Posters at the 2018 Swedish Biennale Stand

- **Math Dislike Cured by 1 Cup & 5 Sticks**
- **Migrant Math for STEM Teachers/Engineers**

INTRO: Saving the Princess with BundleNumbers

LEFT

Good Math: MANY-Math, Tales about Totals
Bad Math: SET-Math, Tales about LineNumbers
Evil MATH: Fraction-Math, Tales about Operators
Good Math: Icons, Bundling, ReCounting & PerNumbers
Core Math from Childhood
Grand Theory in Math Ed Research & Difference Research

MIDDLE

Math Dislike CURED by 1 Cup & 5 Sticks
Improving Schools in Sweden
Migrant-Math making migrants STEM-Teachers or Engineers
Count before you Add
Kids own Math
Activities

RIGHT

1Year online CATS-Course
1Week STEM-Course
Is Math True always or sometimes? Is Mathematics well-defined?
PYRAMIDeDUCATION & Material
Beware of Institutions & Teachers & Research & Forced Classes
Good & Bad & Evil Education
Rejected Research Papers

Research Paper: The Simplicity of Mathematics Designing a STEM-based Core Mathematics Curriculum for Young Male Migrants

(STEM: Science + Technology + Engineering + Mathematics)

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Saving the Princess with BundleNumbers

Once upon a time, a Princess was stuck in division. She simply could not do 336/7 and locked herself in behind a bush of thorns. The King summoned all the Wise who agreed that the Princess should be motivated by reformulating the task to split 336 among 7. Only a newcomer objected that the task was to recount 336 in 7s. “Here we all count in tens, so please wait at the lawn outside.” To solve the disagreement whether 7 should be above or below or to the right or left of 336, the Wise recommended all methods tried out together with an alternative method saying no method at all allowing the Princess to invent her own method. But nothing helped.

“Are there no other methods? Who is out on the lawn?” the King asked. “Just a newcomer with crazy ideas”. But in spite of strong protests from the Wise the King let him in.

“You also want to teach me division?”, the Princess asked. “No, I bring you a cup with 5 sticks that we will count.” “But they are already counted?” “ We will count them in bundles of 2s. As we see on our hand, this can be done in three ways: as 1 bundle & 3, as 2 bundles & 1, and as 3 bundles less 1. Using the cup for the bundles, we see that all numbers have inside bundles and outside singles; and that a total can be counted in the standard way or with an outside overload or an underload.”

“But isn’t 336 a name for a point far out on a number-line?” the Princess asked.

“No. 336 is not a line-number as everyone claims, it is a bundle-number. Asking 3year-olds “How old next time?” they say 4; but object to 4 fingers held together 2 by 2: “That is not 4 that is 2 2s.”

Children both see and count the bundles; and come to school with 2dimensional bundle-numbers or block-numbers with the core of mathematics inside them: 3 2s may be added to 1 4s in two ways; on-top, the units must be the same, and changing units is just another word for proportionality; and next-to means adding areas which is just another word for integral calculus.

So 336 is a bundle-number with 33 bundles inside and 6 singles outside. Wanting 28 bundles inside we move 5 bundles outside; so 33B6 and 28B56 is the same number just recounted with an overload. Counted in 7s we have 4 inside and 8 outside.

Consequently, a block of 33 tens & 6, or 336, can be recounted as a block of 48 7s; which makes sense since a shorter width calls for a larger height.”

All of a sudden, the thorns changed to roses. The Newcomer got the Princess and half the kingdom where they lived happily ever after.

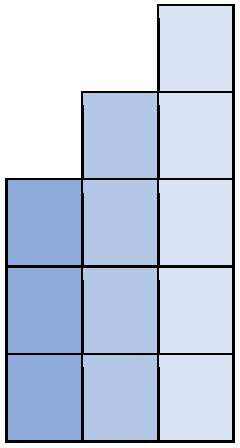
Good Math: MANY-Math

Tales about Totals

MANY-matics: A Natural Science about MANY

Meeting MANY we ask:

"How Many in Total?".



To answer, we Bundle and Stack in Blocks

T = 345 = 3*BB + 4*B + 5*1, or

T = 345 = 3*B^2 + 4*B + 5*1,

The SIMPLICITY of MANY-Math

First Iconize & Count & ReCount, then Add OnTop & NextTo

4 ways to add: + , * , ^ , ∫

Algebra unite/*split*	Variable	Constant
Unit-numbers	T = a+n *T-a = n*	T = a*n *T/a = n*
Per-numbers	T = ∫a dn *dT/dn = a*	T = a^n $log_a(T)=n$, $\sqrt[n]{T}=a$

Bad Math: SET-Math

Tales about LineNumbers

META-matics: concepts as examples of abstractions, not as abstractions of examples

00. Digits are symbols, not icons
01. Numbers are 1dimensional linear names, not 2dimensional bundle-blocks
02. Only ten-counting, no icon-counting
03. No 'T=', only 42; not 'T = 4.2 tens'
04. Add & Subtract before Multiply & Divide
05. Only OnTop addition - no NextTo addtion
06. 6*7 IS 42 – not 6 7s or 4.2 tens
07. 8/4 IS 8 split by 4; not 8 counted in 4s
08. No re-counting to create or remove over- or underloads when operating on numbers
09. Solving equations by neutralizing; not by re-counting in icons or reversed operations
10. Functions as set-relations; not as number-language sentences about the Total
11. Plane before coordinate geometry; not trigonometry before coordinate geometry
12. Differential before Integral Calculus.

Evil MATH: Fraction-Math

Tales about Operators

***Mathema-TISM**: True inside, but seldom outside*

Claim: 1/2+2/3 IS 7/6

But 1 blue of 2 + 2 of 3 is 3 blues of 5,
and not 7 blues of 6?

Claim: 2+3 IS 5

But 2weeks + 3days is 17days?

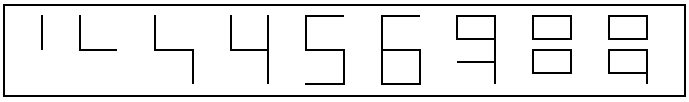
Never ADD without units

00. Fractions are numbers; not operators needing numbers to become numbers

01. Fractions add without units; not with units making it integral calculus

02. Fractions before percentages and decimals; not the inverse order

03. Fractions are equivalence classes in a set product; not per-numbers from double-counting in the same unit

00. Bundle in Icons. 

01. Count with Bundles. 0B1, 0B2, 0B3,…,1B0, 1B1

02. Count in Bundles. T = 5 = 𝍸 𝍸 I = 2**B**1 = 2.1 **2s**

03. ReCount formula predicts. T = (T/B)*B

from T, T/B times, B is taken away

04. ReCount. Same unit. T = 5 = 2.1 = 1.3 = 3.-1 **2s**

IIIII = 𝍸𝍸I = 𝍸III = 𝍸𝍸𝍸I

𝍸𝍸 = 𝍸𝍸I I = 𝍸𝍸II **New unit.** T = 2 **3s** = 1.2 **4s** = 1.1 **5s**

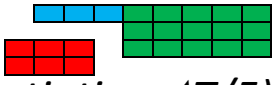
05. ReCount from icons to tens. T = 3 **4s** = 3*4 = 1.2 **tens**

from tens to icons. T = 42 = ? **7s** = x*7

06. Add OnTop.  T = 2 **3s** + 4 **5s** = 5.1 **5s**

NextTo.  T = 2 **3s** + 4 **5s** = 3.2 **8s**

Multiplication first, then addition (integration $\Sigma y^*\Delta x$)

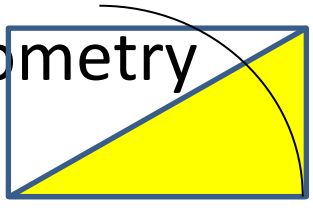
07. Adding reversed. T = 2 **3s** + ? **5s** = 3 **8s** 

Subtraction first, then division (differentiation $\Delta T/5$)

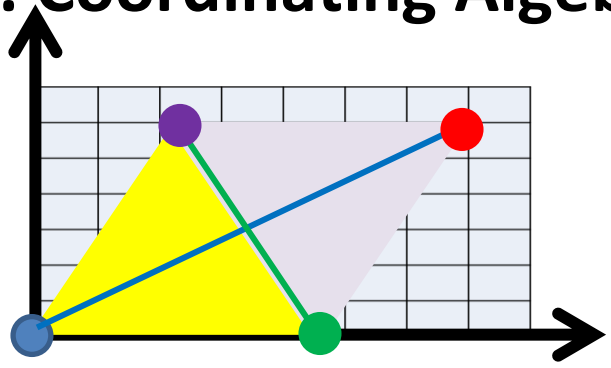
08. DoubleCount. PerNumbers 2$/5**kg** = 2/5 **$/kg**

09. PerNumber -> Fraction 2$/5$ = 2/5 (Same unit)

10. PerNumbers add by areas.  T = $\Sigma y^*\Delta x = \int y\,dx$

11. Counting lines and rotations. Trigonometry 

12. Coordinating Algebra & Geometry



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a Virus-e-cademy

Ask, not the instructor, but Many itself

Core Math from Childhood

Proportionality in Primary & Middle School

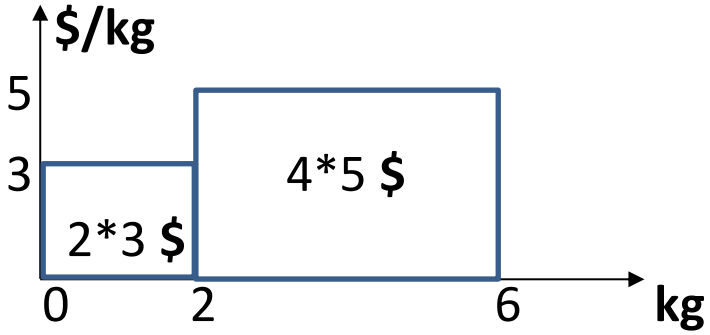
- Recount to change unit: 2 **3s** = (2*3/5)*5 = 1.1 **5s**
- With 2**$**/5**kg**, 20**kg** = (20/5)*5**kg** = (20/5)*2**$** = 8**$**
- Adding OnTop, 2 **3s** + 4 **5s** = ? **5s**

Calculus in Primary & Middle School

- Adding NextTo 2 **3s** + 4 **5s** = ? **8s**

	2 **kg**	at	3 **$/kg**
+	4 **kg**	at	5 **$/kg**
	(2+4)**kg**	at	~~(3+5)~~ **$/kg**

Unit-numbers add on-top.
Per-numbers add next-to as areas under the per-number graph.



