

Indian ganita vs formal mathematics

C. K. Raju

*Indian Institute of Education
G. D. Parikh Centre, J. P. Naik Bhavan
Mumbai University Kalina Campus
Vidyanaigari, Santacruz (E), Mumbai 400 098*

Extended Abstract

Background

Europe learnt almost all its basic mathematics from India: that includes the well-known cases of arithmetic, algebra, and trigonometry, but also calculus,⁵ and probability and statistics.⁶ Native European arithmetic (“Roman numerals”) was primitive, and lacked fractions, hence Christian Europe repeatedly imported efficient Indian arithmetic (“Arabic numerals”) first from Muslim Europe (Cordoba, Gerbert, Pope Sylvester II, 10th c.), again from Africa (Florentine merchants, Fibonacci, 12th c.), and, for a third time, direct from India (Clavius, 16th c.). Why did Europeans need so many centuries to understand and assimilate elementary arithmetic? A similar question arises with the calculus and its infinite series, which Europe imported from India in the 16th c., via Jesuits in Cochin. Europeans (Descartes, Newton’s fluxions etc.) failed to understand the meaning of infinite sums, at least until the formal set theory of the 20th c. enabled some sort of sense to be made of limits and formal real numbers.

Yet, today, because of colonial education, we teach (and do) Western formal math packaged with a systematically false⁷ Christian chauvinist history that all math and science is the work of Christians or their (only) “friends” the early Greeks (e.g. “Newton and Leibniz invented calculus”, “Archimedes” etc.). Students are indoctrinated to believe that the Western way of doing things (including math) is somehow both superior and universal, without applying common sense.

Actually, European difficulties with imported math arose due to epistemic differences in math.⁸

Hence, to enable any consideration of Indian गणित (or normal math) as a viable contemporary alternative to formal math, it is necessary to demolish not only the false Western *history* of math,

5 C. K. Raju, *Cultural Foundations of Mathematics: the nature of mathematical proof and the transmission of calculus from India to Europe in the 16th c. CE*, Pearson Longman, 2007.

6 C. K. Raju, “Probability in Ancient India”, *Handbook of the Philosophy of Science*, vol 7, *Philosophy of Statistics*, ed. Prasanta S. Bandyopadhyay and Malcolm R. Forster. General Editors: Dov M. Gabbay, Paul Thagard and John Woods. Elsevier, 2011, pp. 1175–1196. Also, “Probability” article in *Encyclopedia of Non-Western Science, Technology and Medicine*, ed. Helaine Selin, Springer, 2016. pp. 3585–3589.
<http://ckraju.net/papers/Springer/Probability-springer.pdf>

7 C. K. Raju, *Is science Western in origin?* Multiversity, Penang, 2009. Reprint, Other India Bookstore, 2014.

8 “Math wars and the epistemic divide in mathematics”, *Cultural Foundations of Mathematics*, cited above, chp. 9.

but also the accompanying bad *philosophy* of math,⁹ and related false and incoherent claims of both superiority AND universality.

From the days of the *sulba sutra*, the philosophy of Indian गणित (normal mathematics) differed from the philosophy of formal mathematics, used for mathematics today, though we wrongly translate mathematics as गणित, on the myth that mathematics is universal. Contrary to this myth of universality, our current NCERT school text (class IX, chp. 5) explicitly indoctrinates millions of students into the myth that Indian गणित and, indeed, all non-Western ways of doing geometry were “inferior” to the “superior” Western way of doing geometry, initiated by the “Greeks”.

That superior geometry is falsely¹⁰ attributed to a mythical white-skinned Greek Euclid. But, in the last ten years, no one has met my Euclid challenge prize of Rs 2 lakhs to provide the slightest serious evidence for Euclid; instead leading Western experts acknowledged long ago¹¹ that NOTHING is known about Euclid. However, this false history of “Greeks” serves an unsuspected purpose; it hides the relation of mathematics to religious beliefs, as in Plato.¹² It also hides the church connection:¹³ for the book “Euclid’s” *Elements* was used as a church text for centuries. Hence it *had* to be theologically correct, and was made so by reinterpreting it to fit the post-Crusade church theology of reason. The reinterpretation did *not* fit the actual book, but was acknowledged as false, only after seven centuries, at the turn of the 20th c. Formal mathematics arose from the subsequent attempts of David Hilbert¹⁴ and Bertrand Russell¹⁵ et al. to “save the story”: they rejected the actual book *Elements* as erroneous, but advocated its false (church) reinterpretation as a universal philosophical norm! We follow that norm today because of globalised colonial education which first came as church education.¹⁶

Such claims (“we are superior, you are inferior”), using mere myths, are typical of church chauvinist propaganda, and the key “moral” justification the church used for centuries to brazenly advocate racism¹⁷ and genocide.¹⁸ Accordingly, they should be *critically* examined by the colonised,

