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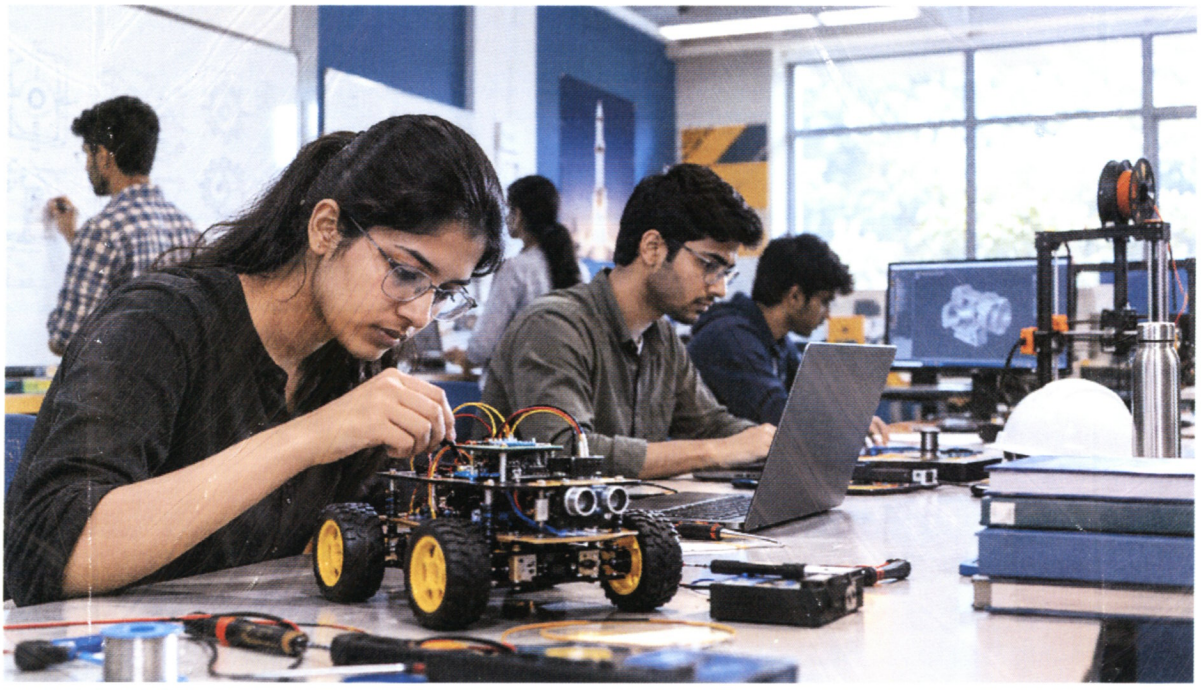
Are India's engineering colleges ready for technological self-reliance?

Indian classrooms remain stuck in mid-20th-century paradigms. Because of the huge increase in the number of sub-standard engineering colleges, quality has been compromised

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AI-generated Photo

Fifty years ago, engineering students used drafting boards and T-squares; hands-on skills in carpentry and machining were prized. Today, students need to get into quantum computing, machine learning, and cyber systems.

An important question arises: are our academic institutions keeping up with technologies that are being constantly upgraded? Progress has mistakenly been perceived by institutions as a mix of science, engineering, technology, and manufacturing. However, technology and engineering are distinct from pure science, but at the same time equally important for national growth.

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While pure sciences explore the question of why, engineering needs to focus on the question of 'how do we build this for social utility?' Engineering is an integral component of technology, and must be distinguished from manufacturing, which, in turn, involves replication and supply chain optimisation, with a focus on consistently producing a pre-designed object. India's ambition to become technologically sovereign will fall short if it merely assembles electronic components designed elsewhere. This is especially true in semiconductors, where local companies put together components manufactured elsewhere.

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Sophisticated digital manual labourers

Indian classrooms remain stuck in mid-20th-century paradigms. Because of the huge increase in the number of sub-standard engineering colleges, quality has been compromised. These colleges and institutions have shifted their focus from education to certification, relying on rote learning that stifles curiosity and prioritises grades over critical thinking. Laboratories often serve as static environments for rote experiments rather than fostering genuine exploration.

The best minds produced by our 'premier' institutions are routinely shunted into back-office software maintenance, outsourced IT services, and routine coding for multinational corporations. We have converted our brightest talent into highly sophisticated digital manual labourers, in other words, computer coolies, optimising software written elsewhere rather than inventing core architectures, developing impactful algorithms and physical infrastructure that the nation desperately requires.

In this context, it is instructive to note that in the June address on 'The State of Science 2025', by the president of the National Academy of Sciences of the United States identified 64 emerging and disruptive technologies that spanned advanced manufacturing, quantum computing, and biotechnology. China led in 57 of these 64 technologies, with the US trailing as a distant second. India was nowhere in this list.

A radical restructure

To reverse this institutional decay, engineering colleges in India must radically restructure both what they teach and how they teach it. Artificial Intelligence (AI) cannot be relegated to a single, isolated course; it must be integral to every single engineering discipline. However, such integration demands new pedagogy.

Students cannot be allowed to passively consume AI-generated outputs. If a civil engineering student asks an AI model to design a building, it will generate something immediately. The student's task is then to rigorously verify the AI result — a task that can be done only by a human. AI accelerates the workflow, but it does not replace the human component of reasoning in any creative task. It cannot be treated as a replacement for human intellect; but rather as a bicycle for the mind, accelerating capability under strict human direction and control.

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Moving to the practical, cloud computing and AI require physical infrastructure that is highly resource-intensive. Building massive data centres that consume millions of litres of water in water-stressed regions is a failure of engineering ethics. The demand for copper metal will rise inexorably because the flux of electricity needed for even moderate AI servers is very large. Where will India get all this copper, and at what price, given the scale involved?

Refashioning technology for India

Colleges must teach students to evaluate holistic impact, encourage them to engage with policymakers and question policy decisions, and to design decentralised, lower-consumption models. Technical education must bridge the gap between innovation and governance. If engineering research cannot translate into a scalable policy intervention that addresses localised healthcare, clean drinking water distribution, sustainable agriculture, and decentralised energy in tier-two and tier-three cities and rural areas, it will fail the test of national utility.

How do we make this transformation a uniquely Indian experience? Refashioning technology for India necessitates radical structural and conceptual changes tailored to our national ethos. The bedrock of any world-class institution rests on three non-negotiable principles: Truth, Trust, and Integrity.

A uniquely Indian educational model must dismantle the stifling, hierarchical administrative structures of the past. Academic leaders must empower faculty and scholars rather than seeking personal aggrandisement. When transparent, trust-embedded governance ecosystems are established — enforcing uncompromising standards of research integrity and swift action against academic misconduct, faculty and students will be empowered to undertake bold, high-risk research.

What is required now is a fundamental mindset shift. Policymakers have wrongly clubbed 'Science' and 'Technology' together under a single 'S & T' label. This has been a fundamental error. Technology and Science are independent silos that establish separate frameworks that reward creation over memorisation while instilling an uncompromising culture of academic integrity.

Only by making several course corrections can India provide its aspirational millions with the appropriate opportunities to construct a sovereign technological future.

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