

Decolonising math and science education

C. K. Raju

School of Mathematical Sciences
Universiti Sains Malaysia
web:ckraju.net

The basic question

- ▶ Science and math are believed to be universal.

The basic question

- ▶ Science and math are believed to be universal.
- ▶ So, is there anything to decolonise?

The thesis

- ▶ Present-day (Western) science and math are **not** universal.

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How superstitions
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The solution

The thesis

- ▶ Present-day (Western) science and math are **not** universal.
- ▶ We need to

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The thesis

- ▶ Present-day (Western) science and math are **not** universal.
- ▶ We need to
- ▶ eliminate the superstitions from Western math and science.

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- ▶ superstitions in science and math?

Making knowledge theologically correct

- ▶ Western society was dominated by the church for over a thousand years.

Making knowledge theologically correct

- ▶ Western society was dominated by the church for over a thousand years.
- ▶ All knowledge had to be made **theologically correct**.

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Making knowledge theologically correct

- ▶ Western society was dominated by the church for over a thousand years.
- ▶ All knowledge had to be made **theologically correct**.
- ▶ Western universities started for that reason.

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Making knowledge theologically correct

- ▶ Western society was dominated by the church for over a thousand years.
- ▶ All knowledge had to be made **theologically correct**.
- ▶ Western universities started for that reason.
- ▶ Bologna was to make the knowledge from Toledo theologically correct.

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Putting superstition into Western science

- ▶ Superstitions in Western science and math arose from a systematic process of making knowledge theologically correct.

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The solution

Putting superstition into Western science

- ▶ Superstitions in Western science and math arose from a systematic process of making knowledge theologically correct.
- ▶ This was done in two ways, through

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The solution

Putting superstition into Western science

- ▶ Superstitions in Western science and math arose from a systematic process of making knowledge theologically correct.
- ▶ This was done in two ways, through
- ▶ **false history** (making origins theologically correct), and

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The solution

Putting superstition into Western science

- ▶ Superstitions in Western science and math arose from a systematic process of making knowledge theologically correct.
- ▶ This was done in two ways, through
- ▶ **false history** (making origins theologically correct), and
- ▶ **reinterpretation** (of non-Western knowledge to align it with theology)

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A simpler case

- ▶ Understanding superstitions in Western science and math is difficult.

A simpler case

- ▶ Understanding superstitions in Western science and math is difficult.
- ▶ Let us start with an easy case.

A simpler case

- ▶ Understanding superstitions in Western science and math is difficult.
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- ▶ Is astrology science or superstition?

A simpler case

- ▶ Understanding superstitions in Western science and math is difficult.
- ▶ Let us start with an easy case.
- ▶ Is astrology science or superstition?
- ▶ What is the difference between science and superstition?

Not *what* you believe, but *why*

▶ (a) Refutability

Not *what* you believe, but *why*

- ▶ (a) Refutability
 - ▶ Science refutable

Not *what* you believe, but *why*

- ▶ (a) Refutability
 - ▶ Science refutable
 - ▶ superstition involves blind trust.

Not *what* you believe, but *why*

- ▶ (a) Refutability
 - ▶ Science refutable
 - ▶ superstition involves blind trust.
- ▶ (b) piling on hypotheses

Not *what* you believe, but *why*

- ▶ (a) Refutability
 - ▶ Science refutable
 - ▶ superstition involves blind trust.
- ▶ (b) piling on hypotheses
 - ▶ Any lie can be defended by telling a thousand more.

An example

The myth of Einstein

- ▶ Everyone knows the equation

An example

The myth of Einstein

- ▶ Everyone knows the equation
- ▶ $E = mc^2$

An example

The myth of Einstein

- ▶ Everyone knows the equation
- ▶ $E = mc^2$
- ▶ meaning

An example

The myth of Einstein

- ▶ Everyone knows the equation
- ▶ $E = mc^2$
- ▶ meaning
- ▶ Einstein = male chauvinist (squared)!

Corrected understanding of relativity

- ▶ Correcting credits for relativity corrects the theory.

