

All Youth Numerate by 2030:
No AI-aided Additive Math in K-3
Only CI-aided Multiplicative Math



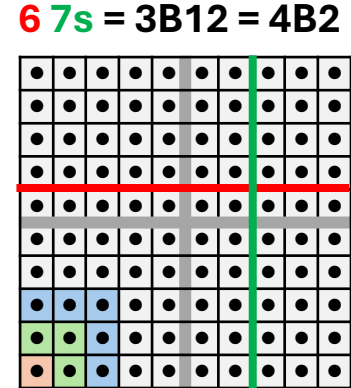
CI, Child-Intelligence, used to count in area-numbers with Bundle-units on a Hand and on a BundleBundleBoard

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Can a Math with Units secure Numeracy for All?

Reviewer's comment to a Paper for 2025 EARCOME 9 in Korea

(9 of 15 submissions accepted)

This proposal tackles an urgently needed conversation in mathematics education by challenging deeply ingrained assumptions about number systems and arithmetic instruction and proposing a truly decolonized approach that foregrounds learners' intuitive "bundle-number" language.

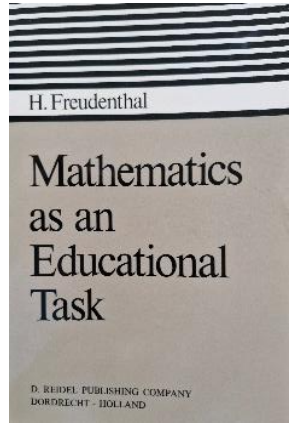
Its strength lies in weaving together a compelling theoretical critique—drawing on Habermas's colonization concept and rich philosophical underpinnings—with concrete instructional innovations like the Algebra Square that reframe operations as intuitive spatial and bundling processes.

By aligning this reconceptualization directly with SDG 4's numeracy targets and illustrating how multiplication-centered reasoning better reflects real-world number use, the paper promises to make a bold and impactful contribution to both research and practice.

We look forward to seeing how this work can reshape numeracy instruction and foster truly inclusive mathematical literacy for all.

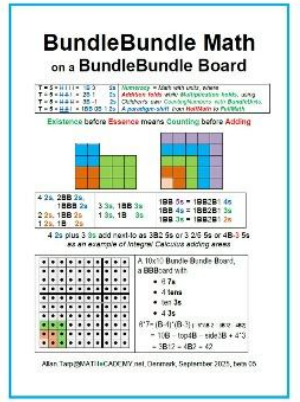
UN SDG 4.6: All Youth Numerate by 2030!

So, we teach Math, but **Additive** or **Multiplicative?**



- **Additive +Mathematics** as an Educational Task (Freudenthal)

uses **LineNumbers** (1, 2, 3) adding without units.

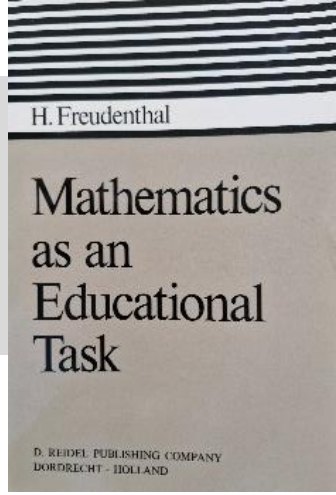


- **Multiplicative xMathematics** as a Learning Task (Tarp)

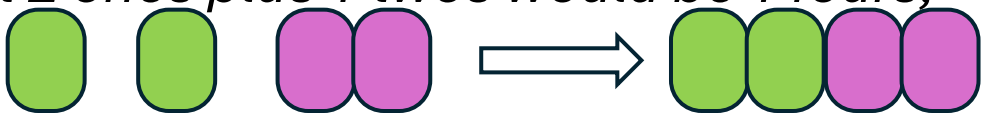
uses **AreaNumbers** (2 **3s**, 4**B**5 **6s**) counted and recounted with **B**undle-units before being added next-to or on-top.

A Hegelian dialectic that may produce a synthesis if put in dialogue.

