6th International STEM Education Conference Istanbul November 2025

Submissions

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From STEM to STeN to make All Youth Numerate by 2030. Accept

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Proposal for Paper presentation

1. From STEM to STeN, why?

The fourth of the 17 UN Sustainable Development Goals, Quality Education, has as a goal target to "By 2030, ensure that all youth achieve literacy and numeracy". Replacing STEM with STeN also including economics and Numeracy may reach the UN goal. STEM integrates mathematics with its roots in science, technology and engineering, all using formulas from algebra and trigonometry to predict the behavior of predictable physical quantities, and to model unpredictable quantities by scenarios. But economics is missing despite mathematics' historical root is the marketplace with production, trade and consumption where quantities always carry units. Without units, mathematics must go and be replaced by numeracy that always uses units.

2. Two different Definitions of 'Numerate' exist

The English Oxford Dictionary defines it as being "competent in the basic principles of mathematics, esp. arithmetic". In contrast, the American Merriam-Webster dictionary defines it as "having the ability to understand and work with numbers." The word 'competent' is a predicate, a non-action word, I cannot 'competent' something, I can only be judged as competent by someone who is competent. In contrast, 'work' is an action word, a verb, since with my body and mind I can work on something and test the result to see if it works. Also, there is a difference between the words 'mathematics' and 'numbers.' Again, mathematics is a non-action word, I cannot 'mathematics' a thing. In contrast, 'number' is both a verb and a noun since I can number different degrees of Many to produce a number for later calculations.

Existentialist philosophy holds that existence must precede essence to prevent colonization. With Numbers as existence and math as essence, numeracy thus should precede math. In fact, numeracy may be defined as 'math with units where addition folds and multiplication holds'.

Also, the foundation of mathematics is '2+1 = 3'. But this is falsified by an open and closed V-sign showing that 2 1s plus 1 2s unite as 1 4s and not as 3 3s as math says without units.

3. Economics gives a Fundamental Understanding of Numbers and Calculations

The basic meanings of geometry and algebra show that they are both rooted in economics. In Greek, geometry means to measure earth, and in Arabic, algebra means to reunite numbers, so they have a common root in the basic economic question "How to divide the earth and what it produces?" Hunter-gatherers need not tell the different degrees of many apart, but farmers do since farmers produce to a market to survive, and here they need to be numerate to answer the question "How many here?". This immediately leads to the answer "That depends on the unit." Economics thus begin at once by reusing the number-names when using bundling to count.

The Romans unsystematically gave names to the bundles 5s, 10s, 50s, 100s, 500s and 1000s. This worked well for administrative addition and subtraction jobs but not for multiplication. So, when German silver reopened the trade between India and Renaissance Italy, Hindu-Arabic numbers named only the unbundled, the bundles, the bundle of bundles (BB or B^2), the bundle-bundle-bundles (BBB or B^3), etc. With tens, 234 is not 1 but 3 numbers, 2BB 3B 4.

At a market, goods are sold in bundles with units as 2 3s, the same numbers that a 3year old child use when seeing four fingers bundled in twos: "No, that is not four, it is two twos". But a buyer may want to have 5s, or to trade 4 per 5, or to pay 4$ per 7. So, changing units is a core job using the proportional recount-formula, T = (T/B)*B, saying "From T, push-away B's to count them". Thus, recounting from tens gives equations solved by moving to opposite side with opposite sign: Find u, so u*2 = 8. Here, 8 recounts in 2s as 8 = (8/2)*2, so u = 8/2.

Recounting into tens leads to early algebra: 6 7s = 6*7 = 6*(½B2) = 3B 12 = 4B 2 = 42. Or 6*7 = (B-4)*(B-3) = BB-3B-4B+4*3 = (10-3-4)B 12 = 4B 2 = 42, as seen on a ten-by-ten BundleBundleBoard when pulling away the top and the side and adding what was pulled twice.

Likewise, when changing the units for length, weight, and currency. And, when changing from the quantity to the price. Here, Renaissance Italy used 'regula detri', the rule of three. Asking "With the per-number 2$ per 3kg, what is the price for 9kg?", first they arranged the three numbers with alternating units: '9kg, 2$, 3kg'. Then the answer comes from multiplying and dividing: 9*2/3 = 6$. Now we recount in the per-number: 9kg = (9/3)*3kg = (9/3)*2$ = 6$.

Trigonometry precedes geometry when recounting the height in the base in a stack as 4 5s: height = (height/base) * base = tan(A) * base, giving $\pi = n$ * tan(180/n) for n high enough.