Formulas in Primary & Middle School

- NumberLanguage Sentences about the Total, T = 4.2 tens = 42
- The general NumberFormula T = 3***B**^2+4***B**+5 with its examples
- T = a*x^2 + b*x + c; T = m*x, T = m*x + c, T = a*x^n, T = a*n^x

Equations in Primary & Middle School

Recount icons ← tens: x*7 = 42 = (42/7)*7, x = 42/7 (***opposite side & sign***)

The ReCount Formula is all over Mathematics

ReCount-formula: T = (T/B)*B 'from T, T/B times, B is taken away'

ReCounting	T = (T/B)*B	T = 8 = (8/2)*2 = 4*2 = 4 2s
Proportionality	$ = ($/kg)*kg	$ = price*kg
Coordinate Geometry	Δy = (Δy/Δx)*Δx	Δy = m*Δx
Differential Calculus	dy = (dy/dx)*dx	dy = y' * dx
Trigonometry	a = (a/c)*c = sinA*c;	a = (a/b)*b = tanA*b
Linearity	y = k*x	F = m*a, dist = vel*time, …
Eigenvalues	Hψ = E*ψ	Schroedinger Equation

Grand Theory in Math Ed Res.

BAUMAN & WEBER: ***Beware of Goal-Means exchanges***
ARENDT: ***- and of the Banality of Evil just following orders***
HEIDEGGER: ***Respect the Subject & question the Predicate***
FOUCAULT: ***- also question Cures and Institutions***

Difference Research

Finding Differences making a Difference

Almost Everything can be Different

DIGITS: Icons vs. symbols
NUMBERS: 2D bundlw-blocks vs. 1D line-names
OPERATIONS: Icons vs. inter-set mappings
ADDITION: OnTop/NextTo vs. only OnTop
MULTIPLICATION: ReCounting to tens vs. tables
DIVISION: ReCounting from tens vs. splitting
RE-COUNTING: Changing units vs. neglect
DOUBLE-COUNTING: Proportionality vs. neglect
PER-NUMBERS: Core numbers vs. neglect
FRACTIONS: PerNumbers vs. rational numbers
FRACTIONS: Operators vs. rational numbers
FORMULAS: Total statements vs. inter-set relations
EQUATIONS: ReCount in icons vs. open statements
GEOMETRY: Trigonometry before coord. geometry
vs. plane geometry first
POLYNOMIALS: Number-formulas vs. functions
CALCULUS: Integrate bef. differentiate vs. inverse

Math Dislike CURED

By 1 Cup & 5 sticks

*My Many Math Tears will not Stay – if I **Bundle** the Stray Away*

BundleCOUNT first - then ADD

T = 5 = II I I I =  I I I = 1]3 = 1B3 = 1.3 **2s**

T = 5 = II II I =  I = 2]1 = 2B1 = 2.1 **2s**

T = 5 = II II III =  I = 3]-1 = 3B-1 = 3.-1 **2s**

3 ways to BundleCount: Overload, Normal, Underload

ReCount 47 in **tens**: T = 47 = 4B7 = 3B17 = 5B-3 **tens**

NO, 4x7 is not 28, but 4 **7s,** or 2B8 = 1B18 = 3B-2 **tens**

NO, 30/6 is not 30 split by 6, it is **3 tens** split (recounted) in **6s**

BundleWriting tells **Inside Bundles** from **Outside Singles**

- **65 + 27**= 6B5 + 2B7 = 8B12 = 9B2 = **92**
- **65 – 27**= 6B5 – 2B7 = 4B-2 = 3B8 = **38**
- **7x 48** = 7x 4B8 = 28B56 = 33B6 = **336**
- **336 /7** = 33B6 /7 = 28B56 /7 = 4B8 = **48**

- **65 + 27** = 6]5 + 2]7 = 8]12 = 9]2 = **92**
- **65 – 27** = 6]5 – 2]7 = 4]-2 = 3]8 = **38**
- **7x 48** = 7x 4]8 = 28]56 = 33]6 = **336**
- 336 **/7** = 33]6 /7 = 28]56 /7 = 4]8 = **48**

Improving Schools in Sweden:

An OECD Perspective

to Improve Schools
choose
Good or Bad or Evil
Math Education

OECD
BETTER POLICIES FOR BETTER LIVES

Migrant-Math

Migrants returning to rebuild as **STEM** Teachers/Engineers

½year STEM-Course using the SIMPLICITY of MANY-Math

Count, ReCount & DoubleCount before Adding

- **Block-numbers** with units, not line-numbers without units
- Dividing & multiplying & subtraction first – adding much later
  - Proportionality as **ReCounting**. The ReCount-formula **T = (T/B)*B**
  - Multiplication tables as **ReCounting**
  - Equations as **ReCounting**
  - Fractions & statistics as **PerNumbers** from **DoubleCounting**
- Adding OnTop & **NextTo** (proportionality & calculus)
- Trigonometry before coordinate geometry
- Functions as Total-formulas, not set-relations
- Calculus as adding **PerNumbers** and fractions with units
- Integral calculus before differential calculus

❖ **PerNumbers** in Time, Space, Matter, Force and Energy

Joule/second, Joule/kg, Joule/degree, meter/second, kg/m^3, g/l, Newton/m^2.

❖ Warming and boiling water

Warm whisky on the rocks in cold water. What is the end temperature?

❖ Letting steam work

Increasing the volume 20% and decreasing the temperature 10% changes the pressure

❖ An electrical circuit

A 60Watt bulb supplied by 110Volt results in which current at which resistance

❖ How high up and how far out

With 30m/s a ball is send up a 30degree incline lifted 1.23 m. What happens?

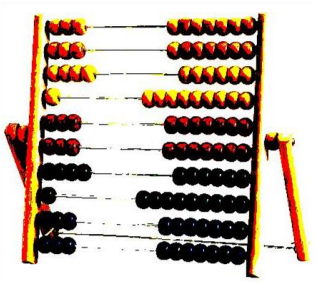
❖ Constructing a road up a steep hill

How many turns will a 10degree road have on a 1x1 km^2 30degree hillside?

❖ Producing alcohol from sugar

How much alcohol comes from 34.5gram sugar?

STEM: Science + Technology + Engineering + Math



Count before you Add

MatheMatics as ManyMath

a Natural Science about MANY

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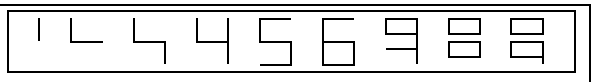
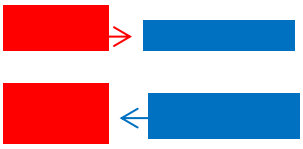
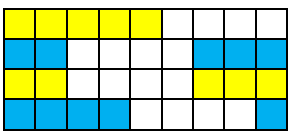
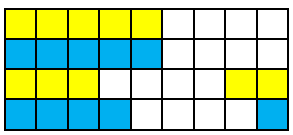
Cure **Math Dislike**: Use Kid's own 2D **BlockNumbers** with Units

Count In *Icons* In *Bundles*	 T = I I I I =  = 4 T = 7 = I I I I I I I = III III I = II I = 2B1 3s or 1B4 3s or 3B-2 3s
ReCount In same Unit In new Unit	**ReBundle** to create Overload & Underload T = 7 = I I I I I I I = 2B1 3s = 1B4 3s = 3B-2 3s T = 2B1 3s = 1B3 4s = 1B2 5s = 3B1 2s = 1BB1B1 2s = 11B1 2s
ReCount In Tens From Tens	 3 7s = ? tens Answer: 3x7 = 21 = 2B1 tens ? 7s = 3 tens Answer: (30/7)x7 = 4B2 7s
DoubleCount in *PerNumbers* in *PerFive, 3/5* in *PerHundred, %*	With 4$ per 5kg or 4/5 $/kg, T = 20kg = (20/5) x 5kg = (20/5) x 4$ = 16$ 3/**5** of 200$ = ?$. 200$ = (200/5) x 5$ = **5** (200/5$) gives (200/5$) x 3 = 120$ 70**%** of 300$ = ?$. 300$ = (300/100) x 100$ = **100** (300/100$) gives (300/100$) x 70 = 210$
Calculator Prediction RecountFormula	T = 2 **4s** = ? 5s = 1B3 5s since T = (T/B) x B = T/B **Bs** 2x4/5 1.some 2x4 – 1x5 3
Add NextTo OnTop	T = 2 3s + 4 5s = 3B2 8s  *Integration* T = 2 3s + 4 5s = 1B1 5s + 4 5s = 5B1 5s  *Proportionality*
Multiply, Divide Use *BundleWriting*	7 x 63 = 7 x 6B3 = 42B21 = 44B1 = 441 7 x 63 = 7 x 6]3 = 42]21 = 44]1 = 441 245 /7 = 24B5 /7 = 21B35 /7 = 3B5 = 35 5 /7 = 24]5 /7 = 21]35 /7 = 3]5 = 35

