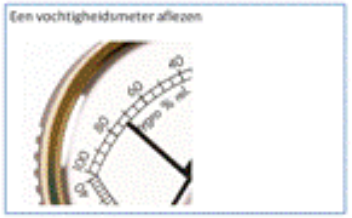
Images of Numeracy

as to be pleasing to the maths eyes



ALM 18 – Dublin 28 June 2011

Kees Hoogland K.Hoogland@aps.nl

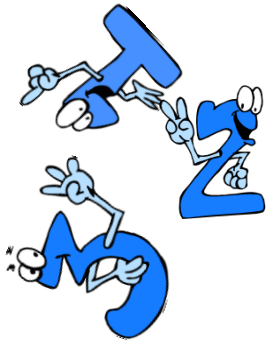
Brief outline

Adult Numeracy Concept Continuum of Development

Phase 1	Phase 2	Phase 3
Increasing levels of sophistication		
FORMATIVE (basic arithmetic skills)	MATHEMATICAL (mathematics in context of everyday life)	INTEGRATIVE (mathematics integrated with the cultural, social, personal, and emotional)

A continuum of development of the concept of numeracy showing increased level of sophistication from left to right (from Maguire & O'Donoghue, 2002)

- Sophistication of numeracy concepts
- Some examples and some incongruities



- The challenge: a specific research

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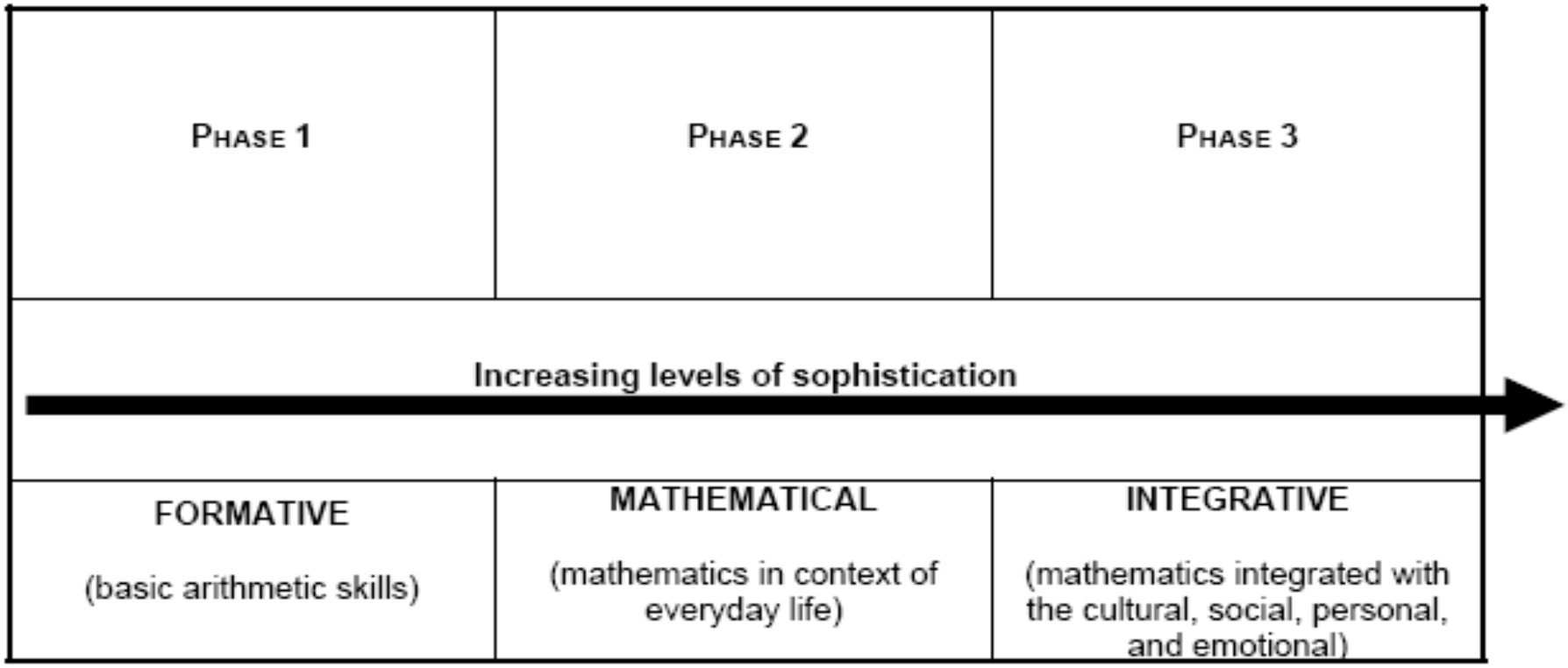
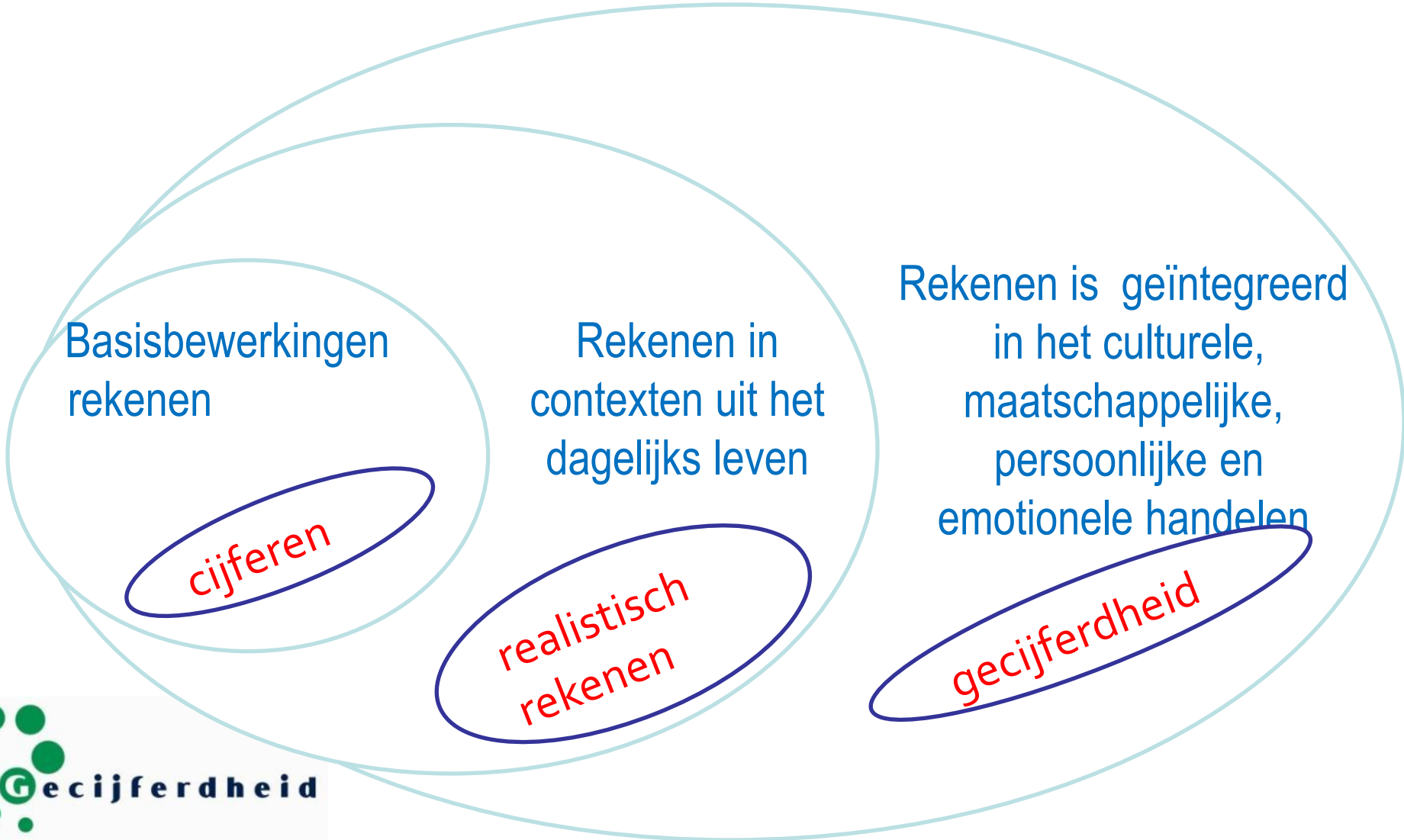
Adult Numeracy Concept Continuum of Development



A continuum of development of the concept of numeracy showing increased level of sophistication from left to right (from Maguire & O'Donoghue, 2002)