Once counted and recounted, 2 3s & 4 5s may add next-to as 8s using calculus to add areas. Or add on-top as 5s using recounting for like units. In a bill as '2kg at 3$/kg + 4kg at 5$/kg', kg's add directly but per-numbers add by their areas using calculus after being multiplied to $.

With economics we learn core mathematics by counting in time and space before adding.

4. Numeracy as Math Counting Totals in Units before Adding them with Units

In a numeracy education using the children's bundle-numbers with units, Tarp (2018) shows that 'counting before adding' give the same concepts but with different identities and order. Counting in 3s leads to 9 as a bundle-bundle, a B^2, which leads on to squares, square roots, and quadratics. Counting transforms the operations into icons where division and multiplication become a broom and a lift that pushes-away bundles to be stacked as shown when recounting 8 in 2s as 8 = (8/2)x2, which creates per-numbers when recounting $ = ($/kg) * kg. Subtraction is a rope that pulls-away the stack to find the unbundled that, placed on-top of the stack as part of an extra bundle, become decimals, fractions, or negatives, e.g., 9 = 4B1 = 4½ = 5B-1 2s. Finally, addition is a cross, showing the two ways to add stacks, on-top using the linearity of recounting to make the units like, or next-to creating integral calculus by adding areas, which is also used when adding per-numbers needed to be multiplied to areas before adding. All this provides an 'Algebra Square' showing how to unite the four types of numbers: multiplication and addition unite like and unlike unit-numbers, and power and integration unite like and unlike per-numbers. And how to split totals with the opposite operations: division and subtraction, together with the factor-finding root or the factor-counting logarithm and differentiation.

Table 1. The Algebra Square shows the ways to reunite unlike and like unit- and per-numbers

Calculations unite/ *split* Totals in	**Unlike**	**Like**
Unit-numbers m, s, kg, $	T = a + n *T – n = a*	T = a * n *T/n = a*
Per-numbers m/s, $/100$ = %	T = ∫ f dx *dT/dx = f*	T = a^n $\sqrt[n]{T}$ = a $\log_a$(T) = n

References

Tarp, A., (2018), "Mastering Many by counting, re-counting and double-counting before adding on-top and next-to", Journal of Mathematics Education, Vol. 11(1), pp. 103–117.

Integral Calculus adds Children's Bundle-numbers with Units and Piecewise or Locally Constant Per-numbers to make all Youth Numerate by 2030. Reject

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In contrast, 'work' is an action word, a verb, since with my body and mind I can work on something and test the result to see if it works. Also, there is a difference between the words 'mathematics' and 'numbers.' Again, mathematics is a non-action word, I cannot 'mathematics' or even 'math' a thing. In contrast, 'number' is both a verb and a noun since I can number different degrees of Many to produce a number for later calculations.

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Math's foundation is '2+1 = 3'. But this is falsified by an open and closed V-sign showing that 2 1s plus 1 2s gives 1 4s and not as 3 3s as math says. Adding without units, math must go.

6. How Numerate are Children before School?

"No, that is not four, that is two twos". Said a 3year old child when asked "How many years next time?"; and when seeing four fingers bundled two by two. As educated, essence is all we see. But as uneducated, the child sees what exists, bundles of twos in space, and two of them when counted in time.

The number 'two' thus exists both in space and in time. In space, 2 exists as 2s, a space number, a bundle of 2s, a 2-bundle, which can be united with a 3-bundle. Either horizontally to a (2+3) bundle, a 5-bundle, or vertically to a stack of 2B1 2s or a stack of 2B-1 3s with B for bundle. In time, 2 exists together with the unit that was counted, as 2 units, a time-number, or a counting-number. So, 2+1 is 3 only with like units. Without units a counting-numbers are operators to be multiplied with units to become totals that can be added if the units are the same.

7. Reflecting on how to teach Calculus in a Decolonized Future

In primary school, using their own bundle-numbers with units, children quickly master 'primary school calculus' where integration occurs in questions as '2 3s + 4 5s = ? 8s' where multiplication precedes addition. In the reverse question '2 3s + ? 5s = 4 8s', subtraction precedes division as in differentiation where their hands first pull away the initial stack, 2 3s, before counting the rest by pushing way 5s (Tarp 2018) thus calculating (T2 –T1) / 5 = ΔT/5.

