The Importance of Quality in Engineering Education and Research for India
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By
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The President, Prof. Manna, Director and faculty of IIT Delhi, other faculty members and attendees of this impactful program, it is a privilege to speak to this distinguished audience today on a subject that has immense significance for our nation's future - the importance of quality in engineering education and research. Thank you for this opportunity.

India stands at a pivotal moment in her developmental journey. We are a young nation, rich in talent and ambition. But, to transform our youthful exuberance into real progress for every Indian – *the urban and the rural, the educated and the not-so-well-educated, the rich and the poor, and the elite and the not-so-elite*, we must invest in the quality and not just the quantity of our engineering education and research. I will just quote verbatim what Sri Fareed Zakaria, a much-respected American current events commentator of Indian origin, said a few days ago. "*Consider the Nature Index, perhaps the most comprehensive guide to high-quality research in the sciences. It tracks contributions to the world's leading academic journals. Its newest rankings show what scientists already know: China is leaping ahead. Of the top 10 academic institutions in the Nature Index, nine are Chinese.*" My parents and teachers taught me, in my early years, that I should learn even from those that I differ with. Verse 3 in chapter 9 of Bhagavad-Gita also alludes to this value.

Organized by our premier educational institutions like the Indian Institutes of Technology, this initiative is about learning the best from everybody in the globe to become #1 in STEM areas in the world. It is not just a training program. It is a national mission. It is a step towards transforming how engineering is taught, learned, used, improved and lived, particularly in our tier-2 and tier-3 institutions that serve as the backbone of India's higher education landscape. Therefore, I congratulate the Indian National Academy of Engineering, the IITs and Infosys for partnering in the creation of the Centre for Engineering Education Excellence (CEEE). All of us here owe a note of gratitude to Prof. Indranil Manna, a visionary, for strategizing and starting this initiative.

Engineering forms the foundation for a nation's economic progress in times of both peace and conflict. While science is about unravelling the secrets of nature, engineering is about applying scientific knowledge to make the world around us a better place to live.

Engineering is at the heart of improving productivity; building smart cities, better buildings and better roads; providing better quality of life and facilities to our citizens; producing better equipment for every sector of a nation's economy; achieving climate control; producing sustainable energy systems; conquering space; improving our defense capabilities and applying digital technologies for our betterment. Engineers invent, innovate, design and produce the machinery of modern civilization. We must develop and nurture engineers who have curiosity, can think critically, question the status-quo, recognize and solve problems we encounter in our daily life. This is the only way India can compete successfully in the global bazaar and improve our prosperity.

India's higher education system is one of the largest in the world. Our engineering colleges – located in metropolitan hubs and rural towns - produce vast numbers of engineering graduates every year. But, as we all know, there is huge unemployment among our engineering graduates. This is primarily because our engineering education system does not produce employable graduates.

Many of our tier-2 and tier-3 institutions are filled with dedicated, passionate educators. But they often lack access to modern pedagogy, evolving industry standards, and research ecosystems. The standard of English must be improved in the case of many teachers. We all know that most of the engineering knowledge in the world is in English. The rapidly changing and the latest knowledge in the globally valued books and research papers is in English. Many of our institutions still grapple with outdated curricula, ill-prepared teachers, inability to speak and understand English by the students and teachers, inadequate industry exposure, and a lack of emphasis on hands-on learning. Too often, we see a gap between what is taught and what the real-world demands. The inequality in exposure and resources between institutions creates a gap - a gap that affects not just institutions, but students, industries, and India's global competitiveness.

This disconnect must be addressed. Quantity without quality leads to unemployment, underemployment, low productivity and wasted potential. Research is the soul of any academic ecosystem. Without cutting-edge research, education becomes static. Without application, most research work becomes irrelevant. India needs a strong research ecosystem where engineering research is not limited to academic journals but translated into solutions to real-world problems - clean water technologies, clean air technologies, renewable energy, good vaccines, AI-powered healthcare, agricultural productivity, climate control, resilient infrastructure and more. Countries that lead in innovation lead the global economy. Your charter is to put India among them.