Functioneel Rekenen en Gecijferdheid
Opvattingen en invullingen



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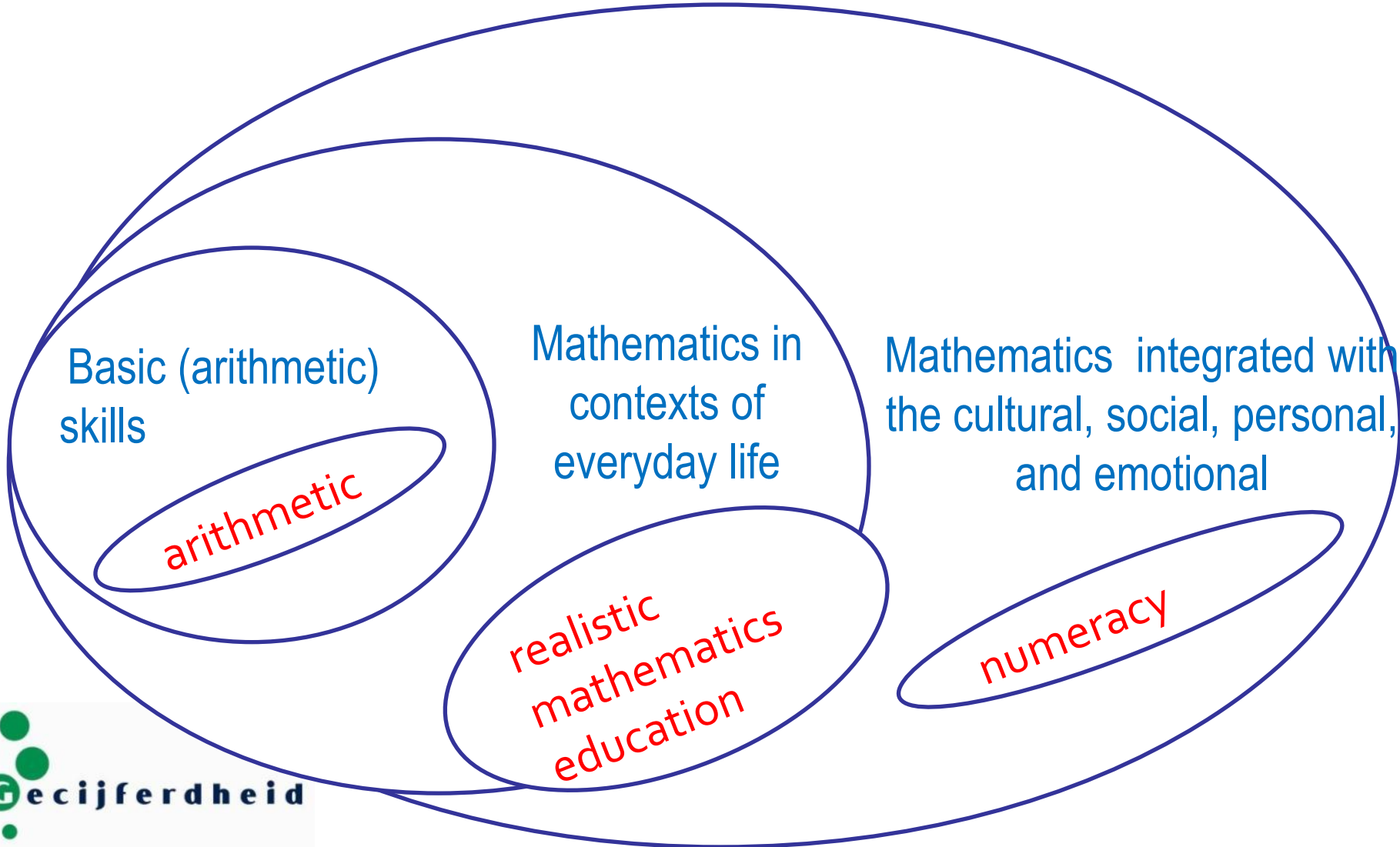
Numeracy & Functional Mathematics
Conceptual development



Gecijferdheid

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Paradigmatic barrier ???
Epistemological shift ??
Lack of imagination ??

Adult Numeracy Concept Continuum o Development

Phase 1	Phase 2	Phase 3
Increasing levels of sophisticati n →		
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A continuum of development of the concept of numeracy howing increased level of sophistication from left to right (from Maguire & Donoghue, 2002)

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Assessment

1 2 3

2. Solve: $-3(x-2) \geq 3(x+3)$

The inequality is equal to

a. $x \leq -2\frac{1}{2}$

b. $x \leq -2$

c. $x \leq -\frac{5}{6}$

d. $x \leq -\frac{1}{2}$

e. $x \geq -2$

f. $x \geq -\frac{1}{2}$

3. Solve: $\frac{1}{2}x^2 - 5x - 3 < 0$.

The set of solutions is

a. $(x \mid 5 - \sqrt{19} < x < 5 + \sqrt{19})$

b. $(x \mid 5 - \sqrt{31} < x < 5 + \sqrt{31})$

c. $(x \mid -5 - \sqrt{31} < x < -5 + \sqrt{31})$

d. $(x \mid x < 5 - \sqrt{19} \vee x > 5 + \sqrt{19})$

e. $(x \mid x < 5 - \sqrt{31} \vee x > 5 + \sqrt{31})$

f. $(x \mid x < -5 - \sqrt{31} \vee x > -5 + \sqrt{31})$

Bron: CEVO (1991), VMBO examen

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Prototype MBO Rekenen 2F
Test

Vraag 2 van 24

Schat hoeveel deze boodschappen in totaal kosten.
Geef het antwoord in hele euro's.