Corrected understanding of relativity

- ▶ Correcting credits for relativity corrects the theory.
- ▶ **FDE not ODE**: One must use functional differential equations (FDE) instead of ordinary differential equations (ODE)

How do you decide?

- ▶ So, **how do you decide** the truth of $E=F$ (Einstein = Fraud)?

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How do you decide?

- ▶ So, **how do you decide** the truth of $E=F$ (Einstein = Fraud)?
- ▶ What method do you use?

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How do you decide?

- ▶ So, **how do you decide** the truth of $E=F$ (Einstein = Fraud)?
- ▶ What method do you use?
- ▶ **Correct method:** read Einstein, Poincare, me. Test the theory.

How do you decide?

- ▶ So, **how do you decide** the truth of $E=F$ (Einstein = Fraud)?
- ▶ What method do you use?
- ▶ **Correct method:** read Einstein, Poincare, me. Test the theory.
 - ▶ Because math is made difficult, university education keeps people scientifically illiterate.

How do you decide?

- ▶ So, **how do you decide** the truth of $E=F$ (Einstein = Fraud)?
- ▶ What method do you use?
- ▶ **Correct method:** read Einstein, Poincare, me. Test the theory.
 - ▶ Because math is made difficult, university education keeps people scientifically illiterate.
- ▶ **Usual method:** **Guess** whom to trust.

Actual process of acceptance

- ▶ People first condemned me. (*Physics Education*).

Actual process of acceptance

- ▶ People first condemned me. (*Physics Education*).
- ▶ Then they ignored it. (For 5 years, after book was published.)

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- ▶ Then they contested it fiercely. (Groningen debate 1999)

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Actual process of acceptance

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- ▶ Then they contested it fiercely. (Groningen debate 1999)
- ▶ Then some began to see there is some new physics (solution of FDEs 2004)

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- ▶ Then a famous Westerner copied it (“Atiyah’s hypothesis” 2005-2006).

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Actual process of acceptance

- ▶ People first condemned me. (*Physics Education*).
- ▶ Then they ignored it. (For 5 years, after book was published.)
- ▶ Then they contested it fiercely. (Groningen debate 1999)
- ▶ Then some began to see there is some new physics (solution of FDEs 2004)
- ▶ Then a famous Westerner copied it (“Atiyah’s hypothesis” 2005-2006).
- ▶ Then I got an award (2010).

What was the process?

- ▶ Constant process: decide truth by Western endorsement.

What was the process?

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- ▶ (Scientific) illiterates deciding truth by trusting those who have exploited them for centuries.

What was the process?

- ▶ Constant process: decide truth by Western endorsement.
- ▶ (Scientific) illiterates deciding truth by trusting those who have exploited them for centuries.
- ▶ Similar to those who believe in astrology.

False gods of science

- ▶ There are many such false gods.

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False gods of science

- ▶ There are many such false gods.
- ▶ E.g. “Euclid”, “Ptolemy”, Copernicus, Newton.

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False gods of science

- ▶ There are many such false gods.
- ▶ E.g. “Euclid”, “Ptolemy”, Copernicus, Newton.
- ▶ This false history used by Macaulay to change education system.

False gods of science

- ▶ There are many such false gods.
- ▶ E.g. “Euclid”, “Ptolemy”, Copernicus, Newton.
- ▶ This false history used by Macaulay to change education system.
- ▶ Still used to maintain it.

Main thesis

- ▶ Reformed math and science curriculum should eliminate

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Main thesis

- ▶ Reformed math and science curriculum should eliminate
- ▶ the belief in these false gods of science

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Main thesis

- ▶ Reformed math and science curriculum should eliminate
- ▶ the belief in these false gods of science
- ▶ and the related superstitions.

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The solution

Main thesis

- ▶ Reformed math and science curriculum should eliminate
- ▶ the belief in these false gods of science
- ▶ and the related superstitions.
- ▶ Trusting the West more dangerous than trusting astrologers.

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Example of superstition in science

- ▶ Everyone has heard of Newton's laws.

Example of superstition in science

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- ▶ How do you know there are "laws" of physics?