We are in the era of the Fourth Industrial Revolution - a time of rapid change driven by AI, IOT, quantum computing, and biotechnology. Our engineers must be future-ready, equipped not just with technical knowledge, but also with adaptability and lifelong

learning habits. Engineering education must evolve to include emerging technologies, sustainability, and social impact.

The responsibility does not lie with just governments alone. Governments will fund and prioritize STEM education. However, I humbly request our bureaucrats and politicians to desist from interfering in running higher education. Institutions must modernize pedagogy. Industry must support R&D and mentorship. Students must approach their education not just as a tool to get a job, but as a mission to solve problems and serve society.

It is said that "*A mediocre teacher gives a monologue, a good teacher explains, a superior teacher demonstrates, and a great teacher inspires.*" Today, India does not need just good engineers. It needs inspired engineers who are creative, ethical, entrepreneurial, and socially conscious.

To produce such engineers, we need inspiring teachers who are not just knowledgeable, but skilled in teaching, able to communicate well in English, exposed to globally acclaimed books, comfortable with research, and connected to real-world applications. You can become transformational agents if you become such inspiring teachers.

Through this initiative, IITs will provide their expertise to uplift institutions across the country by building bridges of knowledge, mentorship, and collaboration. You, the participants, are the carriers of that upliftment that should ripple through classrooms, laboratories, and eventually, society.

This program is not just about learning techniques. It is about elevating mindsets. In addition to this impactful program, some of the other useful initiatives that you, the attendees of this program, can pursue to improve the quality of engineering education in India are:

01. Engineering is about converting scientific ideas into physical reality, and to create new and improved physical inventions and innovations like buildings, rockets, electric vehicles, computers and renewable energy equipment, just to name a few entities. Every one of these is a project with thousands of tasks, with some tasks in the critical path. Your reputation, as an engineer, depends on how good a team member or a team leader you are in completing every project that you take up on time, within budget and with better-than-expected quality. Therefore, project management is an indispensable skill for your students. Please include project management as a mandatory subject for the students of every branch of engineering in their final year. Please ensure that your students assist the project manager of a project in the local context and learn this important skill thoroughly.

02. I am a great admirer of, and I am respectful of Kannada, Hindi, English and every one of the 22 languages recognized by our constitution as of 2025. However, the reality is that most STEM research work, knowledge and reporting of the STEM progress in the world are in English. To be successful engineers, your students must interact with engineers from all over the world. Engineers of even the most developed nations from Europe have adopted English as the link language. It is accepted all over the world that a good command over English is a necessary skill for a successful engineer. Therefore, transform those of your students who are poor communicators in English to those that can hold grammatically correct, heavy-accent-free and unambiguous discussions with the best engineers in the world on global platforms in a universal language like English.

03. To do so, you may want to have at least one course in English in each of the eight semesters of the undergraduate degree and in each of the four semesters of the master's degree in engineering. This will help your students to learn to express their ideas, orally and in writing, correctly, clearly, concisely and unambiguously in English.

04. This humble request is to teachers of IITs, other top ranking engineering schools and globally accomplished teachers in our country. Please write world-class textbooks (modelled after globally acclaimed textbooks) in Indian languages, at least for the core subjects of engineering. This will help even students who are bright but poor in English to access the best and up-to-date knowledge in core engineering subjects. I used to see in Paris bookshops when I was working there more than 50 years ago, that more than 50% of the much-respected engineering textbooks were in French. Once we are on this journey, over a period of 10 to 20 years, we will develop many international quality books in engineering in our major languages.

05. Move your focus from syllabus completion to conceptual understanding.

06. Move away from rote teaching. Relate theory to understanding and solving problems by your students in the towns and cities where your college is located.

07. Adopt open book examinations, at least in the core subjects of engineering. This will enhance independent thinking and problem-solving capabilities of your students.

08. Work with IITs to provide your promising students an opportunity to take at least one course every semester offered in those institutions through a virtual medium like Zoom.

09. Teach your students teamwork by creating opportunities to move from individual classrooms to collaborative networks of students and teachers across the country and, where feasible, across the world.

10. Move from just monologue by you in the classroom to enthusiastic class participation by your students. This will help your students to improve their

curiosity, critical and independent thinking, Socratic questioning and problem-solving. You may want to watch the 12 episodes of Prof. Michael Sandel teaching Philosophy to 2nd year undergraduate students at Harvard University on YouTube. This will help you appreciate the value of your interaction with your students.