€ ,--

Estimate the total costs of these groceries.

http://www.cve.nl/item/centraal_ontwikkelde_examens_taal

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31 Jan knapt zijn slaapkamer op. Hij gaat de drie wanden lichtblauw verven. Hij heeft 5 liter verf gekocht, genoeg voor 30 m^2.

a De eerste muur heeft een oppervlakte van 4 m^2. Hoeveel verf heeft Jan voor deze muur nodig? Gebruik een verhoudingstabel.

b De volgende muur heeft een oppervlakte van 10 m^2. Heeft Jan dan genoeg aan 1 liter verf?

c De grootste muur is 14 m^2 groot. Bereken hoeveel verf hiervoor nodig is.

d Hoeveel liter verf is nodig voor 50 m^2?

Bron: Moderne Wiskunde (1998) MW 2 HV

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Prototype MBO Rekenen 2F
Test

Vraag 14 van 24

Om 8:50 uur ben je bij de bushalte aangekomen.
Hieronder zie je een deel van de tabel met vertrektijden van de bus.

UUR	minuut
7	03 13 23 43 53
8	03 17 33 48
9	03 23 43
10	03 23 43
11	03 23 43
12	03 33
13	03 33

Hoeveel minuten moet je wachten totdat de eerstvolgende bus vertrekt?

minuten

You arrive at the bus stop at 8:50

How many minutes do you have to wait for the next bus departing?

http://www.cve.nl/item/centraal_ontwikkelde_examens_taal

Question 4. Traffic jam

Between Breukelen and Abcoude in the direction of Abcoude, there is a traffic jam of 5 km. The road has three lanes in each direction.