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Example of superstition in science

- ▶ Everyone has heard of Newton's laws.
- ▶ How do you know there are "laws" of physics?
- ▶ Is this a refutable belief?
- ▶ Not refutable, hence not a scientific belief.
- ▶ Yet taught as the first lesson in science to children.

A theological belief

- ▶ Belief in laws of physics is a **religious** belief.

A theological belief

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- ▶ Aquinas said, God rules the world with eternal laws.

A theological belief

- ▶ Belief in laws of physics is a **religious** belief.
- ▶ Aquinas said, God rules the world with eternal laws.
- ▶ Newton thought he was a prophet and those laws were revealed to him.

Why this belief is harmful

- ▶ This belief in “laws” of physics **contrary** to Islamic beliefs

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Why this belief is harmful

- ▶ This belief in “laws” of physics **contrary** to Islamic beliefs
- ▶ (whether or not you accept al Ghazali)

Why this belief is harmful

- ▶ This belief in “laws” of physics **contrary** to Islamic beliefs
- ▶ (whether or not you accept al Ghazali)
- ▶ Hence, used to attack Islam as unscientific, e.g. *Guardian* on Islam.

“Eurocentrism” or a strategy for soft power

- ▶ There are regularities, there are physical models, but no laws.

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“Eurocentrism” or a strategy for soft power

- ▶ There are regularities, there are physical models, but no laws.
- ▶ Stop teaching this harmful belief to children. Can we actually stop it?

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“Eurocentrism” or a strategy for soft power

- ▶ There are regularities, there are physical models, but no laws.
- ▶ Stop teaching this harmful belief to children. Can we actually stop it?
- ▶ What the pope said to Gregorios.

“Eurocentrism” or a strategy for soft power

- ▶ There are regularities, there are physical models, but no laws.
- ▶ Stop teaching this harmful belief to children. Can we actually stop it?
- ▶ What the pope said to Gregorios.
- ▶ Asians are too stupid and illiterate to understand Augustine and Aquinas.

“Eurocentrism” or a strategy for soft power

- ▶ There are regularities, there are physical models, but no laws.
- ▶ Stop teaching this harmful belief to children. Can we actually stop it?
- ▶ What the pope said to Gregorios.
- ▶ Asians are too stupid and illiterate to understand Augustine and Aquinas.
- ▶ E.g. Stephen Hawking.

Example 2

Content of Newtonian physics

- ▶ That was about the word “laws”

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- ▶ What about the **content** of Newtonian physics?

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Content of Newtonian physics

- ▶ That was about the word “laws”
- ▶ What about the **content** of Newtonian physics?
- ▶ People **say** science is about experiment.

Example 2

Content of Newtonian physics

- ▶ That was about the word “laws”
- ▶ What about the **content** of Newtonian physics?
- ▶ People **say** science is about experiment.
- ▶ But when the theory fails, they tell stories!

Newtonian physics vs everyday experience

- ▶ Newtonian physics is (a) reversible, (b) mechanistic.

Newtonian physics vs everyday experience

- ▶ Newtonian physics is (a) reversible, (b) mechanistic.
- ▶ **contrary** to everyday experience.

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The solution

Newtonian physics vs everyday experience

- ▶ Newtonian physics is (a) reversible, (b) mechanistic.
- ▶ **contrary** to everyday experience.
- ▶ of irreversibility, and

Newtonian physics vs everyday experience

- ▶ Newtonian physics is (a) reversible, (b) mechanistic.
- ▶ **contrary** to everyday experience.
- ▶ of irreversibility, and
- ▶ creativity.

Use a different physics

- ▶ So, Newtonian physics cannot be reconciled with the simplest experience.

Use a different physics

- ▶ So, Newtonian physics cannot be reconciled with the simplest experience.
- ▶ But the contradiction is explained by piling on hypotheses.

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- ▶ stories about thermodynamics and “free will” .

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- ▶ So, Newtonian physics cannot be reconciled with the simplest experience.
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- ▶ stories about thermodynamics and “free will” .
- ▶ Theology comes in at even this level of reconciling science with experience.

