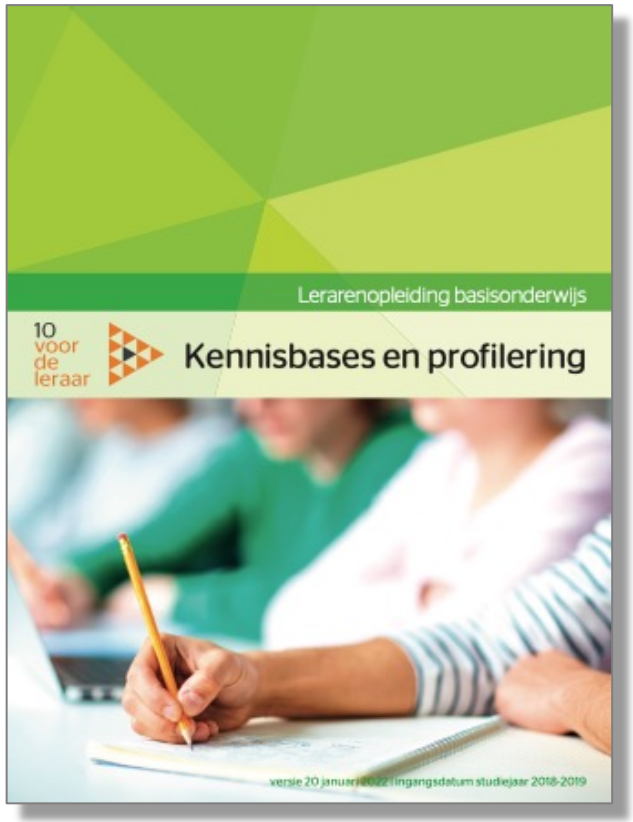
Leerplanpublicaties (1975-1980):
Wiskunde is een menselijke activiteit
Start uit realistische context
Leerlingen zelf kennis construeren
Leerkracht begeleidt het heruitvinden

FI: Ontwikkelingsonderzoek
kleinschalige lesexperimenten, geen empirische vergelijking

- claims zonder bron
- stellingen zonder onderbouwing
- 'weten' zonder te meten

Quartet

1. Teacher training adopted RME (common knowledge base)



No room for an alternative (Van Zanten, 2010)

- An alternative is incompatible with the knowledge base
- Equal attention to both approaches is deemed undesirable
- Integrating an alternative is politically-strategically motivated

Knowledge Base Teacher training (Kennisbasis Pabo, 2009 en 2021)