T = 7 = 2B1 3s on an **Abacus**:


Geometry-mode


Algebra-mode

MrAlTarp

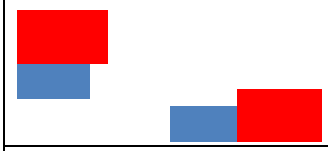
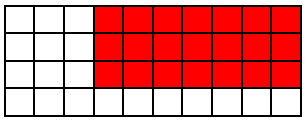
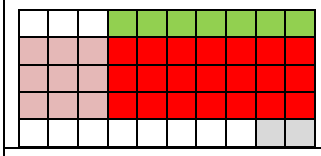
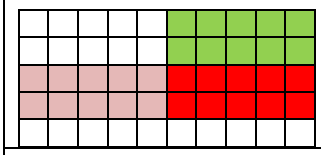
YouTube Videos

Allan.Tarp@MATHeCADEMY.net

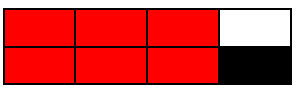
MATHeCADEMY.net **2018 offer: Week 01 ½ price, Vk€**	*Teaching Teachers to Teach MatheMatics as ManyMath* PYRAMIDeDUCATION **CATS**: **C**ount & **A**dd in **T**ime & **S**pace

Kids' own Math

NumberBlocks, ReShaped (Proportionality) - or added NextTo (Calculus), predicted by the ReCount-formula

	*You will be 4 next time?* Yes, but that is not 4, it is 2 **2s**
II I I I *How many?* II II I	1 **2s** & 3 2 **2s** & 1 or 3 **2s** less 1
Talking with a 5year old IIII IIII IIII 3x4/5 2.some 3x4-2x5 2	*How many 5s?* Bundling, I take 5 away 2 times. That leaves 2 singles. So 2 **5s** & 2 *Can you predict it with a calculator?* 3 4s is 3x4. Taking 5s away means dividing by 5. It gives 2. Then the 2 5s is taken away with minus. It gives 2 also. So again 2 **5s** & 2
	*How about adding 2 **3s** and 4 **5s**?* On-top or next-to? *Both, please.* On-top: T = 2 **3s** + 4 **5s** = 1**B**1 **5s** + 4**B**0 **5s** = 5**B**1 **5s** Next-to: T = 2 **3s** + 4 **5s** = 0**B**6 **8s** + 2**B**4 **8s** = 2**B**10 **8s** = 3**B**2 **8s**
	*How many **tens** is 3 **7s**?* On an abacus I see, that the width is longer, so the height is shorter. I take 3 from the top 2 times to get **tens**. So 2 **tens** & 1
	*How many **7s** is 30?* 30 is 3 **tens**, On an abacus I see, that the width is shorter, so the height is longer. I take 3 to the top 3 times to get **tens**. So 4 **7s** & 2
	*Can you solve the equation x*5 = 20?* You mean how many **5s** in 2 **tens**? You just count 20 in **5s** by dividing by 5, 20/5 gives 4. So 20 = 4 **5s**. The answer is 4.
456	*This means what?* 4 **bundle-bundles** and 5 **bundles** and 6 singles
BBB = DDDD	*If 3 **Bs** is the same as 4 **Ds**, then what is 15 **Bs**?* Well I just count 15 in **3s** and get 5 **3s**, so I have 4 **Ds** 5 times, 5 **4s Ds**

A BlockNumber contains 3 numbers: the **COUNTER**, the **UNIT** and the **SINGLES**



T = 43 =	**4**	**ten**	**3**
T = 2.1 3s	**2**	**3**	**1**

Counters: don't add unless the units are the same
Units: don't add, unless you add next-to
Singles: Add, but be aware of bundles

Geometry & Algebra: Always together – never apart

In Numbers, ReCounting, Multiplication, Addition etc.

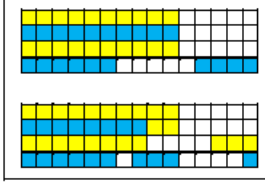
Activities

4 Counted in 3s

Sticks

G-counting		A-counting	
IIII	*lay out*	IIII	*lay out*
𝍸I	*bundle*	𝍸I	*bundle*
		(I) (I)	*cups*
[𝍸] I	*stack*	1) 1)	*cup-writing*
T = 1.1 3s	Total	T = 1.1 3s	*Total*

Abacus

G-mode	A-mode
	

Calculator

4 / 3	1.some
4 – 1 x 3	1

T = 4 = 1.1 3s

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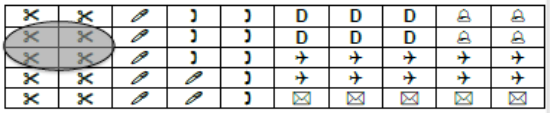
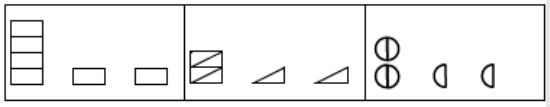
4

Round it up & Color it

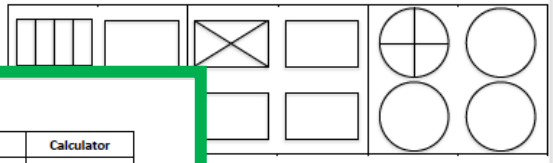


Clap, Sing, Walk, Act & Letter it

Unite it



Split it



each counting two

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Contents

03. CupCounting in Icons

Job		Do	Calculator
9 in 5s	Line	T = I I I I I I I I I	9/5 1.some
	Count	1, 2, 3, 4, B, 1B1, 1B2, 1B3, 1B4	9 – 1*5 4
	Bundle	T = 𝍸𝍸I I I I	
	Stack		9 – 0*5 9
	Cup	T = 1)4 5s = 0)9 5s = 2)-1 5s	9 – 2*5 -1
	Answer	T = 9 = 1.4 5s	
9 in 4s	Line	T = I I I I I I I I I	9/4 2.some
	Count	1, 2, 3, B, 1B1, 1B2, 1B3, 2B, 2B1	9 – 2*4 1
	Bundle	T = 𝍸𝍸I 𝍸𝍸I I	
	Cup	T = 2)1 4s = 1)5 4s = 3)-3 4s	9 – 1*4 5
	Stack		9 – 3*4 -3
	Answer	T = 9 = 2.1 4s	
9 in 3s	Line		9/
	Count		9 –
	Bundle		
	Cup		
	Stack		
	Answer		
8 in 4s	Line		
	Count		8
	Bundle		8
	Cup		
	Stack		
	Answer		
8 in 3s	Line		
	Count		8
	Bundle		8
	Cup		
	Stack		
	Answer		

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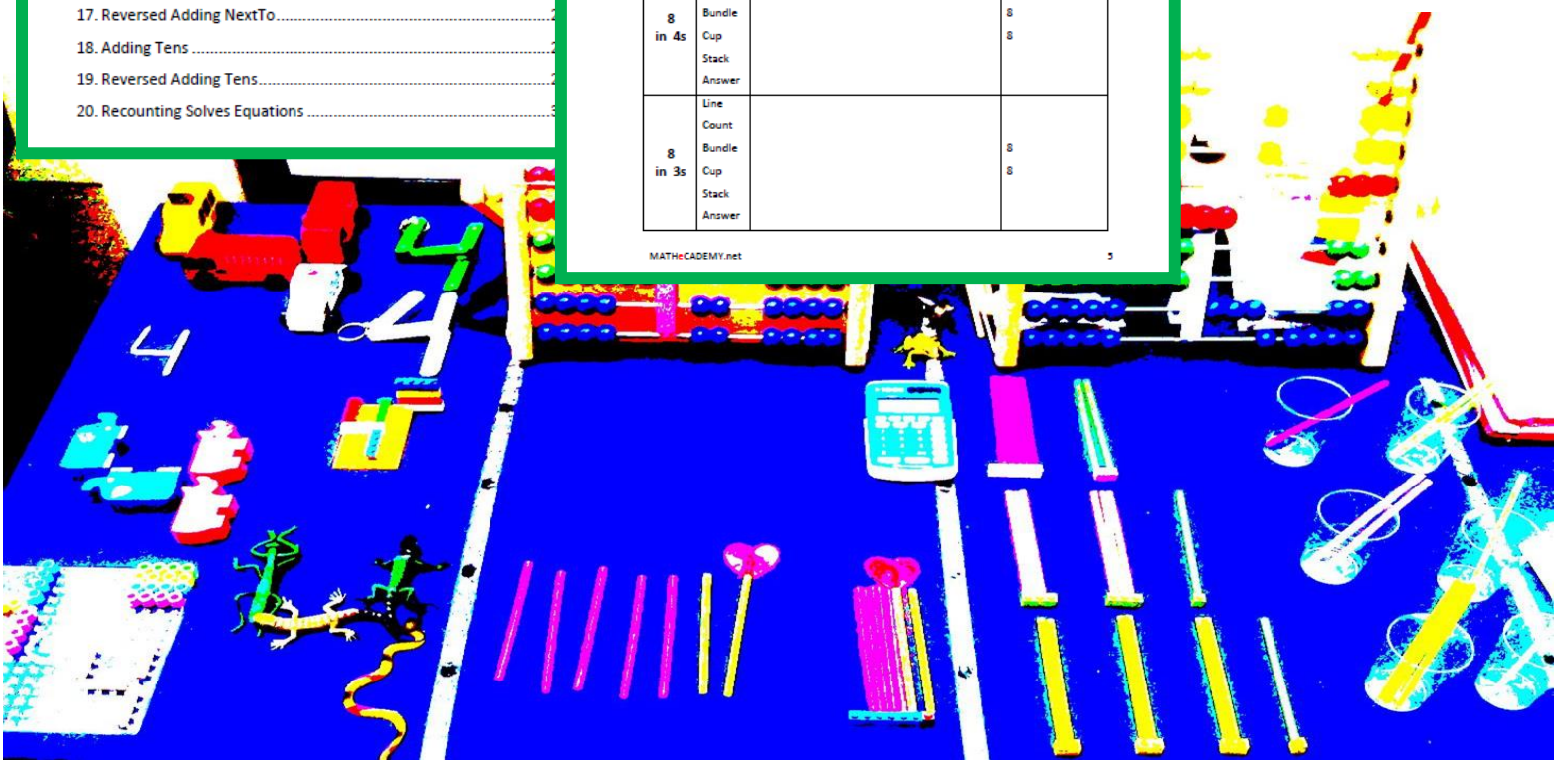


