



## **Prof. C. S. Deshpande Memorial Lecture**

### **Taking India Forward Role of Educational Institutes**

By

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Mumbai, 17 May 2019



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Dr. Anil Kakodkar delivering Memorial Lecture



Prof Vijay Ghupchup, Mr. Vishwas Deshpande, Mr. Ashish Ukidve, and several distinguished friends and colleagues and members in the audience and dear colleagues from Vidyalankar Institutions, students, ladies and gentlemen.

First of all, let me thank you for this honour. This gives an opportunity to pay our respects to Late Professor Chandrashekhar S. Deshpande. We have just seen what he has done, what he has achieved and we are here today to pay our respects to his memories and remember the kind of passion and mission with which he conducted himself. So thank you for this opportunity.

Since Professor Deshpande was in the field of the education, I thought it would be appropriate to speak on one aspect of education because education is a big topic.

One aspect of education which comes to my mind is relevant to higher technical institutions, but I think it is increasingly important in the national context. It will be clear as I proceed. I am not an educationist. Nevertheless, having participated in several committees and having developed a few reports on education, I have figured out that education is one field where everything that is needed or required to be written is written, everything that is required to be said has been said. The problem is in the implementation. So, I may be focused on a single objective, but I think it is of vital importance, so I will take the liberty to expand on it. The point I wish to make is the simple fact that we all say education is for nation-building, we all say education is for nurturing good human beings, education is for shaping responsible citizens...all of this is true.

When we talk about engineering, it is widely assumed that engineering education is to create good professionals. Engineering education is to instill the ability to create new things. To me, the biggest problem with us as Indians has nothing to do with engineers or any other profession. But as Indians, we want to do more what others have done and most of the times, I will not say always, but we lack confidence in doing something on

our own -which others have not done. Charting new territories is rarely done. Of course, learning from others is a good thing, perhaps an important thing to do. But it is also clear that if you copy somebody else, all you can be is the best no.2. But you can never be number 1.

India is making lot of economic progress. The economy is growing. We all say soon it will be, in dollar purchase parity terms, no.3 economy. We have an ambition of becoming the second, and not the first - and I don't know when that will happen. In all that discourse, we completely ignore that when we talk about the economy, we should also look at it in per capita terms and then compare with the rest of the world; I have never seen that being a part of the discourse.

I think we need to mould young people. I believe Indians are very capable and it has been proven repeatedly. The need of the hour is to shape the youth to conquer the world fearlessly. The need of the hour is to be able to decide what is good for the country and have the courage to implement that, and I think that is a bigger perspective of education in the contemporary context.

If you have education taught by people who never do research, then progressively you would start teaching obsolete knowledge. If it is being taught by the people who are engaged in research, they will bring in up-to-date knowledge. There is the matter of the quality of education, quality of understanding, clarity on the concepts, being up to date in the state of art in both science and technology. I think it is important that in higher educational institutions, science and technology form an integral part of education.

The industrial era dawned around 1700 in Europe. We are still in the industrial era, but we are already saying that this is the beginning of the knowledge era. We all keep hearing about what new, big, unheard things are likely to happen. The nature of jobs is likely to change in the knowledge era. You will notice that all the way in the agrarian age, from the beginning till the year 1700, India was the top country in the world in terms of GDP. After the advent of the industrial era, a decline commenced. I will not

blame the industrial era completely because we were also an oppressed country at that time. We were under foreign rule so there were a host of factors, but the fact remains that in the industrial era, we could not continually cope. Our relative economic strength became weaker. Of course, a new country emerged, for example the United States. It emerged much later; it was nowhere during the old agrarian era. The question now that we must ask is- can we catch up in this knowledge era? India has great knowledge credentials. We have the desired demographic dividend. I believe that all conditions for us to catch up and lead the world in the knowledge era are right. Can we do that? That, to my mind, is the challenge to the education system.

Money is important. United States is a big power. Some countries like Monaco have lots of money. It is a small country but a stable per capita income. Oil rich countries like the Middle East, Saudi Arabia are quite wealthy. We don't call them big powers. Russia is not rich, but we call it a big power. This is because of the military strength of those countries. How does that military strength emerge? Countries become powerful based on technologies they possess. And so, if India must become powerful, we must develop our own technologies. Our tendency is to copying technology of others, and this experience we had just after post-independence. Industrialisation was just taking shape, but nobody would do any business on home-grown technology.