Numeracy means understanding Numbers "*Additive +Math, what is 34?*"



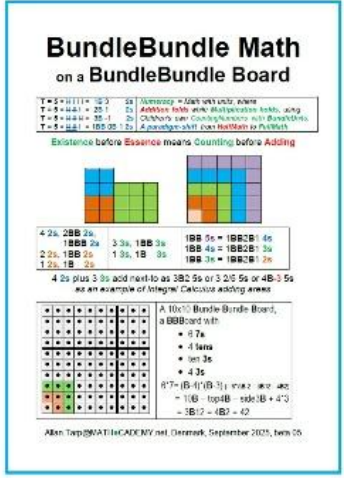
- 34 obeys a place value system saying that 3 is the number of tens, and 4 is the number of ones
- Here, ten is 10 because ten is 1 tens (*sorry for the meaningless self-reference*)
- 34 is an element in the set of natural numbers, N.
- 34 is the follower of 33, generated by the fact that **1+1= 2 always** (*which of course only holds for like units, but we don't talk about units in additive math because then an open and a closed V-sign would show that 2 ones plus 1 twos would be 1 fours, and not the 3 threes we claim*)



- Subtraction defined from Addition: 5–2 is the number *u* that satisfies *u* + 2 = 5.
- Multiplication defined from Addition as repeated addition: 3 x 5 = 5+5+5
- Division defined from Multiplication: 6/2 is the number *u* that satisfies *u* x 2 = 6.

Numeracy means understanding Numbers

"*Multiplicative xMath, what is 34?*"



- 34 is a two-fold multiplicative counting of **B**undles and of un**B**undled.
- 34 = 3**B**4 = 3x**B** + 4x1, i.e., 3 **times** a **B**undle, with tens per **B**undle, and 4 **times** one.
- 34 cannot add with unlike units.
- Ten = 10 = 1**B**0 since, when **B**undle-counting in tens, ten is 1 **B**undle and 0 un**B**undled.
- Addition defined as reversed Subtraction: pull back after pull away: **T = (T – B) + B** (reUnite)
- Multiplication defined as reversed Division: push back after push away: **T = (T /B) x B** (recount to new units)
- Units show when division is counting and splitting: 8s/2s = 4 (so, 8s = 4 2s) and 8s/2 = 4s (so, 8s = 2 4s)
- Multiplication combines a count-number with its unit: 6x7 = 6 7s that may be recounted as 4**B**2 tens
- Two number-types: **in time**, Count-numbers; and **in space**, **B**undle-numbers or per-numbers.

The MMM Multiplicative Math Mission:

To reunite ▪ Unlike & Like ▪ Count-numbers & Per-numbers

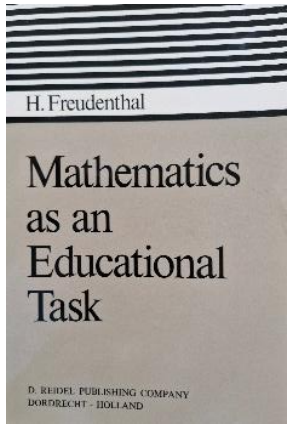
in an **Algebra Square** (Algebra is an Arabic word for reuniting)

Unite Split into	Unlike	Like
Count numbers	**+** **–**	**x** **/**
Per numbers	**Σ** **Δ**	**^** **√** **log**

Numeracy means understanding Numbers "*What is 1/2 + 2/3?*"

Additive +Math:

- 1/2 and 2/3 are rational numbers defined as equivalence classes in a set-product where b/c and p/q are equivalent if b*q = c*p
- 1/2 + 2/3 needs same denominators to add: 1/2 + 2/3 = 3/6 + 4/6 = 7/6



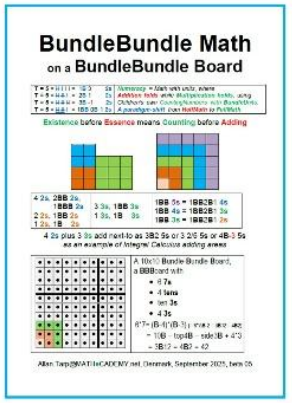
Multiplicative xMath:

- 1/2 and 2/3 are per-numbers with like units, e.g., 2$/3$ = 2/3
- 1/2 + 2/3 needs units to add:

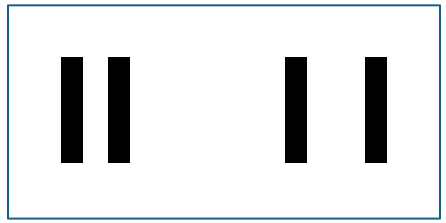
  Apples: 1 of 2 + 2 of 3 = (1+2) of (2+3) = 3 of 5, so 1/2 + 2/3 = 3/5

  2 pizzas: 3 of 6 + 4 of 6 = (3+4) of (6+6) = 7 of 12, so 1/2 + 2/3 = 7/12

  1 pizza: 3 of 6 + 4 of 6 = (3+4) of 6 = 7 of 6, so 1/2 + 2/3 = 7/6

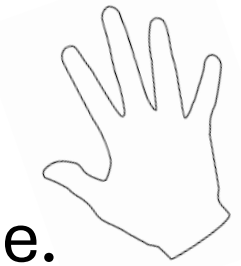


How Numerate are Children Before School?