1Year online CATS-Course

CATS: Count & Add in Time & Space

1: Primary, 2: Secondary School

	Self Instructing QUESTIONS
C1 COUNT	How to count Many? How to recount 8 in **3s**: T= 8 = ? **3s** How to count in standard bundles? How to recount 6**kg** in **$ with 2$/4kg**: T = 6**kg** = ?**$**
C2 COUNT	How can we count possibilities? How can we predict unpredictable numbers?
A1 ADD	How to add blocks concretely? T = 27 + 16 = 2**ten**7 + 1**ten**6 = 3**ten**13 = ? How to add blocks abstractly?
A2 ADD	What is a prime and a folding number? What is a per-number? How to add per-numbers?
T1 TIME	How can counting & adding be reversed ? Counting ? **3s** and adding 2 gave 14. Can all calculations be reversed?
T2 TIME	How to predict the terminal number • If the change is constant? • If the change is variable, but predictable?
S1 SPACE	How to count plane and spatial properties of blocks and round objects?
S2 SPACE	How to predict the position of points and lines? How to use the new calculation technology?
QL	What is quantitative literature? Does it also have the 3 different genres: fact, fiction and fiddle?

1Week STEM-Course

The Simplicity of Math:

First Count & ReCount - then Add OnTop & NextTo

Day 01. Good & Bad & Evil Math in General

The root of math: MANY or SET

Day 02. Good & Bad & Evil Math in Primary School

Iconize & Count & ReCount before you ADD

Day 03. Good & Bad & Evil Math in Middle School

DoubleCounting and PerNumbers vs. Fractions

Day 04. Good & Bad & Evil Math in High School

Calculus: adding locally constant PerNumbers

Day 05. Good Math in a STEM setting

PerNumbers Predicting Matter in Time and Space

Spring 2018 Offer

Week 01: ½ fee Vk€

Is Math True always or sometimes?

Is this True	Always Never Sometimes
$2 + 3 = 5$	X *2weeks + 3days = 17days; only with the same unit*
$2 \times 3 = 6$	X *2x3 is 2 **3s** III III that can always be recounted as 6 **1s***
$\frac{1}{2} + \frac{2}{3} = \frac{3}{5}$	 X *1 red of 2 apples + 2 of 3 is 3 of 5, and not 7 of 6*
$\frac{1}{2} + \frac{2}{3} = \frac{7}{6}$	X *Only if taken of the same total*
A FUNCTION is	• **for example 2+x, but not 2+3;** i.e. a name for a calculation with an unspecified number (before SET, 1750-1900) • **an example of a set relation,** where first component identity implies second component identity (after SET, 1900)

Is Mathematics Well Defined?

Ancient Greece

A common **LABEL** for **Quadrivium**: Arithmetic, Geometry, Music & Astronomy (Many by itself and in space & time). **Trivium**: Grammar, Logic, Rhetoric

PreModern

A common **LABEL** for Arithmetic & Geometry; different from “Rechnung”.

Modern

A self-referring **SET** of Proofs about **SET**-derived Concepts.

PostModern

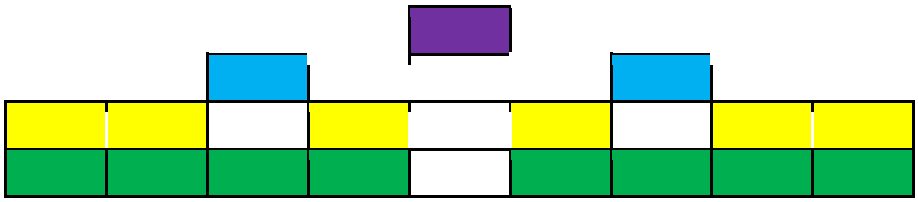
Many-math: A **Natural SCIENCE** Counting & Adding & Predicting Many.

PYRAMIDeDUCATION

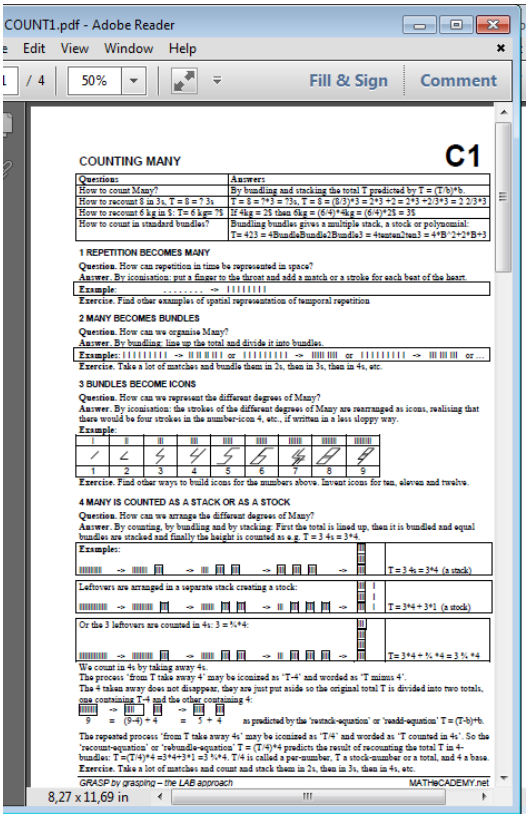
8 learners organized in 2 teams with 2 instructors and 3 pairs by turn.

- Each pair works together to solve **C**ount&**A**dd problems.
- The coach assists the instructors when instructing their team and when correcting the **C**ount&**A**dd assignments.
- Each learner pays by coaching a new group of 8 learners.

1 Coach
2 Instructors
3 Pairs
2 Teams



Material: short & self-instructing


COUNT1.pdf - Adobe Reader

COUNTING MANY C1

Questions | Answers
How to count Many? | By bundling and stacking the total T predicted by T = (T-b)*b
How to recount 8 in 3s, T = 8 = ? 3s | T = 8 = 1*3 + 5, T = 8 = (8/3)*3 + 2 = 2*3 +2 = 2 3*3 = 2 2/3*3
How to recount 6 kg in 5. T= 6 kgs ?5 | If 4kg = 25 then 6kg = (6/4)*4kg = (6/4)*25 = 35
How to count in standard bundles? | Bundling bundles gives a multiple stack, a stock or polynomial: T= 423 = 4Bundle$Bundle2Bundle3 = 4*tentwo2ten3 = 4*B^2+2*B+3

1 REPETITION BECOMES MANY

Question. How can repetition in time be represented in space?
Answer. By iconisation: put a finger to the throat and add a match or a stroke for each beat of the heart.
Example: ..... -> IIIIIIIII
Exercise. Find other examples of spatial representation of temporal repetition

2 MANY BECOMES BUNDLES

Question. How can we organise Many?
Answer. By bundling: line up the total and divide it into bundles.
Examples: IIIIIIIII -> III III III or IIIIIIIII -> IIII III or IIIIIIIII -> III III III or ...
Exercise. Take a lot of matches and bundle them in 2s, then in 3s, then in 4s, etc.

3 BUNDLES BECOME ICONS

Question. How can we represent the different degrees of Many?
Answer. By iconisation: the strokes of the different degrees of Many are rearranged as icons, realising that there would be four strokes in the number-icon 4, etc., if written in a less sloppy way.
Example:

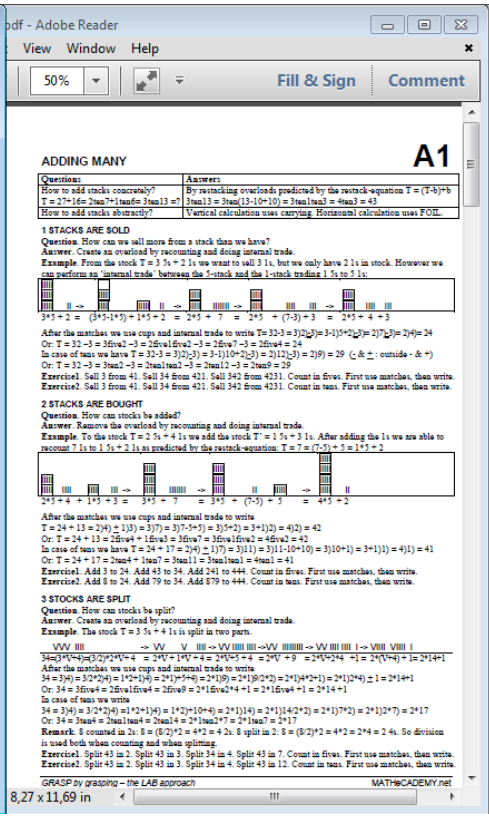
1 2 3 4 5 6 7 8 9

Exercise. Find other ways to build icons for the numbers above. Invent icons for ten, eleven and twelve.