In middle school, per-numbers bridge plastic S- and C-letters if 3 S-letters equal 5 C-letters, which gives the per-number 3S/5C. Recounting gives T = 12S = (12/3)*3S = (12/3)*5C = 20C. This leads on to traditional proportionality questions with per-numbers as 3$/5kg, and 3m/5sec, and 3£/5$. To be followed by fractions introduced as per-numbers with like units, 3$/5$ is 3/5. Again, we use recounting to see that 3/5 of 20$ means 3$/5$ of 20$, so 20$ = (20/5)*5$ gives (20/5)*3$ = 12 $. Adding per-numbers occur in mixture-problems as ‘2kg at 3$/kg + 4kg at 4$/5kg = 6kg at ? $/kg’ and its reversed version. Likewise with adding fractions in problems as ‘2$, of which 3/4 + 6$, of which 4/5 totals 8$, of which ?’, and its reverse. So as operators needing numbers to become numbers, per-numbers and fractions add as areas, needing calculus.

In high school the per-number is locally constant by changing each moment, and no more piecewise constant changing from 3 to 4 after 2 kg as in middle school. Formally, epsilon and delta have changed places. With a falling object the areas under the per-number graph, $A = \Sigma p(x)*\Delta x$ approximates increasingly better the smaller the Δx is chosen, only giving more areas to add. However, since the multiplied per-number is a difference describing a change of the area, $p(x)*\mathrm{d}x = \mathrm{d}A$, addition makes all middle terms disappear leaving only one difference between the terminal and the initial A-number. This motivates extending integration with differentiation solving differential equations as $\mathrm{d}A = x$^2 dx, finding a formula for the area under the per-number graph $p(x) = x$^2. Looking at the narrow shadows of a rectangular $p*q$ book we find the never falsified formula, $\mathrm{d}(p*q) = \mathrm{d}p*q + p*\mathrm{d}q$, so that d($x$^2) = d($x*x$) = 2*$x$*d$x$.

In Arabic, Algebra means ‘reunite’. With units, an ‘Algebra Square’ reunites four types: multiplication and addition unite like and unlike unit-numbers, power and integration unite like and unlike per-numbers. And totals split with the inverse operations: division and subtraction, together with the factor-finding root or factor-counting logarithm and differentiation.

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8. Reflecting on limits

Where a simple interest is added to the loan, a compound interest is also added to former interest amounts. So, a periodical rate, r, gives the total simple rate, R, where 1+R = (1+r) ^n.

If a yearly rate of 100% split in 12 parts and added 12 times we get R = (1+1/12)^12 – 1 = 1.613, showing 61.3% in additional rate. This has a limit since (1+1/n)^n can come close to but not exceed 2.718 called the Euler-number e. A solver shows that (1+1/n)^n = 2.712 for n = 234.

A circle with radius 1 contains many right triangles with the long side from the center to the circle. Splitting 180 degrees in n parts, the height of the triangles is almost tan(180/n). So, on a half-circle, the circumference is close to n*tan(180/n) that is 3.1411 for n = 100. Again, we have a limit since n*tan(180/n) can come arbitrarily close to but not exceed 3.1416 called pi, π.

References

Tarp, A., (2018), “Mastering Many by counting, re-counting and double-counting before adding on-top and next-to”, Journal of Mathematics Education, Vol. 11(1), pp. 103–117.

STeN allows Science, Technology with Engineering, Economics and Numeracy to solve Problems on a BundleBundleBoard and make all Youth Numerate by 2030. Accept

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Proposal for Paper presentation

9. Numerate Now, but How, and what is 'Numerate'?

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11. Economics' Understanding and Working with Numbers leads directly to Numeracy

The basic meanings of geometry and algebra show that they are both rooted in economics. In Greek, geometry means to measure earth, and in Arabic, algebra means to reunite numbers, so they have a common root in the basic economic question "How to divide the earth and what it produces?" Hunter-gatherers need not tell the different degrees of many apart, but farmers do since farmers produce to a market to survive, and here they need to be numerate to answer the question "How many here?". This immediately leads to the answer "That depends on the unit."

At a market, goods are sold in bundles with units as 2 3s, the same numbers that children use before school. But a buyer may want to have 5s, or to trade 4 per 5, or to pay 4$ per 7. So, changing units is a core job using the proportional recount-formula, T = (T/B)*B, saying "From T, push-away B's to count them". Recounting from tens gives equations solved by moving to opposite side with opposite sign: Find *u*, so *u**2 = 8. Here, 8 recounts as 8 = (8/2)*2, so *u* = 8/2.

Recounting into tens leads to early algebra: 6 7s = 6 * 7 = 6 * (½B 2) = 3B 12 = 4B 2 = 42. Or 6 * 7 = (B-4) * (B-3) = BB-3B-4B+4*3 = (10-3-4)B 12 = 4B 2 = 42, as seen on a ten-by-ten BundleBundleBoard when pulling away the top and the side and adding what was pulled twice.