Use a different physics

- ▶ So, Newtonian physics cannot be reconciled with the simplest experience.
- ▶ But the contradiction is explained by piling on hypotheses.
- ▶ stories about thermodynamics and “free will” .
- ▶ Theology comes in at even this level of reconciling science with experience.
- ▶ Alternative: **eliminate the theology from physics.** (FDEs).

Waiting for Western endorsement

- ▶ So, shall we wait for Western endorsement of this?

Why Newton's "laws" failed

- ▶ Newton's physics failed because Newton did not **understand** the calculus.

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Why Newton's "laws" failed

- ▶ Newton's physics failed because Newton did not **understand** the calculus.
- ▶ The calculus developed in India with one epistemology.

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Why Newton's "laws" failed

- ▶ Newton's physics failed because Newton did not **understand** the calculus.
- ▶ The calculus developed in India with one epistemology.
- ▶ It was imported in Europe in 16th c. for its practical value for navigation.

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Why Newton's "laws" failed

- ▶ Newton's physics failed because Newton did not **understand** the calculus.
- ▶ The calculus developed in India with one epistemology.
- ▶ It was imported in Europe in 16th c. for its practical value for navigation.
- ▶ Newton imposed his religious beliefs on it (fluxions).

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Why Newton's "laws" failed

- ▶ Newton's physics failed because Newton did not **understand** the calculus.
- ▶ The calculus developed in India with one epistemology.
- ▶ It was imported in Europe in 16th c. for its practical value for navigation.
- ▶ Newton imposed his religious beliefs on it (fluxions).
- ▶ Hence made time metaphysical.

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The solution

Mathematics as eternal truth

- ▶ On Western theology

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The solution

Mathematics as eternal truth

- ▶ On Western theology
- ▶ God rules the world with eternal laws

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The solution

Mathematics as eternal truth

- ▶ On Western theology
- ▶ God rules the world with eternal laws
- ▶ which he wrote in the language of **math**
- ▶ just because math contains eternal truths.

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Math and mathesis

The origin of mathematics

- ▶ Word “mathematics” originates from mathesis.

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Math and mathesis

The origin of mathematics

- ▶ Word “mathematics” originates from mathesis.
- ▶ mathesis means learning.

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Math and mathesis

The origin of mathematics

- ▶ Word “mathematics” originates from mathesis.
- ▶ mathesis means learning.
- ▶ Plato explains: all learning is recollection

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Math and mathesis

The origin of mathematics

- ▶ Word “mathematics” originates from mathesis.
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- ▶ of eternal ideas in the eternal **soul**, and

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Math and mathesis

The origin of mathematics

- ▶ Word “mathematics” originates from mathesis.
- ▶ mathesis means learning.
- ▶ Plato explains: all learning is recollection
- ▶ of eternal ideas in the eternal **soul**, and
- ▶ mathematics best suited to it, since it contains eternal truths.

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The solution

Infinity, metaphysics and set theory

- ▶ Calculus involved infinite series

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The solution

Infinity, metaphysics and set theory

- ▶ Calculus involved infinite series
- ▶ which could not be physically summed (it would take infinite time).

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The solution

Infinity, metaphysics and set theory

- ▶ Calculus involved infinite series
- ▶ which could not be physically summed (it would take infinite time).
- ▶ The Western solution was to handle infinity metaphysically.

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- ▶ That is what set theory enables.

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Infinity, metaphysics and set theory

- ▶ Calculus involved infinite series
- ▶ which could not be physically summed (it would take infinite time).
- ▶ The Western solution was to handle infinity metaphysically.
- ▶ That is what set theory enables.
- ▶ Set theory comes at the beginning of math teaching today.

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Formal math as metaphysics

- ▶ Present-day mathematics is **formal**: pure syntax, no semantics.

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Formal math as metaphysics

- ▶ Present-day mathematics is **formal**: pure syntax, no semantics.
- ▶ It focuses on proof, and

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Formal math as metaphysics

- ▶ Present-day mathematics is **formal**: pure syntax, no semantics.
- ▶ It focuses on proof, and
- ▶ and **does not allow empirical methods of proof.**

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The solution

Formal math as metaphysics

- ▶ Present-day mathematics is **formal**: pure syntax, no semantics.
- ▶ It focuses on proof, and
- ▶ and **does not allow empirical methods of proof**.
- ▶ Hence, it is metaphysical.