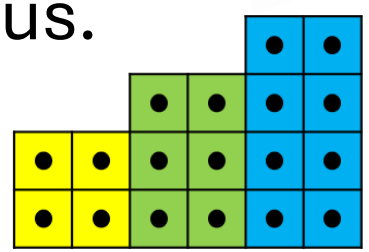


Seeing only the essence, adults say “2 & 2”.

Seeing the existence, children say “One 2s & two 1s”.



Children say: No, we can’t math, neither can you. Math is not an action word. But we can Count and Add in Time and Space using fingers and Lego-bricks and Bundle-units. It makes math concrete. To add and split our area-numbers, of course we use calculus. Why teach us how to math without units? So, please:



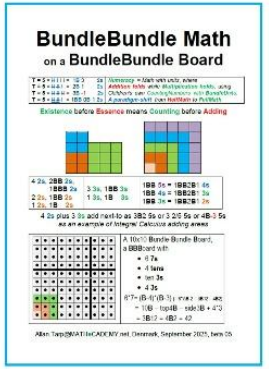
No AI-aided Additive Math without units in K-3

Only CI-aided Multiplicative Math with Bundle-units

CI: Child Intelligence

A Multiplicative Mathematics Manifest

shows how core math learned through counting before adding

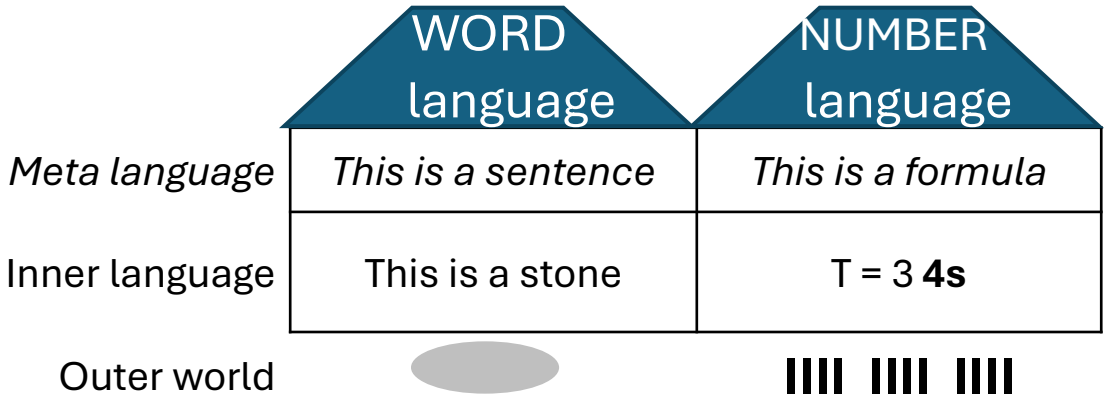


01. Counting in space	Count in 2s. Five = ~~IHI~~ I = 2B1 = 1BB 0B 1 = 101 . Ten = 2x5 = 2BB 0B 2 = 1BBB 0BB 1B 0 = 1010. So, 2*101 = 1010.
02. Counting in time	Count in **H**ands, 6+7 =1**H**1+1**H**2 = 2**H**3 = 1**B**3 = 13. (**0B**1, 0**B**2, …, 0**B**5 = 1**H**0, 1**H**1, 1H2, …, 1**H**5 =2**H**0 =1**B**0)
03. Bundle-units ease calculations	46+19 = 4**B**6 + 1**B**9 = 5**B**15 = 6**B**5 = 65 ☺ 4*19 = 4*1**B**9 = 4**B**36 = 7**B**6 = 76 ☺ 76/4 = 7**B**6/4 = 4**B**36/4 = 1**B**9 = 19☺.
04. Reunite a Total	Minus before plus. Pull away and back to reunite: **T = (T–B)+B**. E.g., 6–2 = 4, & 6 = 4+2. 'Opposite side & sign' method.
05. Recount a Total **Per-numbers change units**	Divide before multiply. Pull away and back to recount: **T = (T/B)xB**. E.g., 6/2 = 3, & 6 = 3*2. Again 'Opposite side & sign' The Per-number, T/B, change units all over **STEM** and **STeN** : With 2m/3$, 8m = (8/2)*2m = (8/2)*3$ = 4 * 3$ = 12$.
06. Trigonometry before Geometry	In 2 **3s** the height, H, recounts in the base, **B**, as H = (H/**B**)***B** = tan(Angle)***B**. So, $pi \approx n * \tan(180/n)$ for n large
07. BundleBundles are squares on aBBBoard	1BB2B1 is next square. Ten-friends are familiar: 3^2 = 9 & 7^2 = 9 + 40 since 7^2 = (10-3-3)B + 3^2 pulled away twice. So, -*- is +. Also, (3+7)^2 = 3^2 + 7^2 + 2*3*7 = D^2 + 4*½*3*7. So, 3^2 + 7^2 = D^2 with D as the diagonal in 3 7s. And 7^2 – 3^2 = (7+3) * (7–3). With (u+3)^2 = (u^2 + 6*u + 8)+1, the equation, u^2 + 6*u + 8 = 0, is solved by u = -4 & u = -2.