When changing units from kg to $, Renaissance Italy used 'regula detri', the rule of three. Asking "With the per-number 2$ per 3kg, what is the price for 9kg?", first they arranged the three numbers with alternating units: '9kg, 2$, 3kg'. Then the answer came from multiplying and dividing: 9*2/3 = 6$. Now we recount in the per-number: 9kg = (9/3)*3kg = (9/3)*2$ = 6$.

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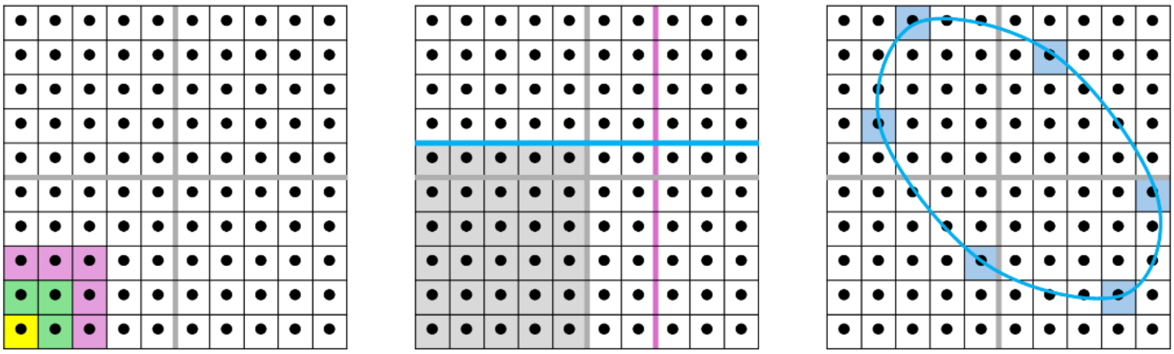

Figure 1. BundleBundleBoards. 1BB2B1 is the next BB-square; 6 7s is 3B12 or 4B2; with 'up-Cats eat out-Mice', M(7 & 2) change C(7-5 & 2-5), and C(7 & 2) change M(5-7 & 5-2)

12. Science on a BundleBundleBoard

Using a BBBoard as a coordinate system, the first dot has the position (x,y) = (½, ½). We like to find the orbit of a ball that begins in (0,0) and that changes position with the steps: (+1, +4), (+1, +3), (+1, +2), etc. How high comes the ball? Where is the touchdown? Next we follow orbits with the steps (+1, + 3), (+1, +2), etc. And with the steps (+2, +4), (+2; +3), etc.

Now we like to find the orbit of a jump from a swing that is fixed in (x,y) = (0, 8) and that turns at the height 4. We jump from the point (4,2) where the speed is √40 m/s.

With a jumping angle A found by, tan(A) = 4/6, our horizontal and vertical velocities are √40*cos(A), and √40*sin(A). Calculations show that there is touchdown after 1.07 seconds at the position (x,y) = (9.63, 0). Can we jump longer than that?

13. Technology on a BundleBundleBoard

Motion is transferred from a circle to a line by a piston with the length 3. On the BBBoard with 2 as the unit we like to find the orbit of its endpoint when the angle with its contact point is A. We soon find the formula √ [9 – (sin(A)^2) – 1 – cos(A)] for the distance between the endpoint and the circle. So, with A as 0, 90 and 180 degrees, the distances are 1, 1.83, and 3.

14. Engineering on BundleBundleBoard

On a sloping hill, roads will be more or less steep. On my bike I can make 20 degrees. So, a BBBoard shows that I can make a 30% slope, but not a 40% slope since here the steepness is 16.7 and 21.8 degrees. My company is asked to plan a road with hairpin turns and a 5 degrees steepness up a hill with a 20 degrees slope. The first guess is a road with √(10^2 + 2^2) = √104 as its length going from (0,0) to the point (10,2) with the height, 2*sin(20). Here the steepness angle A is found by the equation sin(A) = 2*sin(20)/√104, which gives A = 3.84 degrees. Likewise, a road to (10,3) has the angle A = 5.62 degrees. To which point should the road go?

References

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Integrating History in STEM or STeN may make all Youth Numerate by 2030. Accept

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Math's foundation, '2+1 = 3', folds when two V-signs showing that 2 1s plus 1 2s gives 1 4s and not as 3 3s as math says without units. So, Math is replaced by Economics and Numeracy.