2. Educational publishers adopted RME

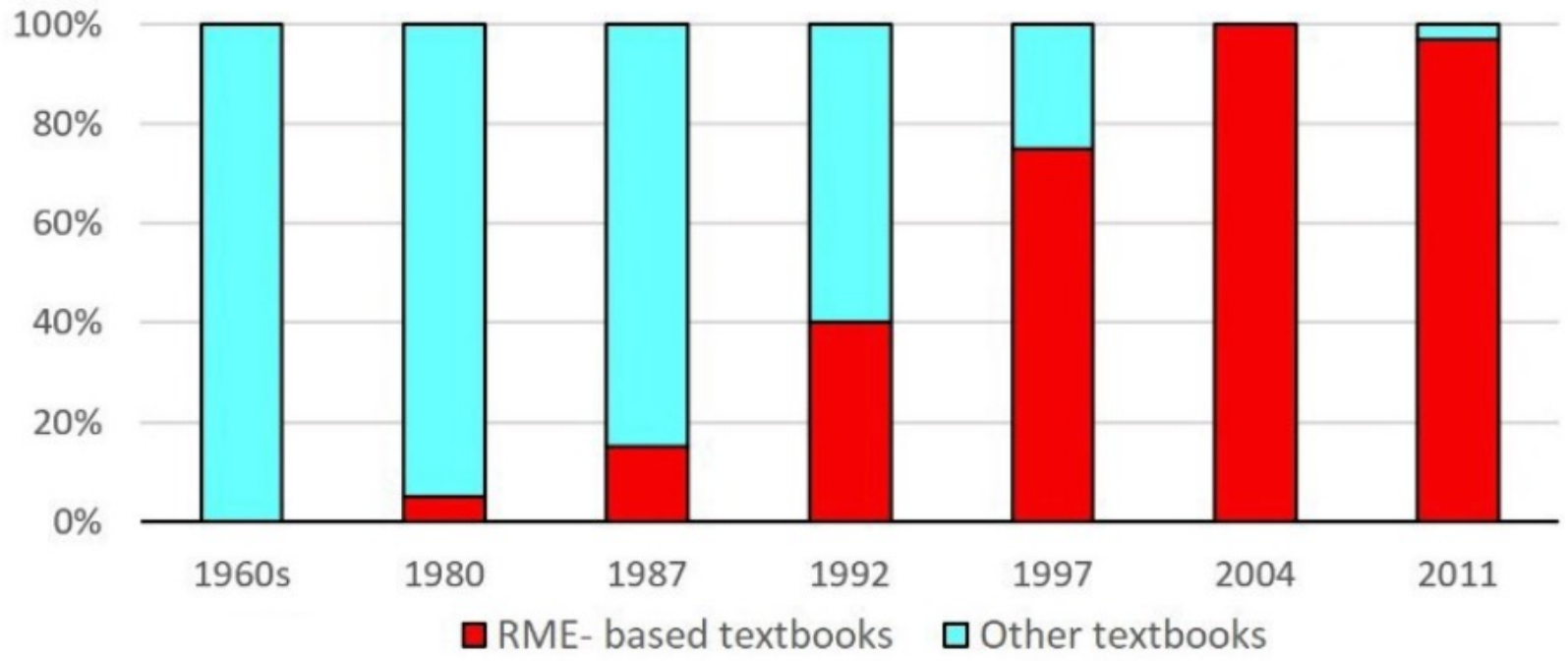


Figure 1. Market shares of RME-oriented and other textbooks over the years

(Van den Heuvel-Panhuizen & Van Zanten, 2020)

3. No national curriculum, instead many learning objectives

11

Core objectives

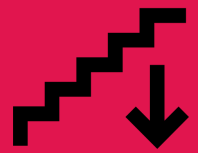
2006

173

Target-level End-of-primary-school

2011

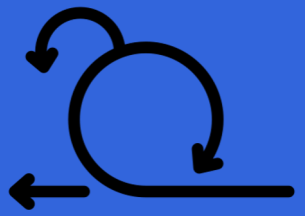
82



Fundamental-level (lower) End-of-primary-school

2011

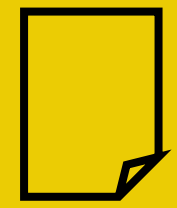
794



Intermediate objectives (groep 2 t/m 8)

2017

404



Educational offering goals

2019

(SLO - Netherlands institute for curriculum development, 2006, 2011, 2017, 2019)

What is wrong with maths education in The Netherlands?

What is known about the relationship between math teaching and mathematical proficiency?

A Traditional maths teaching leads to better maths proficiency

B Realistic maths teaching leads to better maths proficiency

C Type of teaching does not matter for mathematical proficiency

D No scientifically-grounded statement can be made

4. Developmental Research over Comparative Effectiveness Research

Research on maths education in The Netherlands (Onderwijsraad, 2006)

- Focus on small-scale design experiments (to develop and refine teaching materials)
- Reluctance to conduct comparative effectiveness research (mathematics learning is highly individualized, each student develops their own mathematics)
- No noticeable shift towards more evidence-based research

Generalising educational research is considered inappropriate for mathematics education (Gravemeijer, 2022).

What is wrong with maths education in The Netherlands?

1. Teacher training solely focuses on RME
2. Textbooks are RME based
3. Too many maths objectives
4. Absence of empirical research

Monoculture of maths education in The Netherlands
is an impoverishment and cause for concern (KNAW, 2009)

The KNAW calls for more research on alternative approaches.

EXCELLENT MATHS

Institution:	shadow education (NMI private education course)
Type:	accelerated learning
Duration:	12 weeks
Students:	grades 4, 5, 6 (groep 6, 7, 8)
Group size:	6-8 pupils
Content:	23 maths procedures (algoritmes that always work)
Pedagogy:	mastery learning
Materials:	textbook, online LMS, paper, pencil, eraser

School improvement projects

Number:	>320 projects since 2020
Group size:	whole classes (all pupils included)
Grades:	grade 4, 5, 6 (groep 6, 7, 8)
Duration:	12 weeks
Form:	co-teaching
Per week:	instructional lessons once per week (12x) by expert-teacher all other maths lessons guided practice by own teacher (own school textbook is not used)

Curriculum and Didactics
educational research

Experience Sampling
psychology

Effect study in schools
educational research

Mastery Learning
educational research

Conceptual understanding
educational psychology

Conceptual Change
educational psychology

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In this project, the Vrije Universiteit Amsterdam works together with the Netherlands Mathematical Institute

Nederlands Mathematisch Instituut