First, we used to import technology, and do some business. Soon people realised that as long as it was a closed economy, it was your right to sell whatever you made and so even if you could not get the best of technology through technology transfer, you could still make good business. Then came liberalisation, and people who can give you technology on a technology transfer note have the liberty to market their own products directly. So, this issue of being able to compete in the marketplace on the basis of borrowed or purchased technologies became difficult, but still there are markets and many business opportunities and you can leverage the small changes and do business. But that does not fit the bill. So, it is only now that Indian industries have started looking at research and development as an important instrument of survival.

It is now necessary for big Indian industries to resort to their own research and development lest they stand the threat of being wiped out. It is only a matter of time. You want to be in the marketplace, you have to be the best. If you copy others, by definition, you cannot become the forerunner. For a very long time we had cars coming out of Premier Fiat or from Birlas, the Ambassador and the same models on Indian roads decades after decades. The market opened, Maruti arrived on the scene and several other cars followed. Today, of course we have all kinds of cars on Indian roads. Indian cars also move on foreign roads and if you look at the balance of trade in the automobile industry, today the balance is in India's favour. Why has that happened? It has happened because Tatas have invested in research and development. Mahindras have invested in R&D. Technology is the prime reason for countries to become strong. Technology also empowers: it gives you the capability to decide things on your own.

You set up your telephone based on some technology. You get stuck and you want to upgrade the technology. You either pay much more heavily for upgrade, and then you find that there are better things in the market. Then you discard it and buy a different technology. If you are fully knowledgeable about technology, then you can make choices in a manner and make right decisions and issues won't arise. Ability to build technology and ability to understand and implement technology are extremely important to make a nation strong.

The expenditure that we make in India on R&D is larger. We always compare with China, we compare with United States, who spend much more money. We spend less than 1% -we should spend like 2-3 % and this will be in public discourse and there is logic, there is merit. We must spend more of our money. No issues there. But recognise that compared to these countries, Israel, Canada, Sweden, UK, Switzerland, Finland and few others, we actually spend money. Just compare how much of technology-based products we get from these countries and how much of technology-based products we export to these countries. And if you are spending more money than these countries on R&D, why is it that we are not better than them in technology? This question we have

to ask ourselves, not the government. We always have the tendency to claim that the government is not doing anything. I think we need to ask ourselves what we are doing. Somebody may say India is a big country so our resources may be widespread, and become very thinly spread, so they are not producing results. Not true; money that we spend on per capita terms is equivalent if compared to the rest in the world. I think there is something that we need to look at ourselves. Industry investment in R&D of course is still very low. In most of the countries, industry investment in R&D is larger than public investment on R&D. In India there is no confidence. Industry does not trust academia. Academia does not trust industry and so that investment is not coming in. If that happens, 0.8% investment in R&D will straightaway become 1.6 or nearly 2%. That must anyway happen because if it is all public money and no industry money, then what we are seeing will happen. It does not get translated into real product or technology product. So, I think the challenge is investment in R&D needs to grow - that part is quite clear. Domestic size of our country is quite large there is an urgent need to make it much more proactive, much more efficient and that is the challenge, that is what we need to do. We urgently need to evolve, nurture conducive innovation eco-system and respond to technology development demands. As I said earlier that needs the mind-set change, which we need to change ourselves. And this change, of course, is not just only mind set change. It is required in society, academia, industry and democracy, political environment, policy environment and so on. This is what I think we need to do.