4 MANY IS COUNTED AS A STACK OR AS A STOCK

Question. How can we arrange the different degrees of Many?
Answer. By counting, by bundling and by stacking. First the total is lined up, then it is bundled and equal bundles are stacked and finally the height is counted as e.g. T = 3 4s = 3*4.
Examples:
IIIIIIIII -> IIIIIIIII -> IIIIIIIII -> IIIIIIIII -> T = 3 4s = 3*4 (a stack)
Leftovers are arranged in a separate stack creating a stock:
IIIIIIIII -> IIIIIIIII -> IIIII IIIII -> II IIIII IIIII -> T = 3*4 + 3*1 (a stock)
Or the 3 leftovers are counted in 4s: 3 = ¾*4:
IIIIIIIII -> IIIIIIIII -> IIIII IIIII -> II IIIII IIIII -> T = 3*4 + ¾ *4 = 3 ¾ *4
We count in 4s by taking away 4s.
The process 'from T take away 4' may be iconised as 'T-4' and worded as 'T minus 4'.
The 4 taken away does not disappear, they are just put aside so the original total T is divided into two totals, one containing T-4 and the other containing 4:
IIIIIIIII -> IIIII IIIII -> IIIII IIIII
9 = (9-4) + 4 = 5 + 4 as predicted by the 'restack-equation' or 'readd-equation' T = (T-b)+b.
The repeated process 'from T take away 4s' may be iconised as 'T/4' and worded as 'T counted in 4s'. So the 'recount-equation' or 'rebundle-equation' T = (T/4)*4 predicts the result of recounting the total T in 4-bundles: T = (T-4)*4 =2*4+3*1 =3 *4+1. T/4 is called a per-number, T a stock-number or a total, and 4 a base.
Exercise. Take a lot of matches and count and stack them in 2s, then in 3s, then in 4s, etc.

GRASP by grasping – the LAB approach MATHeCADEMY.net
8,27 x 11,69 in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ADDING MANY A1

Questions | Answers
How to add stacks concretely? | By restacking overloads predicted by the restack-equation T = (T-b)+b
T = 27+16= 2ten7+1ten6= 3ten13 =? | 3ten13 = 3ten(13-10+10) = 3ten1ten3 = 4ten3 = 43
How to add stacks abstractly? | Vertical calculation uses carrying. Horizontal calculation uses FOIL.

1 STACKS ARE SOLD

Question. How can we sell more from a stock than we have?
Answer. Create an overload by recounting and doing internal trade.
Example. From the stock T = 3 5s + 2 1s we want to sell 3 1s, but we only have 2 1s in stock. However we can perform an 'internal trade' between the 5-stack and the 1-stack trading 1 5s to 5 1s:
3*5 + 2 = (3+5-1*5) + 1*5 + 2 = 2*5 + 7 = 2*5 + (7-3) + 3 = 2*5 + 4 + 3
After the matches we use cups and internal trade to write T= 32-3 = 3)(2(3)= 3-1)5+2(3)= 2)7(3)= 2)4)= 24
Or: T = 32 -3 = 3five2 -3 = 2five1five2 -3 = 2five7 -3 = 2five4 = 24
In case of tens we have T = 32-3 = 3)(2-3) = 3-1)10+2(-3) = 2)12(-3) = 2)9) = 29 (- & +: outside - & +)
Or: T = 32 -3 = 3ten2 -3 = 2ten1ten2 -3 = 2ten12 -3 = 2ten9 = 29
Exercise1. Sell 3 from 41. Sell 34 from 421. Sell 342 from 4231. Count in fives. First use matches, then write.
Exercise2. Sell 3 from 41. Sell 34 from 421. Sell 342 from 4231. Count in tens. First use matches, then write.

2 STACKS ARE BOUGHT

Question. How can stocks be added?
Answer. Remove the overload by recounting and doing internal trade.
Example. To the stock T = 2 5s + 4 1s we add the stock T' = 1 5s + 3 1s. After adding the 1s we are able to recount 7 1s to 1 5s + 2 1s as predicted by the restack-equation: T = 7 = (7-5) + 5 = 1*5 + 2
2*5 + 4 + 1*5 + 3 = 3*5 + 7 = 3*5 + (7-5) + 5 = 4*5 + 2
After the matches we use cups and internal trade to write
T = 24 + 13 = 2)4) + 1)3) = 3)7) = 3)7-5+5) = 3)5+2) = 3+1)2) = 4)2) = 42
Or: T = 24 + 13 = 2five4 + 1five3 = 3five7 = 3five1five2 = 4five2 = 42
In case of tens we have T = 24 + 17 = 2)4) + 1)7) = 3)11) = 3)(11-10+10) = 3)10+1) = 3+1)1) = 4)1) = 41
Or: T = 24 + 17 = 2ten4 + 1ten7 = 3ten11 = 3ten1ten1 = 4ten1 = 41
Exercise1. Add 3 to 24. Add 43 to 34. Add 241 to 444. Count in fives. First use matches, then write.
Exercise2. Add 8 to 24. Add 79 to 34. Add 879 to 444. Count in tens. First use matches, then write.

3 STOCKS ARE SPLIT

Question. How can stocks be split?
Answer. Create an overload by recounting and doing internal trade.
Example. The stock T = 3 5s + 4 1s is split in two parts.
VV III -> VV V III -> VV IIIII III -> VV IIIIIII I -> VIII VIII I
34=(3*5+4)=(3/2)*2*5+4 = 2*5' + 1*5' + 4 = 2*5'+5 + 4 = 2*5' + 9 = 2*5'+2*4 +1 = 2*(5'+4) + 1= 2*14+1
After the matches we use cups and internal trade to write
34 = 3)4) = 3)7-2)4) = 1*2+1)4) = 2*1)+5+4) = 2*1)9) = 2*1)8/2) = 2*1)4*2+1) = 2*1)2*4) + 1 = 2*14+1
Or: 34 = 3five4 = 2five1five4 = 2five9 = 2*1five2*4 +1 = 2*1five4 +1 = 2*14 +1
In case of tens we write
34 = 3)4) = 3/2*2)4) =1*2+1)4) = 1*2)+10+4) = 2*1)14) = 2*1)14/2*2) = 2*1)7*2) = 2*1)2*7) = 2*17
Or: 34 = 3ten4 = 2ten1ten4 = 2ten14 = 2*1ten2*7 = 2*1ten7 = 2*17
Remark. 8 counted in 2s: 8 = (8/2)*2 = 4*2 = 4 2s. 8 split in 2: 8 = (8/2)*2 = 4*2 = 2*4 = 2 4s. So division is used both when counting and when splitting.
Exercise1. Split 43 in 2. Split 43 in 3. Split 34 in 4. Split 43 in 7. Count in fives. First use matches, then write.
Exercise2. Split 43 in 2. Split 43 in 3. Split 34 in 4. Split 43 in 12. Count in tens. First use matches, then write.

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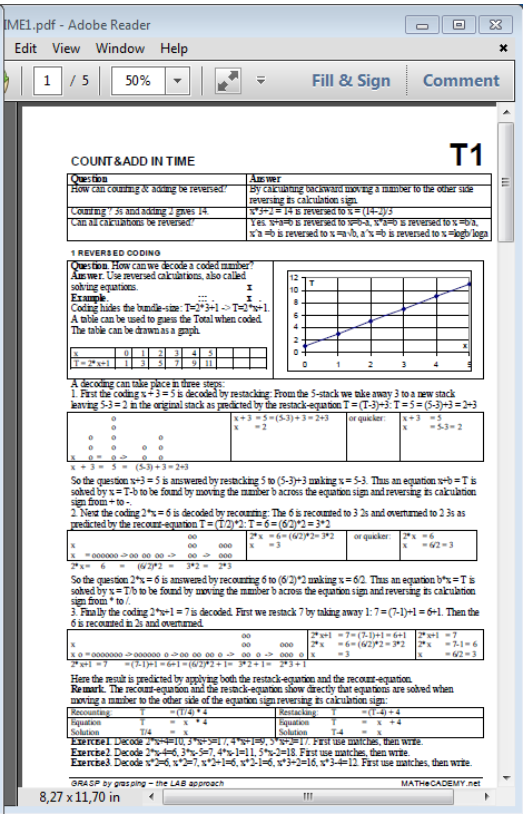
IME1.pdf - Adobe Reader

COUNT&ADD IN TIME T1

Question. How can we decode a coded number?
Answer. Use reversed calculations, also called solving equations.
Example: x
Coding hides the bundle-size: T=2*3+1 -> T=2*x+1.
A table can be used to guess the Total when coded.
The table can be drawn as a graph.