16. How Numerate are Children before School?

"No, that is not four, that is two twos". Said a 3year old child when asked "How many years next time?"; and when seeing four fingers bundled two and two. As educated, essence is all we see. But as uneducated, the child sees what exists, bundles of twos in space, and two of them when counted in time. The number 'two' thus exists both in space and in time. In space, 2 exists as 2s, a space number, a bundle of 2s, a 2-bundle, which can be united with a 3-bundle. Horizontally to a (2+3) bundle, a 5-bundle, or vertically to a stack of 2B1 2s or a stack of 2B-1 3s with B for bundle. In time, 2 exists together with the unit that was counted, as 2 units, a time-number, or a counting-number. So, 2+3 is 5 only with like units. As an example of a decolonized numeracy education that respects the children's bundle-numbers with units, Tarp (2018) shows that a 'counting before adding' approach leads to the same concepts as a traditional approach but with different identities, and in a different order.

17. A short version of the History of Mathematics

As to the Mathematics has two main fields of Mathematics, Geometry means 'earth measuring' in Greek, and Algebra means 'reuniting' in Arabic thus together giving an answer to the fundamental human question: "How to divide the earth and what it produces?"

Humans once survived as other animals as gathers and hunters. The first culture change took place in the warm river-valleys where anything could grow, especially luxury goods as pepper and silk. But trade was only possible with those highlanders that had silver in their mountains. The silver mines outside Athens financed Greek culture and democracy. The silver mines in Spain financed the Roman empire. The dark Middle Ages came when the Greek silver mines were emptied, and the Arabs conquered the Spanish mines. German silver was found in the Harz shortly after year 1000. This reopened the trade routes and financed the Italian Renaissance and the numerous German principalities. Italy became so rich that money could be lend out thus creating banks and interest calculations. The trade route passed through Arabia developing trigonometry, a new number system, and algebra.

The Greek geometry began when the Pythagoreans discovering formulas to predict that to create harmony, the length out the vibrating string must have certain number proportions; and a triangle obeys two laws, and angle-law: A+B+C = 180, and a side law: a^2+b^2=c^2. Pythagoras inspired Plato to install an Academy in Athens based on the belief that the physical is examples of metaphysical forms only visible to philosophers educated at the Academy. The prime example was Geometry and a sign above the entrance said: “Do not enter if you don’t know Geometry”. But Plato found no more formulas, and Christianity transformed his academies into monasteries, later transformed back into universities after the Reformation.

The next formula was found by Galileo in Renaissance Italy: A falling or rolling object has an acceleration, *g*; that connects with the distance, *s*, and the time, *t*, by the formula: *s* = ½**g***t*^2. However, Italy went bankrupt when the pepper price fell to 1/3 in Lisbon after the Portuguese found the trade route around Africa to India thus avoiding Arabic middlemen. Spain tried to find a third way to India by sailing towards the west. Instead, Spain discovered the West Indies. Here was neither silk nor pepper, but a lot of silver, e.g. in the land of silver, Argentine. The English easily stole Spanish silver returning over the Atlantic, but to avoid Portuguese fortifications of Africa the English had to sail to India on open sea by following the moon.

But how does the moon move? The church said ’among the stars’. Newton objected: No, the moon falls towards the earth as does the apple, only the moon has received a push making it bend in the same way as the earth thus being caught in an eternal circular fall to the earth. But why do things fall? The church said: everything follows the unpredictable will of our metaphysical lord only attainable through belief, prayers and church attendance. Newton objected: No, it follows its own will, a force called gravity that can be predicted by a formula. But, Aristotle said that a force upholds the order, replied the Pope. Newton objected: No, a force changes the order, so I must invent change-calculations, calculus.

Brahe used his life to write down the positions of the planets among the stars. Kepler used these data to suggest that the sun is the center of the solar system but could not prove it without sending up new planets. Newton, however, could validate his theory by different examples of falling and swinging bodies.

Newton’s discoveries laid the foundation of the Enlightenment century realizing that when an apple follows its own will and not that of a metaphysical patronizor, humans could do the same. Thus, by enlightening themselves, people could replace the double patronization of the church and the prince with democracy and develop industry by controlling steam and electrons to power machines. Nature’s gravity creates water mills. Heating and cooling a cylinder create positive and negative pressure moving a piston up and down. Heating and cooling the left and right cylinder create a steam wind rotating a turbine rotating a wire in a magnetic field to create a current of electrons carrying motion from a central power plant to local consumers. Turning sockets on and off creates binary signals so a computer can store and process information.

The computer also produced more examples of new applied mathematics called Operational Research: Linear Programming, Queueing Theory, Decision Theory, Information Theory, Graph Theory, and Game Theory.

References

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19. How Numerate are Children before School?

"No, that is not four, that is two twos". Said a 3year old child when asked "How many years next time?"; and when seeing four fingers held together two by two. This statement will change mathematics education forever since, as educated, essence is all we see. But as uneducated, the child sees what exists, bundles of twos in space, and two of them when counted in time.