08. Adding next-to or on-top	Next-to, the sum of 2 **3s** and 4 **5s** is 3**B**2 **8s** using integral calculus to add areas. On-top, the sum is 5**B**1 **5s** or 8**B**2 **3s** using recounting as proportionality to get like units.
09. Change predictable or unpredictable	Predictable change, constant or constant changing as unit- or as per-number: Linear, quadratic, exponential, logistic Unpredictable change, statistics and probability: Past averages predict future confidence intervals
10. Modeling has 3 genres	**Fact** predicts predictable quantities ☺. **Fiction** predicts unpredictable quantities 😐. **Fake** predicts unpredictable qualities ☹.

Modeling has 3 genres, Fact & Fiction & Fake And, not 8, only 2 Competences: Count & Add

- Modeling real world problems is difficult for **additive math** needing 8 competences; and not separating the 3 genres, fact & fiction & fake, or, 'Since-then / If-then / What-then', or 'Room / Rate / Risk' models. All models are said to be approximations.
- Using formulas from the start, **multiplicative math** avoids modeling problems with its 2 competences, Count & Add, as it sees itself as a number-language parallel to the word-language, both having a meta-language (a grammar) and 3 genres.

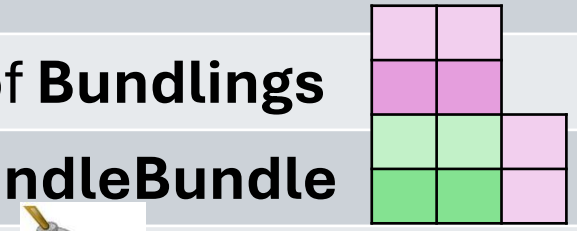
Fake models are, e.g., adding numbers without units, and finding averages of numbers that could never be equal.



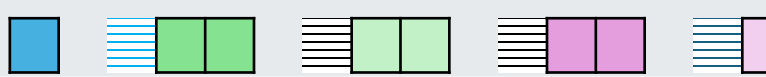
Counting with Bundle-units allows Children develop their Numeracy and learn core Math before Adding

This Reverses	the Operation order
POWER	**Bundles Bundles**
LOG	Counts the number of **Bundlings**
ROOT	Finds the side in a **BundleBundle**
DIVISION	PUSH-away **Bundles**
MULTIPLICATION	PUSH-back **Bundles** to stack
SUBTRACTION	PULL-away **Bundles** to find the **unBundled** to place on-top
ADDITION	PULL-back **Bundles** to unite
ON-TOP	T = (T/**B**)***B** reCounting makes the units like by **LINEARTY**
NEXT-TO	as areas rooting **CALCULUS**

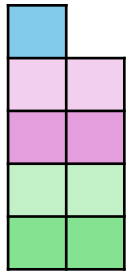
2 **2s** = 2^2 = 1**BB** = **1B^2**
4 **2s** = 1**BBB** = **1B^3**
log2(8) = 3, log3(9) = 2
8 = 1**BB**?, √8 < 3 (=2.8)











9 = 4**B** 1 = 4 ½ **B** = 5**B** -1 **2s**