19. Estimate the number of cars in the traffic jam.
Write down how you arrive at your answer.

Bron: CEVO (1997), VMBO examen

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9.65

a. $\frac{5}{33} + \frac{9}{22} =$

b. $\frac{7}{24} - \frac{3}{16} =$

c. $\frac{13}{12} + \frac{4}{15} =$

d. $\frac{4}{9} \times \frac{4}{11} =$

e. $\frac{7}{5} : \frac{5}{7} =$

9.66

a. $\frac{27}{16} \times \frac{8}{15} =$

b. $\frac{4}{25} + \frac{24}{35} =$

c. $\frac{35}{48} \times \frac{40}{49} =$

d. $\frac{4}{9} - \frac{4}{11} =$

e. $\frac{21}{55} : \frac{7}{5} =$

9.67

a. $\frac{27}{16} - \frac{8}{15} =$

b. $\frac{4}{25} : \frac{24}{35} =$

c. $\frac{35}{48} + \frac{7}{8} =$

d. $\frac{44}{13} : \frac{121}{39} =$

e. $\frac{21}{55} + \frac{7}{5} =$

9.68

a. $\dfrac{\frac{5}{6} + \frac{2}{5}}{\frac{2}{3} + \frac{1}{6}} =$

b. $\dfrac{\frac{3}{4} + \frac{4}{3}}{\frac{3}{4} - \frac{1}{3}} =$

c. $\dfrac{\frac{7}{8} + \frac{1}{3}}{\frac{4}{5} + \frac{1}{4}} =$

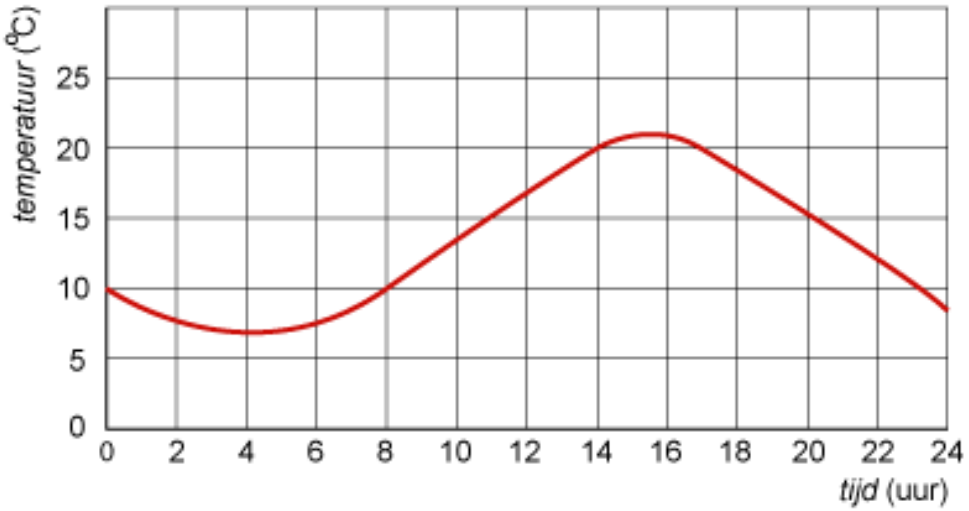
9.69

a. $\dfrac{\frac{5}{6} \times \frac{2}{5}}{\frac{2}{3} + \frac{1}{6}} =$

b. $\dfrac{\frac{3}{4} + \frac{4}{3}}{\frac{3}{4} : \frac{1}{3}} =$

c. $\dfrac{\frac{7}{8} + \frac{1}{3}}{\frac{4}{5} \times \frac{1}{4}} =$

19. Hieronder zie je een grafiek die laat zien hoe de temperatuur in de loop van een dag verandert.
Hoeveel graden Celsius was de temperatuur om 5 uur 's middags?



☐ graden Celsius

What is the temperature at 5 pm?

ɔren 1100 serie:

rukslang van 8 meter.

s, gebogen 840mm lang.

360° draaibaar.

stekker.

		1100W	1100
	bar	140 - 10	160 - 10
	ltr/h	600	780
	EC	60	60
	kW	3,6	4,9
	V/Hz	230 / 50	400 / 50
nk	ltr.	4	4
	mm	390x290x860	390x290x860
	kg	29	29
		30210195	30210196
		1295,00	**1495,00**

7. A bottle $\frac{3}{4}$ filled with liquid weighs 3 kg. The liquid alone weighs $\frac{3}{4}$ kg more than the empty bottle. If the bottle is completely filled, how much will the contents weigh?

Source: SingaporeMath (2007), placement test ,


Calculate the weight of the sugar on the pallet.
maths eyes
Echo

29.

walls

Johan gaat de muren van zijn kamer schilderen.

- twee muren hebben een lengte van 8 meter
- twee muren hebben een lengte van 4 meter
- de hoogte van alle muren is 2,5 meter

In de slaapkamer zijn twee ramen en een deur die samen ongeveer 8 m^2 zijn.

Hoeveel blikken muurverf moet Johan minstens kopen?

☐ blikken

How many cans does he need?

Calculate the correct dose and choose the right syringe

The computer activity

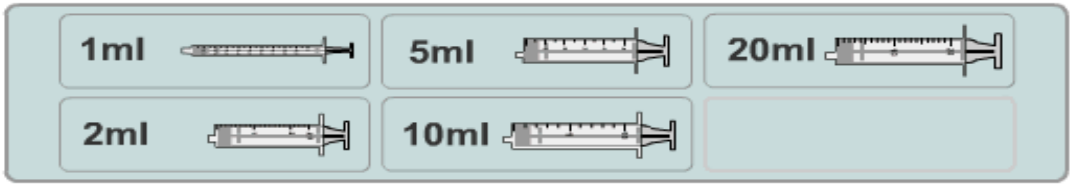
sample item from Authentic World®

Question 22 of 30

Extract the relevant information from the prescription chart and the medication product label. Calculate the correct dose to administer and choose the appropriate syringe with which to administer it.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

REGULAR PRESCRIPTION MEDICINES		DATE
		ADMINISTRATION TIMES
MEDICINE (Approved Name): *Ampicillin*	START DATE: *3/10/2007*	06:00
DOSE: *500mg* / ROUTE: *I.M.* / SPECIAL INSTRUCTIONS: -		14:00
DOCTOR'S SIGNATURE: *Dr. Jones*	PHARMACY SUPPLY: *A. Mann*	22:00



Natasha sell candles in her shop
What is the mathematical name of these shapes?

A. Cylinder
B. Cone
C. Prism
D. Pyramid

15.

Natascha verkoopt in haar winkel deze kaarsen.
Wat is de wiskundige naam voor de vorm die deze kaarsen hebben?

A. cilinder
B. kegel
C. prisma
D. piramide

On two towers, 30 and 40 feet high, birds are sitting.
On a certain time both fly with the same speed to a foutain that is on the straight line between the two towers (or outside the towers).
Find the position of the fountain if the distance beteen the towers is 50 feet.

Source: Liber Abaci, 1202

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I work in a butcher’s shop from Monday to Thursday. One of my jobs is to check the temperature of the fridge twice a day. At the right hand side you see a thermometer.
What is the temperature?