x | 0 | 1 | 2 | 3 | 4 | 5
T = 2*x+1 | 1 | 3 | 5 | 7 | 9 | 11

1 REVERSED CODING

A decoding can take place in three steps:
1. First the coding x + 3 = 5 is decoded by restacking: From the 5-stack we take away 3 to a new stack leaving 5-3 = 2 in the original stack as predicted by the restack-equation T = (T-3)+3: T = 5 = (5-3)+3 = 2+3
x + 3 = 5 = (5-3) + 3 = 2+3 or quicker: x + 3 = 5, x = 5-3 = 2
So the question x+3 = 5 is answered by restacking 5 to (5-3)+3 making x = 5-3. Thus an equation x+b = T is solved by x = T-b to be found by moving the number b across the equation sign and reversing its calculation sign from + to -.
2. Next the coding 2*x = 6 is decoded by recounting: The 6 is recounted to 3 2s and overturned to 2 3s as predicted by the recount-equation T = (T/2)*2. T = 6 = (6/2)*2 = 3*2
2*x = 6 = (6/2)*2 = 3*2, x = 3 or quicker: 2*x = 6, x = 6/2 = 3
So the question 2*x = 6 is answered by recounting 6 to (6/2)*2 making x = 6/2. Thus an equation b*x = T is solved by x = T/b to be found by moving the number b across the equation sign and reversing its calculation sign from * to /.
3. Finally the coding 2*x+1 = 7 is decoded. First we restack 7 by taking away 1: 7 = (7-1)+1 = 6+1. Then the 6 is recounted in 2s and overturned.
2*x+1 = 7 = (7-1)+1 = 6+1 = (6/2)*2 + 1 = 3*2 + 1 = 2*3 + 1
2*x+1 = 7, 2*x = 6 = (6/2)*2 = 3*2, x = 3, or quicker: 2*x+1 = 7, 2*x = 7-1 = 6, x = 6/2 = 3
Here the result is predicted by applying both the restack-equation and the recount-equation.
Remark. The recount-equation and the restack-equation show directly that equations are solved when moving a number to the other side of the equation sign reversing its calculation sign:
Recounting: T = (T/4) * 4 | Restacking: T = (T-4) + 4
Equation T = x * 4 | Equation T = x + 4
Solution T/4 = x | Solution T-4 = x
Exercise1. Decode 2*x+1=10, 3*x+5=17, 4*x+1=9, 5*x+2=17. First use matches, then write.
Exercise2. Decode 2*x-4=6, 3*x-5=7, 4*x-1=11, 5*x-2=18. First use matches, then write.
Exercise3. Decode x*2=6, x*2=7, x*2+1=6, x*3+2=16, x*3-4=12. First use matches, then write.

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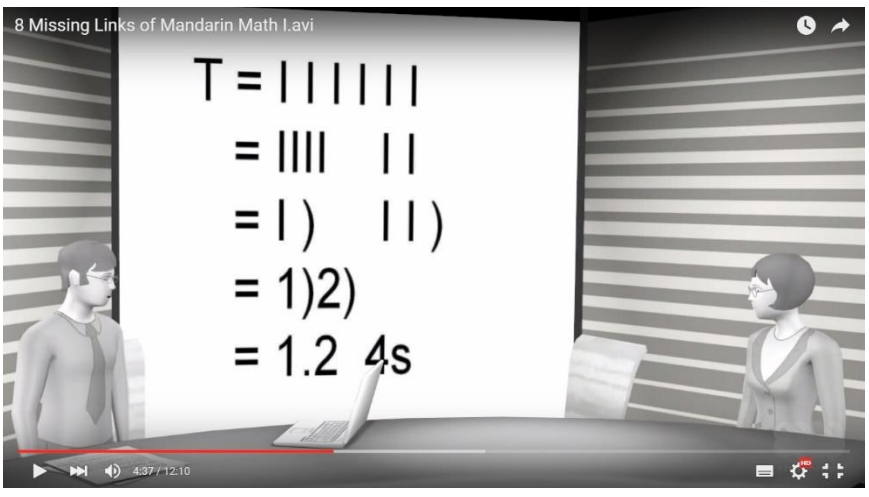
YouTube Videos

- Postmodern Mathematics Debate
- CupCounting removes Math Dislike
- IconCounting & NextTo-Addition
- PreSchool Mathematics
- Fractions
- PreCalculus & Calculus
- Mandarin Mathematics
- World History



Beware of

INSTITUTIONS exchanging goals and means

- The goal of math education is to ~~learn math~~ master Many with quantitative competence

TEACHERS teaching Bad & Evil math

- LINE-numbers instead of BUNDLE-numbers
- Addition before Counting & Multiplication
- Adding Fractions without units
- Differential before Integral Calculus

RESEARCH uncritically

- researching itself instead of math education
- exemplifying instead of questioning itself
- accepting math as self-referring MetaMath
- accepting 50 years of unsuccessful research

FORCED CLASSES

- Constraining young people to stay with their age-group for several years - instead of choosing their own daily ½year blocks in order to uncover and develop their personal talent

EDUCATION

GOOD	
Primary Secon-dary	●An extra parent through a warm Nanny teaching Language&Society and Mathematics&Nature ●Support for the individual identity-work through self-chosen academic or practical ½year blocks with 1-subject teachers apprising the talent or the courage to try out the unknown
BAD	
Primary Secon-dary	●Multiple teachers from grade 1 ●Fixed classes and schedules forcing teenagers to follow the age-group for several years; thus making the school a **PRIS-PITAL** (Foucault) combining the power techniques of a **PRISON** (you can leave after 4 years with a leave after 8 hours) and a **HOSPITAL** (you will be cured for the diagnose 'ignorant')
EVIL	
Primary & Secon-dary	Practicing **Goal Displacement** (Bauman) so a means becomes a goal. *The goal of math education is to learn math?* **NO.** By self-reference math education then becomes an undiagnosed cure. **YES**. The goal of math education is to Master Many through Quantitative Competence

Rejected Research Papers

Allan Tarp, MATHeCADEMY.net, the 2018 MADIF Conference

The Simplicity of Mathematics Designing a STEM-based Core Math Curriculum for Young Male Migrants

Educational shortages described in the OECD report 'Improving Schools in Sweden' challenge traditional math education offered to young male migrants wanting a more civilized education to return help develop and rebuild their own country. Research offers little help as witnessed by continuing low PISA scores despite 50 years of mathematics education research. Can this be different? Can mathematics and education and research be different allowing migrants to succeed instead of fail? A different research, difference-research finding differences making a difference, shows it can. STEM-based, mathematics becomes Many-based bottom-up Many-matics instead of Set-based top-down Meta-matics.

REJECTED

Math Competenc(i)es - Catholic or Protestant?

Introduced at the beginning of the century, competencies should solve poor math performance. Adopted in Sweden together with increased math education research mediated through a well-funded centre, the decreasing Swedish PISA result came as a surprise, as did the critical 2015 OECD-report 'Improving Schools in Sweden'. But why did math competencies not work? A sociological view looking for a goal displacement gives an answer: Math competencies sees mathematics as a goal and not as one of many means, to be replaced by other means if not leading to the outside goal. Only the set-based university version is accepted as mathematics to be mediated by teachers through eight competencies, where only two are needed to master the outside goal of mathematics education, Many.

REJECTED

The Simplicity of Mathematics Designing a STEM-based Core Mathematics Curriculum for Young Male Migrants

Allan Tarp
The MATHeCADEMY.net

Educational shortages described in the OECD report 'Improving Schools in Sweden' challenge traditional math education offered to young male migrants wanting a more civilized education to return help develop and rebuild their own country. Research offers little help as witnessed by continuing low PISA scores despite 50 years of mathematics education research. Can this be different? Can mathematics and education and research be different allowing migrants to succeed instead of fail? A different research, difference-research finding differences making a difference, shows it can. STEM-based, mathematics becomes Many-based bottom-up Many-matics instead of Set-based top-down Meta-matics.

Decreased PISA Performance Despite Increased Research

Being highly useful to the outside world, mathematics is a core part of institutionalized education. Consequently, research in mathematics education has grown as witnessed by the International Congress on Mathematics Education taking place each 4 year since 1969. Likewise, funding has increased as seen e.g. by the creation of a Swedish centre for Math Education. But, despite increased research and funding, the former model country Sweden has seen its PISA result decrease from 2003 to 2012, causing OECD to write the report 'Improving Schools in Sweden' describing its school system as 'in need of urgent change':

> PISA 2012, however, showed a stark decline in the performance of 15-year-old students in all three core subjects (reading, mathematics and science) during the last decade, with more than one out of four students not even achieving the baseline Level 2 in mathematics at which students begin to demonstrate competencies to actively participate in life. (OECD, 2015a, p. 3).

To find an unorthodox solution let us pretend that a university in southern Sweden arranges a curriculum architect competition: 'Theorize the low success of 50 years of mathematics education research, and derive from this theory a STEM-based core mathematics curriculum for young male migrants.'

Since mathematics education is a social institution, social theory may give a clue to the lacking success and how to improve schools in Sweden and elsewhere.

Social Theory Looking at Mathematics Education

Imagination as the core of sociology is described by Mills (1959); and by Negt (2016) using the term to recommend an alternative exemplary education for outsiders, originally for workers, but today also applicable for migrants.

Bauman (1990) agrees by saying that sociological thinking 'renders flexible again the world hitherto oppressive in its apparent fixity; it shows it as a world which could be different from what it is now' (p. 16).

Mathematics education is a rational organization, 'in which the end is clearly spelled out, and the actors concentrate their thoughts and efforts on selecting such means to the end as promise to be most effective and economical (p. 79)'. However

> The ideal model of action subjected to rationality as the supreme criterion contains an inherent danger of another deviation from that purpose - the danger of so-called goal displacement. (..) The survival of the organization, however useless it may have become in the light of its original end, becomes the purpose in its own right. (p. 84)

Such a goal displacement occurs if saying 'The goal of mathematics education is to teach and learn mathematics'. Furthermore, by its self-reference such a goal statement is meaningless. So, if mathematics isn't the goal of mathematics education, what is? And, how well defined is mathematics after all?

In ancient Greece, the Pythagoreans used mathematics, meaning knowledge in Greek, as a common label for their four knowledge areas: arithmetic, geometry, music and astronomy (Freudenthal, 1973), seen by the Greeks as knowledge about Many by itself, Many in space, Many in time and Many in time and space. And together forming the 'quadrivium' recommended by Plato as a general curriculum together with 'trivium' consisting of grammar, logic and rhetoric.