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Biased metaphysics

- ▶ This metaphysics is **religiously biased**.

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The solution

Biased metaphysics

- ▶ This metaphysics is **religiously biased**.
- ▶ E.g. **all** systems of Indian philosophy accept empirical as a means of proof.

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Biased metaphysics

- ▶ This metaphysics is **religiously biased**.
- ▶ E.g. **all** systems of Indian philosophy accept empirical as a means of proof.
- ▶ (*Pratyakṣa* is the first *pramāṇa*).

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Biased metaphysics

- ▶ This metaphysics is **religiously biased**.
- ▶ E.g. **all** systems of Indian philosophy accept empirical as a means of proof.
- ▶ (*Pratyakṣa* is the first *pramāṇa*).
- ▶ If formal math is universal, all Indian philosophy must be discarded

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Biased metaphysics

- ▶ This metaphysics is **religiously biased**.
- ▶ E.g. **all** systems of Indian philosophy accept empirical as a means of proof.
- ▶ (*Pratyakṣa* is the first *pramāṇa*).
- ▶ If formal math is universal, all Indian philosophy must be discarded
- ▶ (includes Advaita Vedānta, Nyāya-Vaiśeṣika, Sāṃkhya-Yoga, Cārvaka/Lokāyata, Buddhist, Jain.)

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Formal math **not** universal

- ▶ Formal math based on proof.

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Formal math **not** universal

- ▶ Formal math based on proof.
- ▶ Proof based on logic.

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The solution

Formal math **not** universal

- ▶ Formal math based on proof.
- ▶ Proof based on logic.
- ▶ (Deductive) logic **not** universal.

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Logic not universal

- ▶ 2-valued logic **not** universal. E.g.

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Logic not universal

- ▶ 2-valued logic **not** universal. E.g.
- ▶ Buddhist catuṣkoṭi (logic of 4-alternatives)

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Logic not universal

- ▶ 2-valued logic **not** universal. E.g.
- ▶ Buddhist catuṣkoṭi (logic of 4-alternatives)
- ▶ Jain syādavāda.

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The solution

Logic not universal

- ▶ 2-valued logic **not** universal. E.g.
- ▶ Buddhist catuṣkoṭi (logic of 4-alternatives)
- ▶ Jain syādavāda.
- ▶ Quantum logic.

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Math as religiously biased metaphysics

- ▶ Thus, formal math is religiously biased metaphysics.

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Math as religiously biased metaphysics

- ▶ Thus, formal math is religiously biased metaphysics.
- ▶ Biased against all Indian systems of philosophy, and

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The solution

Math as religiously biased metaphysics

- ▶ Thus, formal math is religiously biased metaphysics.
- ▶ Biased against all Indian systems of philosophy, and
- ▶ also biased against Islam, as I have explained elsewhere.

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A doubt

- ▶ So, where is the religious belief in $2+2 = 4$?

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Normal math vs formal math

- ▶ First, there are two types of math.

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Normal math vs formal math

- ▶ First, there are two types of math.
- ▶ Normal math, and

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Normal math vs formal math

- ▶ First, there are two types of math.
- ▶ Normal math, and
- ▶ formal math.

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Normal math vs formal math

continued

- ▶ Normal math is what you use for everyday practical purposes

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Normal math vs formal math

continued

- ▶ Normal math is what you use for everyday practical purposes
- ▶ such as commercial transactions.

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continued

- ▶ Normal math is what you use for everyday practical purposes
- ▶ such as commercial transactions.
- ▶ I have no problems with it. I advocate practical math.

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Normal math vs formal math

continued

- ▶ Normal math is what you use for everyday practical purposes
- ▶ such as commercial transactions.
- ▶ I have no problems with it. I advocate practical math.
- ▶ Formal math is what is taught in university. I reject it.

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- ▶ $2 + 2 = 4$ not universal.

- ▶ $2 + 2 = 4$ not universal.
- ▶ On a computer chip $1 + 1 = 0$.