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- 9 C. K. Raju, “To decolonise math stand up to its false history and bad philosophy”, article CENSORED after publication in *Conversation*. Reproduced at <http://ckraju.net/blog/?p=117>, and in *Rhodes Must Fall*, Zed Books, London, 2018. Also in “Black thoughts matter: decolonized math, academic censorship...” *Journal of Black Studies*, 48(3), pp. 256-278.
 - 10 C. K. Raju, “Towards Equity in Math Education 1. Good-Bye Euclid!”, *Bharatiya Samajik Chintan* (New Series) 7 (4) (2009) pp. 255–264. <http://ckraju.net/papers/MathEducation1Euclid.pdf>.
 - 11 David Fowler, <http://mathforum.org/kb/message.jspa?messageID=1175734> . Historia Matematica discussion list, 10 Nov 2002.
 - 12 Plato, *Meno*, *Dialogues of Plato*, trans. B. Jowett, Available online at the Internet Classics Archive hosted by MIT, <http://classics.mit.edu/Plato/meno.html>, etc. (In *Meno*, search for the second occurrence of “soul”.)
 - 13 C. K. Raju, *Euclid and Jesus: how and why the church changed mathematics and Christianity across two religious wars*, Multiversity, Penang, 2012.
 - 14 Hilbert’s “synthetic” reinterpretation of the *Elements* is in D. Hilbert, *The Foundations of Geometry*, trans. E. J. Townsend, Open Court, La Salle, reprint 1950.
 - 15 Russell said Euclid erred in executing his intentions! B. Russell, “The teaching of Euclid”, *The Mathematical Gazette* 2 (33) (1902), pp. 165-167.
 - 16 C. K. Raju, “Education and church: decolonising the hard sciences”, *Frontier Weekly*, 46(7), Aug 25-31, 2013. <http://www.frontierweekly.com/archive/vol-number/vol/vol-46-2013-14/46-7/46-7-Decolonising%20Hard%20Sciences.html>.
 - 17 For a detailed discussion on church advocacy of racism, see *Euclid and Jesus*, cited above. For a quick account, see J. Priest, *Bible defence of slavery*, Louisville, Kentucky, 6th ed. 1851. Also, <http://utc.iath.virginia.edu/christn/chesjpat.html>.
 - 18 For a quick account of persistent church advocacy of genocide of all non-Christians, see C. K. Raju, “Meaning of Christian discovery”, *Frontier Weekly* 47(29), Jan 25-31 (2015), <http://www.frontierweekly.com/archive/vol-number/vol/vol-47-2014-15/47-29/47-29-The%20Meaning%20of%20Christian%20Discovery.html>.

without trusting Western authority (or Wikipedia) one inch. But any attempt to critically examine the purported superiority of Western ethnomathematics, and its related myths, is taboo, and is hence repeatedly censored worldwide,¹⁹ including in India, at both the popular²⁰ and academic²¹ level. Secretive censorship was the stock church way of indefinitely preserving foolish dogmas, and it is a regrettably glorified²² part of our academic system.

The myths and superstitions of formal math

In this talk I will analyse the false philosophical myths and dogmas underlying this claim of “superior” Western mathematics and comprehensively refute them.

Myth 1. The first myth is that “Indian *ganita* lacked proof”. To refute it, I will compare the Indian proof of the “Pythagorean theorem”²³ with Western (pre-Hilbert) proofs to show that those Western proofs are merely very prolix and ritualistic, and do not involve any difference of principle.

Myth 2. The second myth is that “Greeks alone used reason”. However, almost all systems of ancient Indian philosophy (न्याय-वैशेषिक, सांख्य-योग, मीमांसा, बौद्ध, जैन), from long before even the historical Aristotle,²⁴ accepted BOTH empirical proof (प्रत्यक्ष प्रमाण) AND reasoning (अनुमान) as the two basic means of proof. Indian *ganita* did likewise: it accepted BOTH empirical proofs and reasoning. For example, as Lalla²⁵ explains, the 5th Aryabhata inferred²⁶ that the earth is round from the fact that far off trees cannot be seen, no matter how tall, a deduction the Bible failed to make.²⁷ Further, there is a double speak about “reason” here: people take it to mean “normal reason” (= reason + facts) whereas the church took it to mean metaphysical or “formal reason” (= reason minus facts). As stated above, contrary to myth, formal reason is absent in “Euclid’s” *Elements*.

19 C. K. Raju, “Mathematics and censorship”, Kafila, <https://kafila.online/2017/06/25/mathematics-and-censorship-c-k-raj/>.

20 Scroll.in first reproduced the above *Conversation* article, then censored it when *Conversation* did. This was repeated worldwide. The Wire however put it back. <https://thewire.in/history/to-decolonise-maths-stand-up-to-its-false-history>.