A +15° C

B -15° C

C + 15° F

D - 15° F

XXX

Opgave 2

Hoeveel procent korting krijg je ongeveer op de kamerplant?

A 40%
B 10%
C 67%
D 60%

Source: Cito (2009). Referentietoetsen 1F/2F

yyy

M047: Lichen

A result of global warming is that the ice of some glaciers is melting. Twelve years after the ice disappears, tiny plants, called lichen, start to grow on the rocks.

Each lichen grows approximately in the shape of a circle.

The relationship between the diameter of this circle and the age of the lichen can be approximated with the formula:

$$d = 7.0 \times \sqrt{(t - 12)} \quad \text{for } t \geq 12$$

where d represents the diameter of the lichen in millimetres, and t represents the number of years after the ice has disappeared.

Question 1: LICHEN

M047Q01- 0 1 8 9

Using the formula, calculate the diameter of the lichen, 16 years after the ice disappeared.

Show your calculation.

Source: PISA Samples 2004

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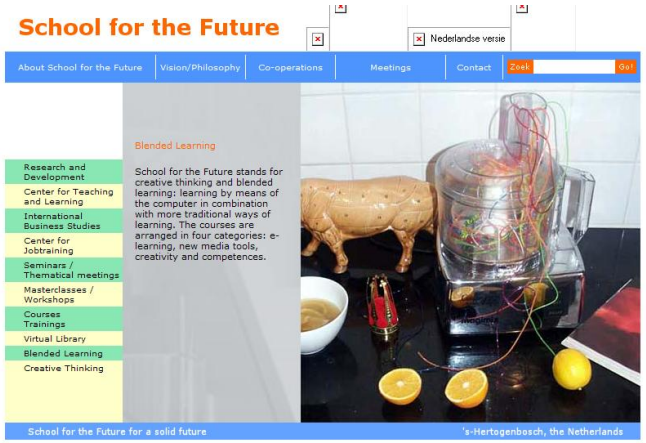
Pens down
Test completed

1 2 3

School situation:

Regional Education Centres (20,000 student
Koning Willem 1 College
School for the future



Target group:

16-19 Vocational Education
Basic stream
Competency based curriculum

They wanted advice:

We have a problem.
Students lack skills in basic arithmetic operations skills: multiplication division, fractions, et cetera and they lack skills in doing arithmetic with basic mathematics concepts: area, volume, ...

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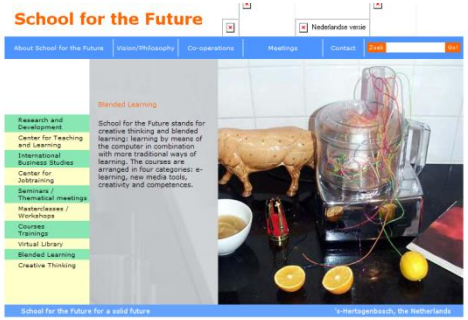

School for the Future®

The educational renaissance of the 21st century will be built on two pillars: creativity and technology. For some time now education has no longer been just a question of knowledge transfer and one-sided attention to logical and analytical thought processes. Today, education is recognised as a process that involves emotions, interaction between the senses, behavioural changes, and creative thought processes. For the development of this ‘new education’, **Koning Willem I College** has set up a separate organization - School for the Future. Here high-quality technology and purposeful creativity form the basis for trail-blazing learning processes.

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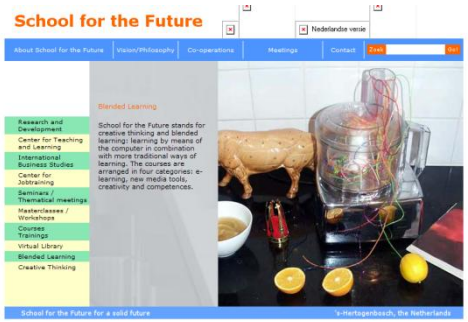

Their solution:

Assess the bsic skills of all the students with computer graded multiple choice test items.

Chart for every individual student the deficiencies.

Remediate the deficiencies with made to measure computer computerized exercises in a maximum of a 40 hours module.

My analysis:

This kind of solutions are completely useless.
It could well be quite a waste of time and
money to design it.

It would be for the 5th time in their educational career that they undergo the same procedure, with hardly any accumulation of knowledge or transfer at all.

My advice:

Take a completely other approach that is more consistent with your educational vision and more consistent with the students characteristics.