The number 'two' thus exists both in space and in time. In space, 2 exists as 2s, a space number, a bundle of 2s, a 2-bundle, which can be united with a 3-bundle. Either horizontally to a (2+3) bundle, a 5-bundle, or vertically to a stack of 2B1 2s or a stack of 2B-1 3s with B for bundle. In time, 2 exists together with the unit that was counted, as 2 units, a time-number, or a counting-number.

So, 2+3 is 5 only with like units. Without units, counting-numbers are operators to be multiplied with units to become totals that can be added if the units are the same.

20. Numeracy as Math Counting and Recounting Totals in Units before Adding them

As an example of a decolonized numeracy education that respects the children's bundle-numbers with units, Tarp (2018) shows that a 'counting before adding' approach leads to the same concepts as a traditional approach but with different identities, and in a different order.

A01. Intro to a ten-by-ten BundleBundleBoard. Kids count with bundles as 2 3s. So do we: 47, 1 number? No, 3 numberings. 47 = 4tens 7 = 4Bundles, at tens per-bundle, and 7 unbundled.

A02. Bundle-count in space. Five and ten fingers in 2s, 3s, 4s and 5s. 5 = 1B 3 = 3B -1 = 2B 1 = 1BB 0B 1 2s, and Ten = 2BB 0 B2 = 1BBB 0BB 1BB 0 2s. And T = 38 = 3B 8 = 2B 18 = 4B -2. T = 35+46 =3B 5 + 4B 6 = 7B 11 = 8B 1. T = 6*28 = 6*2B 8 = 12B 48 = 16B 8 = 168. T = 168/6 = 16B 8 /6 = 12B 48 /6 = 2B 4 = 24. Place value and carrying are unneeded.

A03. Bundle-count in time. “1,2,3,4,5,6” no! “0B1, 0B2, 0B3, 0B4, 0B5 or ½B0, ½B1”. Time-count from 88 to 100: “8B8, 8B9, 8Bten or 9B0, …, 9B9, 9Bten or tenB0 or 1BB0B0”.

A04. Add and subtract 1digit numbers counted in half-bundles. T = 6+7 = ½B1 + ½B2 = 1B3 = 13. T = 4+7 = ½B-1 + ½B2 = 1B1 = 11. T = 3+4 = ½B-2 + ½B-1 = 1B-3 = 7. And T = 8-6 = ½B3 - ½B1 = 3-1 = 2. T = 6-4 = ½B1 - ½B-1 = 1 - -1 = 2 (so, - - = +).

A05. Digits are icons. 4 strokes as a 4-icon: I I I I → IIII → 4. And 5 as a 5-icon.

A06. Operations are icons. Push-away and -back to lift to stack, (division & multiplication). ‘From 6 push-away 2s’ (6/2). 6 = 3x2 = (6/2)x2, T = (T/B)xB (the recount-formula). Pull-away and -back (minus and plus) to get decimals, fractions and negatives. 7 = 3B1 = 3½B = 4B-1 2s.

A07. Recount between icon and tens. “? 5s gives 40”: *u**5 = 40 = (40/5)*5, so *u* = 40/5, “Move to Opposite Side with Opposite Sign”. 6 7s = ? tens leads to multiplication tables where 6 7s = 6*7 = (B-4)*(B-3) = From BB, pull-away 3B & 4B and pull-back the 4*3 pulled-away twice = 3B12 = 4B2 = 42. So (B-4)*(B-3) = BB - 3B - 4B + 4*3. Here, minus * minus is +. Including B as a unit gives early algebra with FOIL. Or, 6*7 = 6* ½B 2 = 3B 12 = 4B 2 = 42.

A08. Recount physical gives per-numbers as 2$/5kg. 20kg = (20/5)*5kg = (20/5)*2$ = 8$. Fractions with like units: 2$/5$ = 2/5. Meter = (meter/sec)*sec = speed*sec. Trigonometry in a stack: height = (height/base)*base = tan(Angle)*base. $\pi = n * \tan(180/n)$ for *n* high enough.

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A10. Square stacks. T = 6 4s = 1BB where B =√(6*4). Guess 1: ‘(6-1) (4+1)s’ or ‘5 5s’, since ½*(6-4) = 1. The 1-corner needs 2 ‘*t* 4s’ stacks, *t**4 = ½ gives *t* = 1/8. Guess 2: ‘4.9 4.9s’.

A11. Solve quadratics. A (*u*+3)square has 2 squares and stacks: (*u*+3)^2 = *u*^2+ 3^2 + 2*3*u = *u*^2+6*u+9. If *u*^2 + 6*u + 8 = 0, all disappears but 1, so, (*u* + 3)^2 = 1, so *u* = -4 or *u* = -2.