We all stress on R&D, but most of the higher education institutions stress on research. There is also a debate that whether we should focus on basic research or whether we should focus on applied research. According to me, this debate is worthless when we talk about it. There is a paper by Pasteur. We should take the total space where you want to carry out research and you kind of define that with x co-ordinate which is used. What do I get with research? What is the application that I make out with my research? And y axis, which is the curiosity axis or request axis, where to what extent I can improve my understanding? Because you know research can be a quest towards knowledge, research can be for some utility value and both are important and if you put these axes

and divide that space in 4 quadrants. First quadrant which we don't worry about what do we get out of it but you take your understanding forward. It addresses the trust issue. It addresses the curiosity issue because it is purely basic research- Bohr's quadrant. Curiosity driven pure voyage to discovery. Second quadrant is high in terms of quest and also high in terms of utility value. This is user-inspired basic research - Pasteur's quadrant. The work that locates the centre of research in an area of the basic scientific ignorance that lies at the heart of the social problem. In fact, I am going to come to the fact that this is the most important quadrant where all the researchers must focus. The third quadrant is of pure applied research - they call it as Edison quadrant. Obviously don't worry too much about fundamentals and whether things work or not and Edison did that kind of work and succeeded.

The fourth quadrant is neither high in terms of utility and nor high in terms of pushing the frontiers of knowledge - research to nowhere. So, now start looking where should we start work? We should not waste time and we should not waste public money in doing research in that area. I will leave it to you to decide how much of Indian research belongs to other quadrants and to this quadrant and that will partly give you the answer to the question that I mentioned.

On the other hand, if you are in the Pasteur quadrant you are addressing both. You are bearing roots of a new technology emerging out of new science and that technology could be dealt for the first time ever. Commercialise that technology- you will have first movers of advantage in the market place and then you can make money and the country will become powerful because majority of the people are like that and that's the transition to which we must look at. To be able to do this kind of work we should know what topics to choose. Normal tendency is go and read in the library about the fashionable research topic. People forget it may be very fashionable somewhere else and we tend to copy. We must also test whether it has, in terms of priority, high value. So, what are we doing? We are adjusting our priorities to priorities of other countries. So, we are spending money here to serve the cause of other countries. We are happy

that we have published a paper, very happy that to secure a good position and from the education perspective this is all very important, one cannot question this. A high position indicates higher level of performance. Compared to no publications, good publication indicates a good level of performance. The question that we need to ask ourselves is that is it good enough? Are we working to the priorities of our country or are we working towards the priorities of other countries? When you do like that when technology also happens somewhere then we say a new technology has emerged. So you pay for that and get the technology here. Again that copy master attitude continues. But then what are the alternate ways? How do you decide what research topics to choose?

Someone must propose simple ways. There could be multiple ways. What is done here is simply search Google and find out the top items of the import and top items of the export and to my big surprise, you will find that most of the items are common. There is iron steel as top 10 items of import and iron steel top 10 items of export. So, what does this mean? That means that we are continuing that old problem or old habit of exporting our raw materials and bringing in and finishing the goods. We used to say that pre-independence era, the Brits came and took away all the raw materials and they sent us finished goods. We are not doing any different and this is true in most of the areas and you have only very few exceptions. Automobiles is one -we have reversed the trend in India's favour. Another is the pharmaceutical sector. This country has done very well. I know there is a large research ambience in the pharma sector, they have their own R&D labs. And third is the garment sector, textile where I only want to ask you how much of a connection academic section has with these sectors? Good part is that this research has happened in the industry. What happens to the public funded research? What happens to research in education domain? And I think we need to guide when our students pick up a research topic, we have to tell them how to choose the topic of research, so that it is of some value. And we can still pick up an area and choose the topic which is very contemporary in research, so it is one way. Second way, I was fortunate enough to be the part of this technology vision 2035. By the capacity as the

chairman of TIFACT (Technology Information Forecasting and Assessment Council) we undertook this exercise of shaping technology vision for the country and that exercise was people-centric. But we need to look at what are our basic needs? And what are the technologies that will address those basic needs better? So, you made it people-centric; what will be the kind of the people in 2035? What will be their needs and how to satisfy those needs?