With astronomy and music as independent knowledge areas, today mathematics is a common label for the two remaining activities, geometry and algebra, both rooted in the physical fact Many through their original meanings, 'to measure earth' in Greek and 'to reunite' in Arabic. And in Europe, Germanic countries taught counting and reckoning in primary school and arithmetic and geometry in the lower secondary school until about 50 years ago when they all were replaced by the 'New Mathematics'.

Here the invention of the concept SET created a Set-based 'meta-matics' as a collection of 'well-proven' statements about 'well-defined' concepts. However, 'well-defined' meant defining by self-reference, i.e. defining top-down as examples of abstractions instead of bottom-up as abstractions from examples. And by looking at the set of sets not belonging to itself, Russell showed that self-reference leads to the classical liar paradox 'this sentence is false' being false if true and true if false: If $M = \{ A \mid A \notin A) \}$ then $M \in M \Leftrightarrow M \notin M$.

The Zermelo–Fraenkel Set-theory avoids self-reference by not distinguishing between sets and elements, thus becoming meaningless by not separating concrete

examples from abstract concepts. In this way, SET transformed grounded mathematics into today's self-referring 'meta-matism', a mixture of meta-matics and 'mathe-matism' true inside but seldom outside classrooms where adding numbers without units as '2 + 3 IS 5' meet counter-examples as e.g. 2weeks + 3days is 17 days; in contrast to '2x3=6' stating that 2 3s can be re-counted as 6 1s.

So, mathematics has meant many different things during its more than 5000 years of history. But in the end, isn't mathematics just a name for knowledge about shapes and numbers and operations? We all teach 3*8 = 24, isn't that mathematics?

The problem is two-fold. We silence that 3*8 is 3 8s, or 2.6 9s, or 2.4 tens depending on what bundle-size we choose when counting. Also we silence that, which is 3*8, the total. By silencing the subject of the sentence 'The total is 3 8s' we treat the predicate, 3 8s, as if it was the subject, which is a clear indication of a goal displacement, according to what Bauman (1992, p. ix) calls 'the second Copernican revolution' of Heidegger asking the question: What is 'is'?

Heidegger sees three of our seven basic is-statements as describing the core of Being: 'I am' and 'it is' and 'they are'; or, I exist in a world together with It and with They, with Things and with Others. To have real existence, the 'I' (Dasein) must create an authentic relationship to the 'It'. However, this is made difficult by the 'dictatorship' of the 'They', shutting the 'It' up in a predicate-prison of idle talk, gossip.

> This Being-with-one-another dissolves one's own Dasein completely into the kind of Being of 'the Others', in such a way, indeed, that the Others, as distinguishable and explicit, vanish more and more. In this inconspicuousness and unascertainability, the real dictatorship of the "they" is unfolded. (..) Discourse, which belongs to the essential state of Dasein's Being and has a share in constituting Dasein's disclosedness, has the possibility of becoming idle talk. (Heidegger, 1962, pp. 126, 169)

Heidegger has inspired existentialist thinking, described by Sartre (2007, p. 22) as holding that 'existence precedes essence'. In France, Heidegger inspired Derrida, Lyotard, Foucault and Bourdieu in poststructuralist thinking pointing out that society forces words upon you to diagnose you so it can offer cures including one you cannot refuse, education, that forces words upon the things around you, thus forcing you into an unauthentic relationship to yourself and to your world (Lyotard, 1984; Bourdieu, 1970; Foucault, 1995).

As to the political aspects of research, Foucault says:

> It seems to me that the real political task in a society such as ours is to criticize the workings of institutions, which appear to be both neutral and independent; to criticize and attack them in such a manner that the political violence which has always exercised itself obscurely through them will be unmasked, so that one can fight against them. (Chomsky & Foucault, 2006, p. 41; also on YouTube)

Bauman and Foucault thus both recommend skepticism towards social institutions where mathematics and education and research are examples. In theory, institutions are socially created as rational means to a common goal, but as Bauman points out, a goal displacement easily makes the institution have itself as an inside goal instead, thus marginalizing or forgetting its original outside goal.

To avoid this, difference-research is based upon the Greek sophists, saying 'Know nature form choice to unmask choice masked as nature.'; and Heidegger saying 'In sentences, trust the subject but question the rest.'; and Sartre saying 'Existence precedes essence'; and Foucault, seeing a school as a 'pris-pital' mixing power techniques of a prison and a hospital by keeping children and adolescents locked up daily to be cured without being properly diagnosed. For it is differences that unmask false nature, and unmask prejudice in predicates, and uncover alternative essence, and cure an institution from a goal displacement.

Furthermore, difference-research knows the difference between what can be different and what cannot. From a Heidegger view an is-sentence contains two things: a subject that exists and cannot be different, and a predicate that can and that may be gossip masked as essence, provoking 'the banality of Evil' (Arendt, 2006) if institutionalized. So, to discover its true nature, we need to meet the subject, the total, outside its predicate-prison of traditional mathematics. We need to allow Many to open itself for us, so that, as curriculum architects, sociological imagination may allow us to construct a core mathematics curriculum based upon exemplary situations of Many in a STEM context, seen as having a positive effect on learners with a non-standard background (Han et al, 2014), aiming at providing a background as pre-teachers or pre-engineers for young male migrants wanting to help develop or rebuild their original countries.

So, to restore its authenticity, we now return to the original Greek meaning of mathematics as knowledge about Many by itself and in time and space; and use Grounded Theory (Glaser & Strauss, 1967), lifting Piagetian knowledge acquisition (Piaget, 1969) from a personal to a social level, to allow Many create its own categories and properties.

Meeting Many, Children use Block-numbers to Count and Share

How to deal with Many can be learned from preschool children. Asked 'How old next time?', a 3year old will say 'Four' and show 4 fingers; but will react strongly to 4 fingers held together 2 by 2, 'That is not 4, that is 2 2s. Children also use block-numbers when talking about Lego bricks as '2 3s' or '3 4s'. When asked 'How many 3s when united?' they typically say '5 3s and 3 extra'; and when asked 'How many 4s?' they say '5 4s less 2'; and, placing them next-to each other, they say '2 7s and 3 extra'.

You don't need research to observe how children love digital counting by bundling, replacing a bundle of 2 1s with 1 Lego Brick with 2 knobs to be placed

in a cup for the bundles; and they don't mind exchanging 2 2s with 1 Lego brick with 4 knobs to be placed in a cup for 4s. And they have fun recounting 7 sticks in 2s in various ways, as 1 2s &5, 2 2s &3, 3 2s &1, 1 4s &3, etc. And children don't mind writing a total of 7 using 'cup-writing' as T = 7 = 1]5 = 2]3 = 3]1 = 1]0]3 = 1]1]1. And with 1 plastic S for 1 borrowed, some children even writes T = 7 = 3]1 = 4]S = 5]SSS. Also, children love to count in 3s and 4s. Recounting in 5s is unfortunately not possible since Lego refuses to produce bricks with 5 knobs.

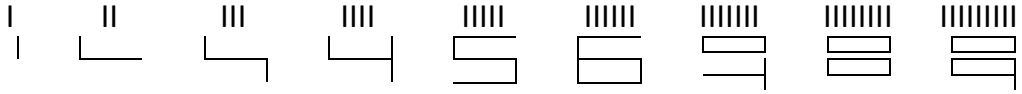
Sharing 9 cakes, 4 children takes one by turn as long as possible; with 4s taken out they say 'I take 1 of each 4', and with 1 left they say 'let's count it as 4'. And they smile when seeing that sharing 4 5s by 3 is predicted by asking a calculator 4*5/3. Thus 4 preschool children typically share by taking away 4s from 9, and by taking away 1 per 4, and by taking 1 of 4 parts. So children master sharing, taking parts and splitting into parts before having learned about division and counting- and splitting-fractions, which they would like to learn before being forced to add.

Children thus show core mastery of Many before coming to school, allowing school to build upon this knowledge instead of rejecting it. So, school could ask research to design a curriculum, that counts totals in two-dimensional block-numbers instead of one-dimensional line-numbers; that counts and re-counts and double-counts totals before they are added, and then both on-top and next-to; that teaches 8/4 as 8 counted in 4s giving 2 4s instead of as 8 split between 4 giving 4 2s; and that root counting-fractions and splitting-fractions in per-numbers and re-counting. Difference-research gladly takes on such a curriculum design.

Meeting Many Creates a Count&Multiply&Add Curriculum

Meeting Many, we ask 'How many in Total?' To answer, we total by counting and adding to create a number-language sentence, T = 2 3s, containing a subject, a verb and a predicate as in a word-language sentence.

Rearranging many 1s in 1 icon with as many strokes as it represents, icons can be used as units when counting: four strokes in the 4-con, five in the 5-icon, etc.



1 2 3 4 5 6 7 8 9

We count in bundles to be stacked as block-numbers to be re-counted and double-counted and processed by on-top and next-to addition, direct or reversed.

To count we take away bundles (thus rooting division as a broom wiping away the bundles) to be stacked (thus rooting multiplication as a lift stacking the bundles into a block) to be moved away to look for unbundled singles (thus rooting subtraction as the trace left when dragging the block away). A calculator predicts the result by a re-count formula T = (T/B)xB saying that 'from T, T/B times, B can be taken away':

7/3 gives 2.some, and 7 – 2x3 gives 1, so T = 7 = 2B1 3s.

Finally, bundle- or cup-writing double-counts the bundles inside the bundle-cup and the singles outside, where an overload or underload is removed or created by re-counting in the same unit, T = 7 = 2B1 3s = 2]1 3s = 1]4 3s = 3]-2 3s.