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Vul de getallen in:

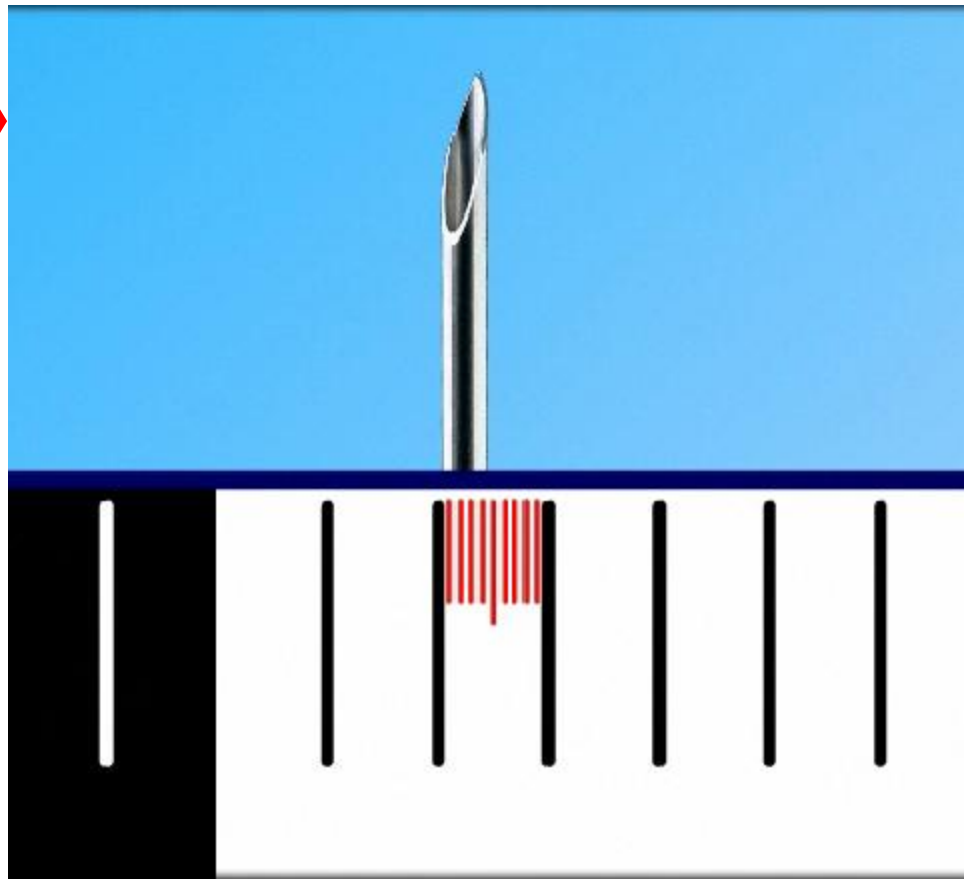
a. 25 mm = _____ cm

b. 3,75 km = _____ m

c. 5,5 cm^2 = _____ mm^2

d. 24.000 cm^2 = _____ m^2

e. 60 m^3 = _____ dm^3



Incongruity example 2

- TED Lectures
- Khan videos
  - http://www.khanacademy.org/
- Equation of a line
- GMAT problem solving 26

Incongruity example 3

- Dutch Numeracy Framework
- Lesson materials
- State tests

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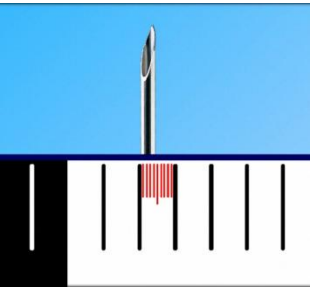
Can we improve “regular“ lesson materials and “regular” tests to fit more sophisticated numeracy concepts?