Six of them at the individual level, six of them at the collective level. It talks about individual technologies for each one of those prerogatives. Some of those are available, some of those are underdeveloped. Some of them may be in the idea stage and when choosing research topics one can choose one of them and that will become India's focus. Still there are some grand challenges; you should do some broad-based research, but you should pick up some topic that should make a difference just as the Worli sea link. I will not call it as a grand challenge; but it has become a landmark in Mumbai. So, like that we say national grand challenge. Why can't you have a train going up to Leh? Those terrains are very difficult. It will serve a strategic need. It will serve economical need and it will fill the nation with pride. And so, we have collected so many grand challenges. We picked up the 10 biggest ones and then we have decided to arrange them on a priority and in an order of importance. So we had a big discussion. Which should be first, which should be second? And you will be surprised the first grand challenge as it is written there came out to be guaranteeing nutritional security and eliminating female and child anaemia. This is the problem the country is fighting since Independence. How can you say that in a technology document this is most important? But it so turns out that if you don't attend to this challenge, you would lose generations after generations in terms of their capability. We say India is diabetes capital of the world and we blame it on the lifestyle and this is true. Higher incidents of heart problem and things of that type, so this is not the place to discuss that in detail; but the simple thing as the higher iron content in your salad - how much of it is bio available and a little lemon that you crush on the top and what difference it makes to the bio availability of iron? And apparently it makes a lot of difference. Has it become a part of our habit?

On this a professor says you cook vegetables in an iron *kadai* - don't worry if it gets black in colour. But it will take iron as kind of the nutritional supplement. I am not propagating this but I think there is a huge scope of research for such problems and I think we need to be focused on this.

Now let's say you have chosen your problems rightly, and started doing the research. Will it solve the problem? You may push that subject little better at the individual level. It is not going to take you to your destination and that is because a national problem a societal problem is not necessarily a pure problem in physics or a pure problem in chemistry or biology. It is the other way. You are talking about the nutritional problem, you are talking about the transportation problem, you are talking about the communication problem and then you need to bring all the subjects that go into it to bear on it to carry research.

A problem of communication cannot really be fully solved unless you understand the humanity part of it. So if we say that the problem of communication means electronics and communication engineers will do then probably push that subject forward they will not be able to make a good product because you have to understand the requirements, you have to understand the psychology of the user consumer and unless all these issues are addressed you are not going to make a good product. So along with individual research you require group research in the same institution. What we have in our universities and it is also there in other universities but group research is largely missing in our Indian education also. And I think we need to promote individual research. We need to promote group research. And group research, consisting of students belonging to diverse disciplines, is the real meaning.

You see start-ups; many young people are doing start-ups. Most of the start-ups have diverse people - the fellow who knows finance better, the fellow who knows technology better, the fellow who knows marketing better. It is not that all technology in which 3 people come together; the same thing is true about research. But we don't seem to

recognise that even if we create projects, we put 5 mechanical students together to do one project, 3 electrical students to do one project. Why can't we randomly select? And if you choose a problem, learn whatever is required to address that problem - that project will have a far bigger practical meaning. All the way right from the individual research to the group research there is sharing. Of course, at the group research level, industry participation is much larger. But industry participation must be there. If you do this research without industry, it will remain within the four walls of the institution and then question is taking it to the marketplace and all becomes a challenge. Another important thing that we need to address is our value system. See in a research laboratory or in an academic institution, what do you mean by a good performance? Good teaching - yes. Good publications - yes. Good technology transfers - yes. But in how many places in terms of actual reward system if somebody is like Edison say he will do a good practical work, good invention there won't be any publications. Most of the Indian University fellows won't be promoted. He will not become a professor the question is why? Some minimum publications must be there. Counting somebody has published 10 papers is better than somebody who has published 5 papers. What is the logic? There is no logic to this. There are people who publish very few papers and are recognised world over for their scientific contribution. Now these things cannot be captured by filling forms and looking at numbers and then some weighted average of those numbers and then assigning returns of this paper. This has to be done by peer process.

That's why on the other day I was very happy when one *panditji* said, all universities have M.A Music, PhD Music and there are these *gharana* system or *gurukul* system where people go and learn music staying with the master. He said you can never bring the quality of that regardless of what kind of degree you get from the university. That is because we do not value the peer system and that has to be brought in our system. So, say I want to do a new technology, I am a technology institution, I can keep on evolving new technologies, make it more and more robust, this can happen. But in terms of disruptive technology just look at it if I am in an institution dealing with fundamental science as compared to an institution which is a technology institution where disruptive