Likewise, placing the singles next-to or on-top of the stack counted as 3s, roots decimals and fractions to describe the singles: T = 7 = 2.1 3s = 2 1/3 3s

T = 7 = 2 3s & 1 = 2B1 3s = 2.1 3s = 2 1/3 3s

A total counted in icons can be re-counted in tens, which roots multiplication tables; or a total counted in tens can be re-counted in icons, T = 42 = ? 7s, which roots equations to be solved by re-counting, resulting in moving numbers to the opposite side with the opposite sign: u x 7 = 42 = (42/7)x7 gives u = 42/7.

Double-counting in physical units creates per-numbers bridging the units, thus rooting proportionality. Per-numbers become fractions if the units are the same. Since per-numbers and fractions are not numbers but operators needing a number to become a number, they add by their areas, thus rooting integral calculus.

Once counted, totals can be added on-top after being re-counted in the same unit, thus rooting proportionality; or next-to as areas, thus rooting integral calculus. Then both on-top and next-to addition can be reversed, thus rooting equations and differential calculus.

In a rectangle split by a diagonal, mutual re-counting of the sides creates the per-numbers sine, cosine and tangent. Traveling in a coordinate system, distances add directly when parallel, and by their squares when perpendicular. Re-counting the y-change in the x-change creates change formulas, algebraically predicting geometrical intersection points, thus observing the ‘geometry & algebra, always together, never apart’ principle.

Predictable change roots pre-calculus (if constant) and calculus (if variable). Unpredictable change roots statistics to ‘post-dict’ numbers by a mean and a deviation to be used by probability to pre-dict a confidence interval for numbers we else cannot pre-dict.

Meeting Many in a STEM Context

Having met Many by itself, now we meet Many in time and space in the present culture based upon STEM, described by OECD as follows:

> In developed economies, investment in STEM disciplines (science, technology, engineering and mathematics) is increasingly seen as a means to boost innovation and economic growth. The importance of education in STEM disciplines is recognised in both the US and Europe. (OECD, 2015b)

STEM thus combines knowledge about how humans interact with nature to survive and prosper: Mathematics provides formulas predicting nature’s physical

and chemical behavior, and this knowledge, logos, allows humans to invent procedures, techne, and to engineer artificial hands and muscles and brains, i.e. tools, motors and computers, that combined to robots help transforming nature into human necessities.

A falling ball introduces nature's three main actors, matter and force and motion, similar to the three social actors, humans and will and obedience. As to matter, we observe three balls: the earth, the ball, and molecules in the air. Matter houses two forces, an electro-magnetic force keeping matter together when colliding, and gravity pumping motion in and out of matter when it moves in the same or in the opposite direction of the force. In the end, the ball is lying still on the ground since motion transfers through collisions, now present as increased motion in molecules; so the motion has lost its order and can no longer work.

Science is about nature itself. How three different Big Bangs, transforming motion into matter and anti-matter and vice versa, fill the universe with motion and matter interacting with forces making it combine to stars and planets and galaxies. Some planets have a size and a distance from its star that allows water to exist in its three forms, solid and gas and liquid, bringing nutrition to green and grey cells, forming communities as plants and animals: reptiles and mammals and humans. Animals have a closed interior water cycle carrying nutrition to the cells and waste from the cells and kept circulating by the heart. Plants have an open exterior water cycle carrying nutrition to the cells and kept circulating by the sun forcing water to evaporate through leaves.

Technology is knowledge about ways to satisfy human needs. First by gathering and hunting, then by using knowledge about matter to create tools as artificial hands making agriculture possible. Later by using knowledge about motion to create motors as artificial muscles, combining with tools to machines making industry possible. And finally using knowledge about information to create computers as artificial brains combining with machines to artificial humans, robots, taking over routine jobs making high-level welfare societies possible.

Engineering is about constructing technology and power plants allowing electrons to supply machines and robots with their basic need for motion and information; and about how to build houses, roads, transportation means, etc.

Mathematics is our number-language for predicting Many by calculation sentences, formulas, expressing counting and adding processes. First Many is double-counted in bundles and singles to create a total T that might be re-counted in the same or in a new unit or into or from tens; or double-counted in two physical units to create per-numbers and fractions. Once counted, totals can be added on-top if recounted in the same unit, or next-to by their areas, called integration, which is also how per-numbers and fractions add. Reversed addition is called solving equations. When totals vary, the change can be unpredictable or predictable with a change that might be constant or not. Finally, triangulation predicts spatial forms.

So, a core STEM curriculum could be about cycling water. Heating pumps in motion transforming water from solid to liquid to gas, i.e. from ice to water to steam; and cooling pumps motion out. Heating an imaginary box of steam makes some molecules leave, so the lighter box is pushed up by gravity until becoming heavy water by cooling, now pulled down by gravity as rain in mountains and through rivers to the sea. On its way down, a dam can transform moving water to moving electrons, electricity. To get to the dam, we build roads on hillsides.

The Electrical circuit, an Example

To work properly, a 2000Watt water kettle needs 2000Joule per second. The socket delivers 220Volts, a per-number double-counting Joules per charge-unit.

Recounting 2000 in 220 gives (2000/220)*220 = 9.1*220, so we need 9.1 charge-units per second, which is called the electrical current counted in Ampere.

To create this current, the kettle has a resistance R according to a circuit law Volt = Resistance*Ampere, i.e., 220 = R*9.1, or Resistance = 24.2Volt/Ampere called Ohm. Since Watt = Joule per second = (Joule per charge-unit) *(charge-unit per second) we also have a second formula Watt = Volt*Ampere.

Thus, with a 60Watt and a 120Watt bulb, the latter needs twice the current, and consequently half the resistance of the former.

Supplied next-to each other from the same source, the combined resistance R must be decreased as shown by reciprocal addition, 1/R = 1/R1 + 1/R2. But supplied after each other, the resistances add directly, R = R1 + R2. Since the current is the same, the Watt-consumption is proportional to the Volt-delivery, again proportional to the resistance. So surprisingly, the 120Watt bulb only receives half of the Joules of the 60Watt bulb.

Difference-research Differing from Critical and Postmodern Thinking

Together with difference-research, also critical thinking and postmodernism show skepticism towards knowledge claims, so how does difference-research differ?

As to critical thinking, Skovsmose & Borba (2000) describes a Brazilian research group that, focusing on issues related to new technologies and mathematics education, has developed software and work with students at different levels and with teachers. The group was approached by a teacher from a nearby school where she had some tough problems to face and hoped that the computers would be able to help her. She was teaching rational numbers to a class of 5th graders, with a mixture of 11year old students and 15year old repeaters having given up rational numbers and turning to violence.

> The teacher was enthusiastic about a software, which deals with rational numbers. (..) Both researchers and teacher had the ‘intuition’ that the computer might have a positive effect in this class and maybe could avoid that the students had to repeat this grade again. (p. 7)

By recommending computers, the researchers showed criticism, not towards fractions as such, but towards how they are taught. Critical thinking thus sees mathematics as an unquestionable goal, only how it is taught can be questioned.

Contrary to this, difference-research sees fractions as a means rooted in double-counting, and recommends fractions introduced as per-numbers via the 'fraction-paradox': 1 red of 2apples and 2red of 3apples total 3red of 5apples and not 7red of 6apples as says the textbook. Fractions thus add by their areas as integral calculus. Adding fractions of the same total can be treated later. Introducing fractions via per-numbers and separating core-mathematics from 'footnote-mathematics' will side the teacher with the learner against the textbook.

As to postmodern thinking, the book 'Mathematics Education within the Postmodern' (Walshaw, 2004) contains 12 chapters divided into three parts: thinking otherwise for mathematics education, postmodernism within classroom practices, and within the structures of mathematics education. The preface says:

> It is a groundbreaking volume in which each of the chapters develops for mathematics education the importance of insights from mainly French intellectuals of the post: Foucault, Lacan, Lyotard, Deluze. (p. vii)

Although the book wants to be skeptical towards both mathematics and its education, it is only the educational part that is scrutinized; and most authors describes how what is labeled postmodern thinking can be exemplified in educational contexts, they don't see mathematics itself as a social construction that could be questioned also. A central thinker as Derrida is mentioned only in the two survey chapters, and the core concept of deconstruction is not mentioned at all despite its fundamental importance to a postmodern perspective to mathematics education.

By going behind French thinking to its root in Heidegger existentialism, difference-research is the only skeptical thinking raising the basic sociological question about a possible goal displacement in mathematics itself.

Conclusion and Recommendation

The task of the curriculum architect competition was 'Theorize the low success of 50 years of mathematics education research, and derive from this theory a STEM-based core mathematics curriculum for young male migrants.'

One explanation sees the situation caused by mathematics itself as very hard to teach and learn. This paper, however, sees it caused by a goal displacement seeing mathematics as the goal instead of as an inside means to the outside goal, mastery of Many. The two views lead to different kinds of mathematics: a set-based top-down 'meta-matics' that by its self-reference is indeed hard to teach and learn; and a bottom-up Many-based 'Many-matics' simply saying 'To master Many, count to produce block-numbers and per-numbers that might be constant or variable, to be united by adding or multiplying or powering or integrating.

Thus, this simplicity of mathematics as expressed in a Count&Multiply&Add curriculum allows learners to keep their own block-numbers, and to acquire core mathematics as proportionality, calculus, equations and per-numbers in early childhood. Imbedded in STEM-examples, young male migrants learn core STEM subjects at the same time, thus allowing them to become pre-teachers or pre-engineers after two years to return help develop or rebuild their own country. The full curriculum can be found in a 27-page paper.

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