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Is higher education evolving quickly to prepare students for AI-driven biotechnology?

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Whether the students are prepared when they graduate depends on the choices we make today



The question is no longer whether biotechnology is changing. It already has. The question is whether our universities are keeping pace. The biotechnology sector is in the throes of a fundamental transformation. Artificial intelligence (AI) and machine learning are no longer adjacent technologies—they are central to how modern biotech works. Drug discovery platforms use AI to screen molecular compounds in weeks instead of years. Diagnostic companies deploy deep learning models that rival human specialists. Gene therapies rely on computational tools for analysis. Precision medicine frameworks use genomic data at scale. These are not fringe innovations; they are the operating standard of the industry. DeepMind's AlphaFold has fundamentally altered structural biology—a tool that compressed decades of crystallography work into months.

Companies like Recursion Pharmaceuticals and Insilico Medicine are running fully AI-orchestrated drug discovery pipelines. Closer home, firms such as Strand Life Sciences and MedGenome are building India's genomic data infrastructure with computational biology at their core. CRISPR-based therapeutics, once purely a molecular intervention, now depend on high-throughput computational screening to identify guide RNA sequences, predict off-target effects, and model therapeutic windows. What this means for higher education is profound: the textbook a student reads today may be obsolete before they graduate.

Yet when we look at biotechnology curricula across Indian universities, we find a persistent architecture built around classical disciplines. Students study biochemistry, microbiology, and molecular biology in careful isolation. They may take bioinformatics as an elective, but often as an afterthought. The implicit message is clear: biotechnology is fundamentally a laboratory science, and computation is optional. This assumption was reasonable fifteen years ago. It is obsolete today. The biotech professional of 2030 needs to be genuinely bilingual: fluent in both the language of molecules and the language of algorithms.

What Interdisciplinary Education Actually Means

True interdisciplinarity means that from day one, students see biology and computation as inseparable. A student studying enzyme kinetics also writes code to model it. A student learning gene expression works with RNA-seq datasets. Computational biology, bioinformatics, and data science are not electives—they are the fabric of the curriculum. This matters because the industry is already selecting for it. When biotech companies hire, they seek professionals who can move fluidly between sequencing datasets and protocols, between statistical results and biological interpretation. The global academic community has begun to respond. MIT's Department of Biological Engineering now embeds computational modelling into every core course. IISc Bengaluru has restructured its integrated biology programmes to make data science mandatory rather than elective. These are not isolated experiments—they reflect a growing consensus that the old disciplinary walls between biology and computing must come down, and the sooner the better.

Emerging Domains: Precision Medicine, Gene Therapy, and Antimicrobial Resistance

Precision medicine, gene therapies, synthetic biology, and antimicrobial resistance research represent the cutting edge of industry practice. Precision medicine integrates genomics, clinical data, and machine learning to tailor treatments to individual patients. This is a business model companies execute on today. Gene therapy, as it moves from research to commercialisation, demands professionals who understand both molecular biology and computational analysis of therapeutic outcomes. Antimicrobial resistance—flagged by the WHO as a top global health threat—requires researchers who can sequence genomes at scale, analyse mutation patterns computationally, and design new strategies. These are inherently interdisciplinary challenges that traditional biotechnology programmes are not systematically preparing students to tackle.

Bridging the Gap: Academia and Industry Partnership

The responsibility for closing this gap cannot fall to universities alone. The biotech industry has a vested interest in graduates who are immediately productive. This is enlightened self-interest: a company that spends six months training a new hire on skills that should have been learned in university pays a hidden cost. Deep collaboration is essential—companies working with faculty to co-design curricula, offering access to real datasets for student projects, hosting extended internships on genuine business challenges, and potentially teaching courses on emerging topics. Universities must remain nimble, updating programmes every few years rather than running the same curriculum for a decade.

Universities must move beyond seeing industry engagement as secondary to their core work. Designing programmes that produce industry-ready graduates is a legitimate form of academic excellence. It requires recruiting faculty with active industry engagement, who are comfortable teaching emerging domains, and who can bridge theory and practical application. It requires investment in computational infrastructure and the humility to recognise that some of what students need to learn comes from the sector, not from peer-reviewed journals.

The Competencies That Matter Most

If I were advising a student or university designing a biotechnology programme today, here is what the industry actually needs: First, foundational technical depth in core life sciences—molecular biology, biochemistry, genetics, and cell biology remain non-negotiable. Second, fluency in programming and computational thinking. Python, R, and SQL are now as essential to biotechnology as pipettes. Third, exposure to real-world data and data science practices: sequence analysis, statistical inference, machine learning basics, and data visualisation. Fourth, understanding of how biology scales: fermentation, bioprocess engineering, manufacturing and regulatory considerations. Finally, the ability to communicate, collaborate, and navigate ambiguity. Modern biotech operates through cross-functional teams. A graduate who has never presented findings to non-specialist audiences or worked on team projects is missing a critical piece of professional readiness.

Bengaluru has emerged as one of Asia's most significant biotechnology hubs. India's National Biotechnology Development Strategy and the BioE3 policy framework signal the government's ambition to grow the nation's bioeconomy to \$300 billion by 2030—a target that is only achievable if the talent pipeline keeps pace with the science. Yet this growth is constrained by a consistent bottleneck: the availability of professionals who combine deep biological knowledge with computational capability. This problem cannot be solved by industry alone, nor by universities alone. It requires deliberate, ongoing partnership. The students who will build the next generation of biotech innovation are in classrooms right now.

Whether the students are prepared when they graduate depends on the choices we make today—choices to redesign curricula around the competencies that matter, to invest in infrastructure, and to recognise that creating industry-ready graduates is not a zero-sum game but an investment in the ecosystem's future.

Dr Sumitra Datta, Director, Amity Institute of Biotechnology, Amity University Bengaluru