technologies can emerge? And I will put it to you there is larger chance of the disruptive technology coming from the institute dealing with fundamental science. Let's say electro magnetics - take the bullet train. Bullet train is actually the evolution of the regular train's better bearings. You can understand the dynamics better, you understand the railway track line better, keep on increasing and that's the robust Shinkansen or this high-speed train going up to 500 kms. The groups which are into this research - could they have invented magnetic trains? On the other hand, there is a fundamental research institution dedicated to electro magnetics they can think of this. And then this new disruptive technology can emerge from there. I think there is merit to somebody capable of doing fundamental research in a technology institution and somebody capable of doing technology in a fundamental research institution because that is rare you will get these new things happen. You will notice we will shun this person of a different kind coming into a new environment. He will be the fish out of the water and the whole group will make sure that this fellow is uncomfortable and leaves the place. That is the problem. So, our value system must be such that we must be clear what we want to achieve and what is the peer view of the contribution of the individual in terms of what the institution wants to achieve. I hope the institutions always want to achieve the right things and that is how things will work.

Now in terms of development strategies it is not meant that you need to develop technologies.

You must have a balanced judgement. Some things are very important to us but not available easily. Some things which have lot of money involved in it we must do. Some things do not make sense where need is small, investments are larger and it is not any problem to access it why do we need to do it? We can always borrow it. Like that we need to have a graded approach and then decide our priority where we want to put our research?

I think you know understanding of this logic of defining priorities is not clear even at policy making levels. This is the problem. We need to correct that. I want to go also beyond our academic institutions, research institutions. We all know Indians going abroad to do better. This is the statistics of how many billion-dollar start-ups have been created by people from different universities and institutions and you will find IITs in India are rank 4<sup>th</sup> in the world. We keep lamenting that they are not in 150, they are not in 100 they have changed the whole NIRF. We don't ask this question if there could be the Indian students emerging out of our education institution can be at the top of the table in terms of creating the billion-dollar start-ups, why can't that happen here? There are many IITians here in India so it has nothing to do with the institutions. It has something to do with the larger eco system and I think we need to address that.

It is equally important for us to recognise the fact that India ranks first amongst countries that has provided immigrant founders of billion-dollar start-up company in US as per National Foundation forum for American policy brief March 2016. So, of all the countries, Indian immigrants are on the top of the table. So why can't we have that here? So, I think we need to search and find what is that we need to do?

I was fortunate enough to be a part of creating an ecosystem It is called BETIC Bio Medical Engineering Technology Incubation Centre. It is a virtual set up. There is no building, fancy investment nothing. It is a small shed in IIT Bombay, an equally small lab in College of Engineering Pune. Most of you who will go to Pune will not even see that and also a similar small place in VNIT Nagpur. The 3 most important engineering institutions in Maharashtra and we said let us join hands, the faculties in this institution, the practising medical doctors and mind you know what the importance of time for these people is. But some very renowned people have come and spent time once in a week, once in a month. Morning till evening they spent brainstorming, they are an equal part of this technology. And then there are 10 other institutions some medical colleges, some engineering colleges, some other institutions. This was begun in 2015 so less than 4 years ago; at 10 centres over 100 faculty researchers, students, experts, doctors and

consultants that is the eco system, virtual ecosystem. They have identified 400 unmet clinical needs, developed proof of concepts for 100 devices they have already filed 40 patents, licensed 15 products and they have earned crores of money in prizes because of the new technology. They have already given birth to 6 start-ups, 4 companies or production agencies and they have already touched more than 150 patients.

If you create a good ecosystem, an environment you can do good research, good technology and very large societal impact. What is it we need to do - even there are problems; there are internal problems and external problems. But I think this is what we need to do to make India strong.

Here's another example. This time it is the University of Sweden. As you drive from the city you never realise when you have entered the university area. There is no compound wall. The orange vertical area identifies the scientific park is a research park where the industry and the academia work together like research park at IIT Chennai or one it is coming here in IIT Mumbai. And then this white boundary outside all the companies which have their own set ups, some do R&D, some do production. Bluetooth emerged from here. And all these are borderless; I can traverse from one place to another place smoothly. There are teams working across and I think we need to create an ecosystem of that kind. That kind of congruity between the industry and the academia must be set up. And then you need to create an atmosphere where you have to move from idea to projects, projects to start-ups to development growth. And then you need to create a right environment. You have system of advisors and the financing team. Slowly it is taking shape in our country. We have figured this out when I was doing the report for the IITs. At that time Sweden has 75 such centres and China had 300 and India was just beginning one in IIT Chennai and now that is completed. We must remember where we are compared to others.