- ▶ $2 + 2 = 4$ not universal.
- ▶ On a computer chip $1 + 1 = 0$.
- ▶ Or $1 + 1 = 1$.

$$2+2 = 4$$

in daily life

▶ 2 stones + 2 stones (+ break stone) = 5 stones

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$$2+2 = 4$$

in daily life

- ▶ 2 stones + 2 stones (+ break stone) = 5 stones
- ▶ 2 big fish + 2 small fish = 4 big fish?

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$$2+2 = 4$$

in daily life

- ▶ 2 stones + 2 stones (+ break stone) = 5 stones
- ▶ 2 big fish + 2 small fish = 4 big fish?
- ▶ Solution: weigh the fish. 2 big fish + 2 small fish = 3.67 kg fish

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$$2+2 = 4$$

in daily life

- ▶ 2 stones + 2 stones (+ break stone) = 5 stones
- ▶ 2 big fish + 2 small fish = 4 big fish?
- ▶ Solution: weigh the fish. 2 big fish + 2 small fish = 3.67 kg fish
- ▶ 2 gold bars + 2 gold bars = 3.960 kg = 4 kg?

- ▶ So, we cannot just talk of 2, for it might be 2.0.

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- ▶ In normal math we stop with some precision.

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- ▶ A few grams OK for fish.

- ▶ So, we cannot just talk of 2, for it might be 2.0.
- ▶ In normal math we stop with some precision.
- ▶ A few grams OK for fish.
- ▶ A few micrograms OK for gold, etc.

- ▶ Formal math demands infinite precision.

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- ▶ Since West thought math is eternal truth, perfect, etc.

- ▶ Formal math demands infinite precision.
- ▶ Since West thought math is eternal truth, perfect, etc.
- ▶ Infinite precision only possible metaphysically.

- ▶ If you accept finite precision

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- ▶ as in computer arithmetic

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- ▶ the rules of arithmetic will change:

- ▶ If you accept finite precision
- ▶ as in computer arithmetic
- ▶ the rules of arithmetic will change:
- ▶ E.g. associative “law” will fail.

The solution

- ▶ Eliminate the superstitions and religious bias

The solution

- ▶ Eliminate the superstitions and religious bias
- ▶ in university mathematics and physics.

Calculus without limits

- ▶ Calculus is at the base of hard science.

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Calculus without limits

- ▶ Calculus is at the base of hard science.
- ▶ Today taught using “limits”.

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Calculus without limits

- ▶ Calculus is at the base of hard science.
- ▶ Today taught using “limits”.
- ▶ ”Limits” are a Western metaphysical impositions.

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Calculus without limits

- ▶ Calculus is at the base of hard science.
- ▶ Today taught using “limits”.
- ▶ ”Limits” are a Western metaphysical impositions.
- ▶ So, calculus should be taught without limits

Calculus without limits

- ▶ Calculus is at the base of hard science.
- ▶ Today taught using “limits”.
- ▶ ”Limits” are a Western metaphysical impositions.
- ▶ So, calculus should be taught without limits
- ▶ using the epistemology with which it developed.

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The solution

The experiment

- ▶ This solution has been tried out

The experiment

- ▶ This solution has been tried out
- ▶ on 1 group in CUTS, Sarnath

The experiment

- ▶ This solution has been tried out
- ▶ on 1 group in CUTS, Sarnath
- ▶ and 4 groups in USM, Penang.

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Advantages

- ▶ It makes math easy,

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Advantages

- ▶ It makes math easy,
- ▶ by eliminating the religious bias in it

Advantages

- ▶ It makes math easy,
- ▶ by eliminating the religious bias in it
- ▶ gives a better math

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Advantages

- ▶ It makes math easy,
- ▶ by eliminating the religious bias in it
- ▶ gives a better math
- ▶ physics

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- ▶ It makes math easy,
- ▶ by eliminating the religious bias in it
- ▶ gives a better math
- ▶ physics
- ▶ and history.

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Advantages

- ▶ It makes math easy,
- ▶ by eliminating the religious bias in it
- ▶ gives a better math
- ▶ physics
- ▶ and history.
- ▶ Details in my books, papers, and blog.
(<http://ckraju.net/blog>)

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