21 For example, the extended abstract “Ganita vs math: ten myths of Western math and the need to refute them”, <http://ckraju.net/blog/?p=111>, was presented as an invited talk at an ICPR sponsored conference on “Plurality in math” in Kolkata. However, the organizer Mihir Chakraborty CENSORED it refusing to publish it in JICPR (a journal I once helped to edit) on some silly false excuses (that “it was not relevant to plurality in math”), but in reality because its anti-Western tone would jeopardize his chances of getting foreign invitations. Clearly, the academic system of secretive review suits the editor’s interests not those of the subject. Again, NCERT at a recent conference (Dec 2018) on Indian tradition in math CENSORED my article on Rajju Ganit because it exposes the falsehoods in the NCERT text.

22 Instead, there ought to be post-publication open peer review, as advocated in C. K. Raju, *Ending Academic Imperialism*, Citizens International, Penang, 2011.

23 C. K. Raju, “Computers, mathematics education, and the alternative epistemology of the calculus in the YuktiBhāsā”, *Philosophy East and West*, 51(3) (2001) pp. 325–362.

24 It is necessary to discriminate between the mythical Aristotle of Toledo (to whom hundreds of texts are indiscriminately attributed) and the historical Aristotle of Stagira. In particular, there is no evidence that the syllogism is due to Aristotle. See, C. K. Raju, “Logic”, *Encyclopedia of Non-Western Science, Technology and Medicine*, Springer, 2008, 2016. pp. 2564–2570. <http://ckraju.net/papers/Nonwestern-logic.pdf>.

25 लल्ल, शिष्यधीर्द्धिद, chp. 20 मिथ्याज्ञाननिराकरणम्

26 आर्यभट्ट, आर्यभटीय, गोलपाद 6-7 compares the earth to a *kadamba* flower and asserts it stands supportless in space.

27 E.g. King James version, Daniel 4:10-11: 10 “...I saw, and behold a tree in the midst of the earth, and the height thereof was great.” 11 “The tree grew, and was strong, and the height thereof reached unto heaven, and the sight thereof to the end of all the earth”.

Myth 3. The third Western philosophical myth is that “deductive proofs are infallible or superior to empirical proofs which are fallible”. This is false. It is true that empirical proofs are fallible, but so are deductive proofs. The mind is more easily deceived than the senses, and therefore almost invariably errs in a complex deductive proof (or deductive chain, such as a game of chess). Therefore, invalid deductive proof may be mistakenly accepted as valid, as was done by ALL Western scholars for centuries who mistook the proofs in “Euclid’s” *Elements* for valid deductive proofs. Any doubt about errors in a deductive proof can only be settled inductively, hence it may persist as a philosophical doubt, and deduction is no better than induction. In actual practice the validity of a deductive proof is decided by blindly trusting mathematical authority (which lies in the West). Hence, deductive proofs are *more* fallible than empirical proofs. Thus, **the proofs of formal math lack any epistemic value (over those of normal math).**

Myth 4. The fourth philosophical myth is that “mathematical theorems are valid knowledge” (eternal truths “up there” in some Platonic sense). To the contrary, as the Lokayata pointed out long ago, bad postulates lead to wrong conclusions. Even formalism accepts that theorems are at best relative truths, relative to the postulates, and any nonsense proposition whatsoever can be established as a mathematical theorem starting from appropriate postulates. However, the postulates of formal math (e.g. set theory) involve a metaphysics of infinity, which *cannot* be empirically checked. Its postulates have to be accepted on mere authority, and are a mere agreement among authoritative Western mathematicians. That metaphysics of infinity is allied to church dogmas of eternity.²⁸ This has political value: for example, this metaphysics can be used to twist physics into supporting church dogmas as was done²⁹ by Stephen Hawking et al. who claimed that general relativity supports the doctrine of one-time creation. Thus, **formal math has political value, but only for the West.**

Myth 5. The fifth myth is that “formal math “works””. Actually what “works” in practice is normal math: **all practical value comes from normal mathematics.** For example, Russell’s 378 page formal proof of $1+1=2$ in integers adds nothing to the pre-existing practical value of $1+1=2$ in a grocer’s shop. Formal math merely adds a complex layer of metaphysics over normal math; it is commonsense that metaphysics is irrelevant for real-world practical applications. Thus, again, all practical applications of math to science and engineering today, such as sending a rocket to the moon, involve numerical solution of differential equations in exactly the manner of the Indian calculus (normal math) since the days of Aryabhata. Obviously, too, Newton worked out his physics (using a rejected metaphysics of fluxions) long before the metaphysics of limits, formal real numbers needed for that, and set theory needed for that, all of which is today declared essential for calculus. (Incidentally, Indians such as नीलकंठ summed infinite geometric series using non-Archimedean arithmetic³⁰ [Brahmagupta’s अव्यक्त गणित], and a philosophy of inexactitude [शून्यवाद] today called zeroism.³¹ This results in a superior calculus today, for advanced

28 C. K. Raju, “Eternity and Infinity: the Western misunderstanding of Indian mathematics and its consequences for science today.” *American Philosophical Association Newsletter on Asian and Asian American Philosophers and Philosophies* 14(2) (2015) pp. 27–33. <http://ckraju.net/papers/Eternity-and-infinity-Pages-from-APA.pdf>.