A12. Add next-to and on-top. 2 3s + 4 5s = ? 8s. Integral calculus adds areas, and recounting change units. 2 3s + ? 5s = 3 8s. Here ? = (T2-T1)/5 = ΔT/5 roots differential calculus.

A13. Add per-numbers & fractions. 2kg at 3$/kg + 4kg at 5$/kg = (2+4)kg at (3*2+5*4) / (2+4) $/kg. And, 2 apples with ½ red + 3 apples with 2/3 red = (2+4) apples of which (2*½+3*2/3)/(2+3) red. Integral calculus adds piecewise or locally constant per-numbers.

A14. An ‘Algebra Square’ unites the four types of existing numbers: multiplication and addition unite like and unlike unit-numbers, and power and integration unite like and unlike per-numbers. And splits totals with the inverse operations: division and subtraction, together with the factor-finding root or factor-counting logarithm and differentiation.

Table 1. The Algebra Square shows the ways to reunite unlike and like unit- and per-numbers

Calculations unite/ ***split Totals in***	**Unlike**	**Like**
Unit-numbers m, s, kg, $	T = a + n *T – n = a*	T = a x n *T/n = a*
Per-numbers m/s, $/100$ = %	T = ∫ f dx *dT/dx = f*	T = a ^ n $\sqrt[n]{T} = a$ $\log_a(T) = n$

References

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Math is so Fun on a Bundle-Bundle-Board that it may reach the United Nations' Sustainable Development Goal and make all Youth Numerate by 2030. Reject.

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Proposal for STEM Expo & Materials Market

21. Numerate Now, but How, and what is 'Numerate'?

The fourth of the 17 UN Sustainable Development Goals, Quality Education, has as a goal target to "By 2030, ensure that all youth achieve literacy and numeracy". But, two different definitions of 'numerate' exist. The English Oxford Dictionary defines it as being "competent in the basic principles of mathematics, esp. arithmetic". In contrast, the American Merriam-Webster dictionary defines it as "having the ability to understand and work with numbers." The English definition uses the passive term 'competent' where the American uses the active term 'work'. The word 'competent' is a predicate, a non-action word, I cannot 'competent' something, I can only be judged as competent by someone who is competent.

In contrast, 'work' is an action word, a verb, since with my body and mind I can work on something and test the result to see if it works. Also, there is a difference between the words 'mathematics' and 'numbers.' Again, mathematics is a non-action word, I cannot 'mathematics' or even 'math' a thing. In contrast, 'number' is both a verb and a noun since I can number different degrees of Many to produce a number for later calculations.

Existentialist philosophy holds that existence must precede essence to prevent colonization. With Numbers as existence and math as essence, numeracy thus should precede math. In fact, numeracy may be defined as 'math with units' where 'addition folds and multiplication holds'.

Math's foundation is '2+1 = 3'. But this is falsified by an open and closed V-sign showing that 2 1s plus 1 2s gives 1 4s and not as 3 3s as math says. Adding without units, math must go.

22. How Numerate are Children before School?

"No, that is not four, that is two twos". Said a 3year old child when asked "How many years next time?"; and when seeing four fingers bundled two and two. As educated, essence is all we see. But as uneducated, the child sees what exists, bundles of twos in space, and two of them when counted in time.

The number 'two' thus exists both in space and in time. In space, 2 exists as 2s, a space number, a bundle of 2s, a 2-bundle, which can be united with a 3-bundle. Either horizontally to a (2+3) bundle, a 5-bundle, or vertically to a stack of 2B1 2s or a stack of 2B-1 3s with B for bundle. In time, 2 exists together with the unit that was counted, as 2 units, a time-number, or a counting-number.

So, 2+3 is 5 only with like units. Without units, counting-numbers are operators to be multiplied with units to become totals that can be added if the units are the same.

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As an example of a decolonized numeracy education that respects the children's bundle-numbers with units, Tarp (2018) shows that a 'counting before adding' approach leads to the same concepts as a traditional approach but with different identities, and in a different order.

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Reviews

Text STEM Expo/Materials Market November 2025

ID Title Review Status Preference Submit Date Action

874 Math is so Fun on a Bundle-Bundle-Board that it may reach the United Nations' Sustainable Development Goal and make all Youth Numerate by 2030

We appreciate your submission "Math is so Fun on a Bundle-Bundle-Board that it may reach the United Nations' Sustainable Development Goal and make all Youth Numerate by 2030". While the proposal aligns with the conference themes, its content and activity design closely replicate the material presented in your accepted workshop, "Children's own Numbers with Bundle-units...".