11. Make it mandatory for each student to use the theory taught in the class to find the solution to a real-life engineering problem in the student's locality. Create a special hour every month and call on a student in a random order to explain how he or she used the class theory to solve the problem. Create a library of those solutions for future students.

12. For core courses, use the class presentation material, available free on the internet, from world's leading engineering educational institutions. Adopt books by globally respected authors as the designated textbooks. Right now, I am studying entry level college Physics. The books I use are – *The lighter side of gravity by Jayant Narlikar; Conceptual Physics by Paul G Hewitt; Thinking Physics by Lewis Carroll Epstein; The Physics of Everyday Things by James Kakalios; For the Love of Physics by Walter Lewin* and *How Things Work – The Physics of Everyday Life by Louis Bloomfield.* Find out, from globally respected engineering educational institutions, what textbooks they use and choose such acclaimed books as textbooks in each of the subjects that you teach.

13. At least once a year, create a mechanism to enhance interaction between your students and their cohorts from the top-50-ranked engineering educational institutions in the developed world.

14. I suggest that your deans visit Olin College in Boston, Massachusetts, Harvey-Mudd College in Claremont, California and Plaksha University in Mohali to learn how you can create small, good STEM teaching institutions.

15. The heads of the tier-2 and tier-3 engineering colleges must make it mandatory for every teacher in their college to earn some consulting fees every year from the local industry. This will improve the problem-solving mindset of their teachers.

16. If your college can afford, send one teacher every semester from each department to credit a course, as a student, in a relevant subject at an IIT or at a top 50 globally ranked engineering educational institution. The cost could be reduced by using a virtual medium like Zoom. These teachers must take all the examinations of the course like a real student and must be evaluated by the teacher teaching that course in the institution that provides the opportunity to your teacher. This will help your teachers understand learning from the perspective of a contemporary student.

17. Make it compulsory for every teacher to obtain a year-long internship, once in five years, in a local company of their specialization. This will help your teachers understand a major problem the company is grappling with, contribute to the

solution, return to the college and enhance the problem-solving capabilities of their students.

18. Each institution must hold a "**Grand Challenges in our locality**" contest every year in each discipline so that its students can focus on solutions to the "big" problems of our country and develop a problem-solving mindset. Invite jury from Tier-1 institutions. The winner should get a full course credit, the next semester, to work with the local government to either complete the design or implement the solution.

19. Allocate a semester of the fourth-year undergraduate students to identify and solve or improve some function of your own institution. For example, the computer science students may develop some of the information systems needed by your college. The civil engineering students can be given a project to strengthen a weak building or a dilapidated road on the campus. The passing of the students in this course should depend on the acceptance by you of the defense of the idea and the project plan to implement the idea by the student.

20. If you want your students to reach the state-of-the-art in any field, they must learn from the best teachers in the world. Today, it is not difficult for you to become an inspiring teacher since internet provides free access to most knowledge and class presentations by world-class teachers in English. You must put in lots of hard work for every lecture. Do you know that Prof. Walter Lewin of MIT spent 20 to 30 hours for each undergraduate Physics lecture even after teaching Physics at MIT for several decades?

21. Finally, remember that no student will become a successful professional unless he or she has competence and, more importantly, values. Values form the cultural foundation without which durable and fast economic growth of our country will not happen. One of the important attributes of a good value system is humility and not boasting about our own achievements. Professionals from other countries should praise you. You are the role model for generation after generation of the future hopes of our country. Please demonstrate, by your own example, the importance of high aspiration, humility, civility, honesty, integrity, decency, courtesy, hard work, transparency, fairness, accountability, sacrifice, excellence and discipline in your everyday interactions with your students.

Friends, this program is more than just a faculty development initiative. It is a nation-building exercise. IITs have set the stage, but the true change will have to come from each of you when you return to your institutions not only with new skills, but with a renewed purpose.

Let us remember that education is not the filling of a pail, but the lighting of a fire. May this program ignite that fire in every one of you, and, through you, in every student, in every classroom and in every campus in our beloved country.

Thank you, and Jai Hind.