29 C. K. Raju, *The Eleven Pictures of Time*, Sage, 2003.

30 C. K. Raju, “Calculus”, and “Calculus transmission”, in *Encyclopedia of Non-Western Science, Technology and Medicine*, Springer, 2016, pp. 1010–1015. <http://ckraju.net/papers/Springer/ckr-Springer-encyclopedia-calculus-1-final.pdf>, and 1016–1022. <http://ckraju.net/papers/Springer/ckr-Springer-encyclopedia-calculus-2-final.pdf>

31 C. K. Raju, “Zeroism”, in *Encyclopedia of Non-Western Science, Technology and Medicine*, Springer, 2016, pp. 4604–4610. <http://ckraju.net/papers/Springer/zeroism-springer-f.pdf>.

applications to science.) Thus, **formal math adds no practical value to normal math.** On the contrary, it subtracts value because it adds a huge amount of complex metaphysics, which makes math difficult, as in the complex proof of $1+1=2$ (even more complex in formal reals).

Myth 6. The sixth myth is that “mathematics is exact”. In contrast, the Manava sulba sutra (10.10) states the “Pythagorean theorem” using square *roots* which may be inexact (सविशेष). On the other hand, the “Pythagorean theorem” does NOT apply *exactly* to triangles drawn on the curved surface of the earth, as noted long ago³² by Bhaskar 1; nor does it apply exactly in space (which is curved on general relativity). So it does not apply exactly anywhere in the real world. Accepting mathematics as inexact knowledge in the real world, from the outset, is preferable to bringing in an intermediate fantasy (metaphysical) world in which it is exact, for this greatly reduces the difficulties of present-day mathematics, and the resulting errors in science.

Myth 7. The seventh myth is that “logic is universal” (since it binds God³³). However, the Buddhist logic of चतुष्कोटि, or the Jain logic of स्यादवाद, are not even truth-functional,³⁴ so logic is certainly not culturally universal. Nor is it empirically universal, for quantum logic which is quasi truth-functional,³⁵ applies at the microphysical level, so that an arbitrary proposition cannot be deduced from a contradiction (“Schrodinger’s cat is both alive and dead at one instant of time”), as is done in formal mathematics (e.g. to prove the existence of a Lebesgue non-measurable set). The theorems of mathematics (from the same postulates) will change with logic, so, logic, the basis of deduction, must be determined empirically, hence inductively. Hence, also, deduction is weaker and more fallible than induction.

Conclusion

Colonial indoctrination is the only thing that stands in the way of a comprehensive rejection of formal mathematics as biased Western metaphysics of nil practical or epistemic value.

Follow-up

Once the philosophy of formal mathematics has been comprehensively refuted, and its false history exposed and rejected, we can begin to critically examine गणित (normal mathematics) as an alternative. Specifically, the workshop will examine two specific courses on (1) school geometry and (2) university calculus which have been tested over the past decade. I will also briefly explain the (3) advantages for science, of rejecting current formal math, though this is a relatively more complex and technical topic.³⁶

32 *Maha Bhaskariya*, 2.5, ed. and trans. K. S. Shukla, Department of Mathematics and Astronomy, Lucknow University, 1960, p. 51. “The distance (obtained above) has been stated to be incorrect by the disciples of (Arya)Bhata...on the grounds that the hypotenuse is gross...on account of the sphericity of the earth.”

33 C. K. Raju, “The religious roots of mathematics”, *Theory, Culture & Society* 23 Jan-March 2006, Special Issue ed. Mike Featherstone, Couze Venn, Ryan Bishop, and John Phillips, pp. 95–97. <http://ckraju.net/papers/Religious-roots-of-math-TCS.pdf>.

34 See article on “Logic” cited above, or *Cultural Foundations of Mathematics*, cited above. A detailed examination of the Buddhist and Jain syllogisms is also in *Eleven Pictures of Time*, cited above.

35 C. K. Raju, *Time: Towards a Consistent Theory*, Kluwer Academic, Dordrecht, 1994. Chp. 6B, “Quantum mechanical time”, and appendix to it.

36 C. K. Raju, “Declonising math: how and why it makes science better (and enables students to solve harder problems)” CENSORED extended abstract of two invited keynote addresses to have been delivered at Palestine Technical University, 2018.