All this is alright, but you notice our higher educational environment is city-centric. You may say because infrastructure is good it makes sense, it is easy. It is more

practical. Concentrated client is available; all that is valid. But notice Maharashtra is bit exception but two-third of India still lives in villages. You want to take India forward and concentrate all our education research environment in cities who will address the problems of villages both in terms of education of young people also the problems they face which requires R&D. Luckily now government is forcing institutions, adopt 10 villages or 5 villages. Students are going so that engagement is beginning. But if you ask me, I would recommend to the government you want to set up a university, set it up in a village. It may cost you. Normally University may cost 500-600 crores, doing it may cost you 200-300 crores more or 50% more. It is my submission that it is well worth it. It will produce returns much larger than that, much faster.

In the least it will contribute to the local development in more fundamental way. They will try to address their problem themselves and I tried this. I have shown here a model. This has been actually practised in 2 or 3 places in Maharashtra and you see people address problems themselves. There are some interneers instead of going to some fancy institutions; they have gone there to sort of understand what is about making business in rural areas. What it takes in terms of social entrepreneurship, in terms of increasing the divide in the country. Country's economy is improving but rich-poor divide is growing, urban-rural divide is growing, huge migration is taking place. You may talk about urban reconstruction renewal in spite of waste of smart city program. But the question is why can't we create opportunities for people in the villages?

Agrarian villages have an upper hand because agriculture cannot be done so easily in the urban area now it can be done vertical farming has come but still it has advantages in rural areas. Industries so far probably there was advantage in urban area because you know Industrialisation requires supply chain and so on. Today through internet you can have 3D printing in a garage or in a city or in a cow shed in a village and you can make a car part and deliver.

So in a knowledge era which promotes decentralisation, democratisation, rural areas also have significant opportunities. So why should we say rural areas means let us focus on agriculture, value addition and food products and reserve only that part for them. Why can't we empower rural young people with good education? You manufacture in your own place in terms of internal driven things. Industry4.0, why can't you do that? Service sector as long as young people are sufficiently educated in trade, they can live in both the places. So where are the larger opportunities? Larger opportunities lie in villages. But we are creating a system where there are no opportunities in villages. We will not set up educational institutions in villages why? Because it costs more money. Now if the rural income goes up and the gap brings down and suppose you have to set up 100 universities. 200 to 300 crores extra per university; is that too much of money? Why can't our planners think like that?

The point is that we need to change our view on education, education delivery and what is the objective we are trying to achieve. Simply saying we want to make good citizens does not make sense.

There are 3 segments: a society, an economy and a knowledge domain. In India, traditionally, economy and society have to be engaged. In order to earn your living, you have to earn money. That engagement between the society domain and economy is inhabitant. It will take place everywhere every time. What about the knowledge domain? We have a huge tradition about knowledge domain, time tested wisdom is there in our scriptures. Does it engage with the society or the economy?

If you don't bring the knowledge to bear on this then what is happening will continue the way it always has. Knowledge has not participated. Knowledge has not contributed to the technology, to applicative operations.

The worst part is that in such a situation the engagement between the society and the economy is more transactional. I buy something from somebody, give something to somebody and I earn some percentage commission. It is traded by a transactional logic. Imagine when knowledge starts engaging with society and the economy; then you talk about start-ups, about entrepreneurship, you talk about creating new technologies. The mindset becomes that of a creator. You want to create new values and such mindset is far beyond what we have today.

We witness so much of degeneration in society. I just want to leave this with you. Suppose we create our education in a manner where young people become more creative. Young people create more value not just money. Young people are satisfied. Why young and old? All of us have satisfaction of spending the day in a more creative manner because we have derived some joy out of it. Which society would be a better society? Which society would have lesser crime? Which society would be more virtuous? I will leave it up to all of you to judge for yourself, but I think that is the objective of education.



Shri Vishwas Deshpande, Trustee, Vidyalankar Dnyanapeeth Trust  
felicitating Dr. Anil Kakodkar

### August gathering



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