Because the workshop will already offer participants a direct, hands-on experience with the same methods and examples, including this submission in the STEM Expo / Materials Market would lead to unnecessary duplication in the programme. To maintain diversity and balance across sessions, the programme committee has decided not to accept this proposal.

We encourage you to integrate any additional elements from this Expo proposal into your workshop so participants can still benefit from them in a single, comprehensive session.

Rejected STEM Expo/Materials Market 05/08/2025 9:14 am 1 View

875 Children's own Numbers with Bundle-units may reach the United Nations' Sustainable Development Goal and make all Youth Numerate by 2030

Thank you for your submission, "Children's Own Numbers with Bundle-units may reach the United Nations' Sustainable Development Goal and make all Youth Numerate by 2030". This proposal presents an engaging, hands-on approach to numeracy education through the use of children's bundle-numbers and unit-based counting methods.

The workshop format is particularly well-suited for this contribution, as it allows participants to actively experience the proposed methods, explore the BundleBundleBoard concept, and practice the activities directly. This interactive design will provide attendees with concrete strategies and materials they can adapt for their own educational contexts.

We look forward to seeing your session in the Workshop programme, and to the opportunities it will create for participant interaction and skill development.

Accepted Workshops 05/08/2025 9:21 am 1 View

876 From STEM to STeN to make All Youth Numerate by 2030

The proposal presents an innovative perspective on rethinking STEM education by introducing "STeN" – incorporating economics and numeracy alongside science, technology, and engineering. The author effectively links this approach to the UN Sustainable Development Goal of achieving global numeracy by 2030 and provides a detailed rationale for replacing mathematics with a unit-based numeracy framework. The discussion on the historical and economic roots of geometry and algebra adds depth and originality to the argument. Overall, this is a thought-provoking and original contribution with clear relevance to the conference theme. With additional structuring and practical application details, it could make a compelling and engaging paper presentation.

The section contrasting definitions of "numerate" is particularly engaging, as it highlights the importance of action-oriented competencies over static descriptors. Additionally, the use of economic contexts, bundling concepts, and proportional reasoning to frame mathematical understanding is both creative and pedagogically relevant.

Accepted Single Oral Presentation 05/08/2025 9:26 am 1 View

877 Integral Calculus adds Children’s Bundle-numbers with Units and Piecewise or Locally Constant Per-numbers to make all Youth Numerate by 2030

We appreciate your submission and the effort in preparing "Integral Calculus adds Children’s Bundle-numbers with Units and Piecewise or Locally Constant Per-numbers to make all Youth Numerate by 2030". While the topic aligns with the general theme of the conference, much of the conceptual and introductory content significantly overlaps with your other submitted proposals. The additional focus on integral calculus, although technically relevant, does not present sufficient new insights or applications beyond what is already covered in your other accepted contribution(s).

To ensure diversity in the conference programme and avoid repetition, we have decided not to include this paper in the final programme. We encourage you to integrate the unique aspects of this work into your accepted presentation or workshop, so that participants can still benefit from the calculus-related ideas within a broader context.

Rejected Single Oral Presentation05/08/2025 9:29 am 1 View

878 STeN allows Science, Technology with Engineering, Economics and Numeracy to solve Problems on a BundleBundleBoard and make all Youth Numerate by 2030

Thank you for your submission "STeN allows Science, Technology with Engineering, Economics and Numeracy to solve Problems on a BundleBundleBoard and make all Youth Numerate by 2030". The proposal presents a range of concrete, visual, and interactive examples demonstrating the BundleBundleBoard concept and its applications across science, technology, engineering, and economics.

While the theoretical foundations overlap with some of your other submissions, the emphasis here on practical demonstrations, problem-solving activities, and visual models makes it especially well suited for the STEM Expo / Materials Market format. This setting will allow participants to directly engage with the materials, observe the methods in action, and discuss potential classroom applications in a hands-on environment.

We look forward to seeing your work showcased in the Expo.

Accepted STEM Expo/Materials Market 05/08/2025 9:33 am 1 View

879 Integrating History in STEM or STeN may make all Youth Numerate by 2030

Thank you for your submission "Integrating History in STEM or STeN may make all Youth Numerate by 2030". This proposal offers a distinctive perspective by embedding the historical development of mathematics, science, and technology into the discussion of numeracy and STEM/STEN education. The integration of historical context provides valuable insights into the evolution of mathematical concepts and their socio-economic foundations, enriching the conference dialogue.

Although some foundational ideas overlap with your other submissions, the historical framing and narrative approach in this paper bring a fresh angle that will be of interest to conference participants. For these reasons, the programme committee has decided to include this work as an Oral Presentation.

We look forward to your contribution to the conference programme.