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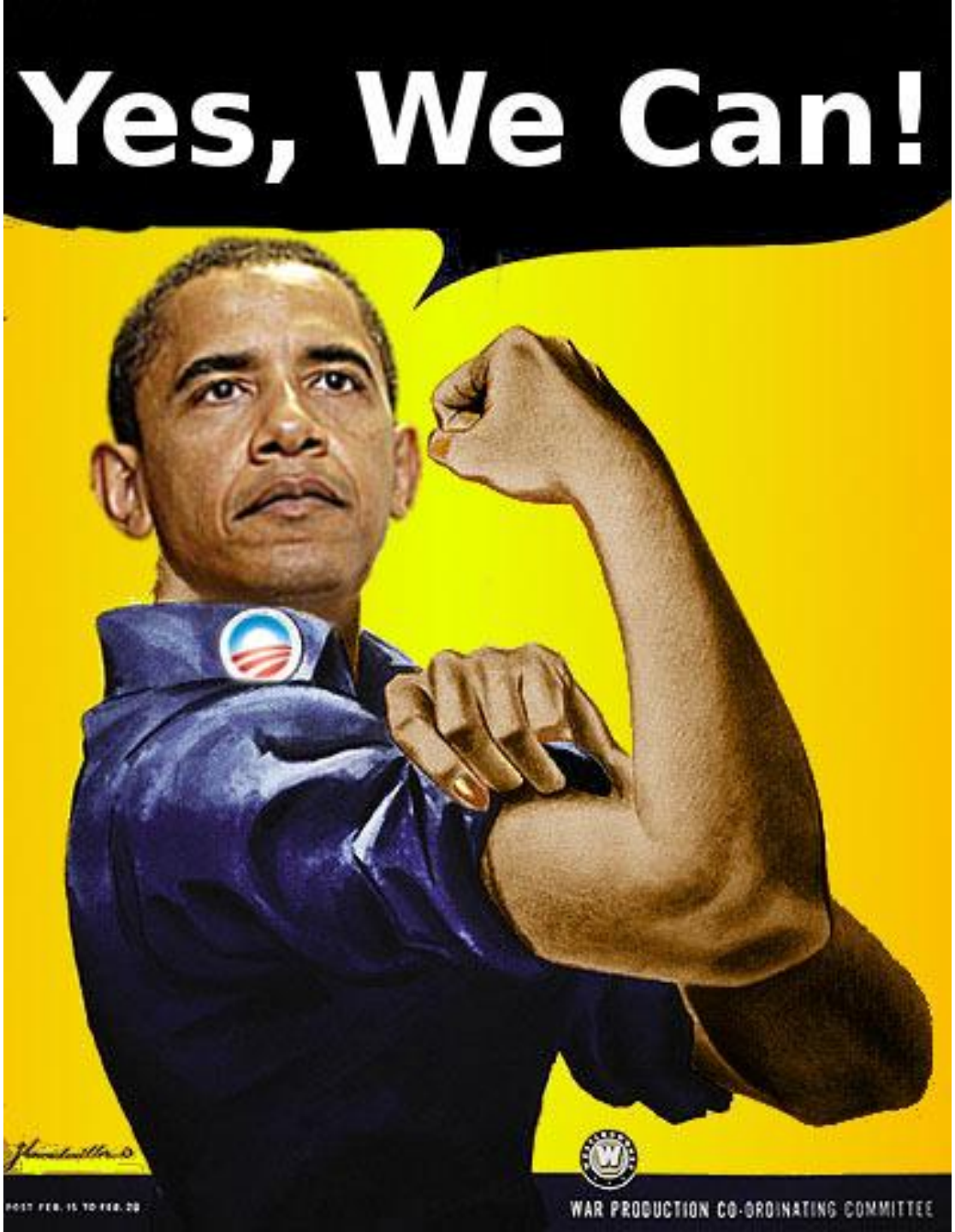

Criteria Numeracy problems

- It is a **N**umeracy problem when you have …
- …. **I**maginable questions …
- … **C**onnected with the real world, …
- … with a **M**inimum of language and …
- … a maximum use of **R**eal Images.

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Theoretical notions

- About the interaction
  - Visualisations and cognitive structures
  - Modality learning
  - Cognitive load theory
- About Learning
  - Activity theory
  - Inferentialism

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Franse Wraps met brie en honing

Frans tussendoor/snack met Wraps/pizza's

Bereidingstijd 15 minuten
Aantal personen 10 personen

Voor 10 personen:
- 1 pak wraps
- 200 g brie
- 150 g notenmelange
- honing

Hoeveel gram notenmelange heb je nodig voor 20 personen?

[ ] g

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Apple iPod nano 64 GB

Apple
Oranje | ook verkrijgbaar in Zwart, Blauw

Flashgeheugen, 64 GB | Audioformaten: mp3, mp3 VBR, AAC, WAV | Radio

1 muzieknummer is ongeveer 4 Mb

Hoeveel muzieknummers kunnen er ongeveer op deze iPod?

[ ] nummers.

Hoeveel minuten moet je met deze snelheid nog ongeveer rijden naar Stuttgart?

[ ] minuten

Research design

- 24 items in 2 equivalent versions: A and B
  - A = context is primarily language
  - B = context is primarily image
- Large scale testing with 24 items:
  - random 12 A + 12 B
- Research question: What is the effect of item characteristics on students' results?
- Hypothesis: low achieving students can show their skills better on version B items.

Preliminary results

- A lot of interest from schools
- Test run
  - > 100 schools
  - > 10.000 students
- Test run with 21 (not yet validated) pairs of items
- Ongoing as we speak
  - B version scores 5 - 10% higher

Interested?

To obtain the files from the hand outs , please send an e-mail to

K.Hoogland@aps.nl

Or visit the websites

www.gecijferdheid.nl

or

www.gecijferd.nl