



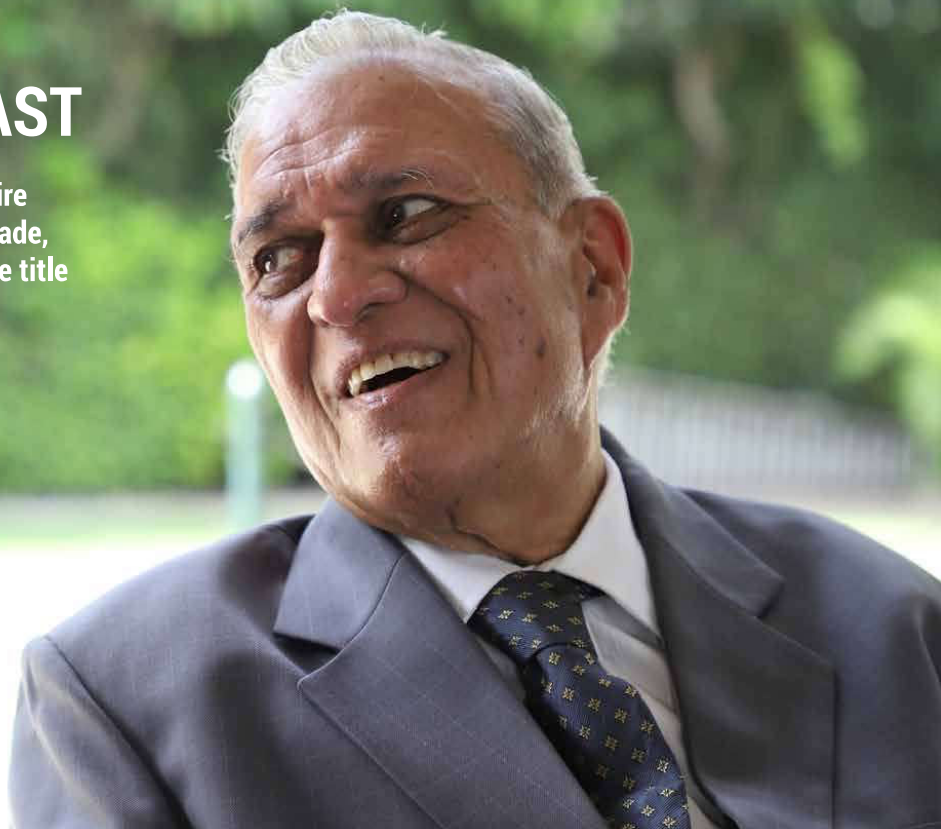
Prof. K K Aggarwal  
Chairman, NBA

**Prof. K K Aggarwal, Chairman, NBA and Founder Vice Chancellor, Guru Gobind Singh Indraprastha University**, has been a teacher all his working life. An alumnus of Punjab University, he completed his Ph.D from NIT Kurukshetra, where he worked with utmost dedication for almost three decades. Prof. Aggarwal also served as Pro Vice-Chancellor, GJU, Hisar for three years. He has served as President of a number of organisations including South East Asia Regional Computer Confederation (SEARCC), Institution of Electronics and Telecommunication Engineers, and Computer Society of India. He has been widely consulted by the industry, most-notably for his contribution towards the Reliability Analysis for PSLV (Polar Satellite Launch Vehicle).

**Prof. Aggarwal** has published over 200 papers in international journals, and over 400 research works in all. He was conferred the Honorary Fellowship by the Broadcast Society of India, as well as Lifetime Achievement Award by IETE and Computer Society of India. Prof. Aggarwal has been associated with NBA in various capacities since its inception and took over as Chairman, NBA on 14th January 2019. In this exceptionally insightful interaction, he speaks about the New Education Policy, reforms needed in higher education, future of Indian IT industry, and much more.

# INDUSTRY IS CHANGING SO FAST

We do not know what the industry will require 10 years hence. A study found that in a decade, 65% of our graduates will be doing a job, the title of which none of us knows at present.





**What according to you are the pros and cons of the new education policy? Is it entirely positive or does it pose some challenges for the universities and the industry?**

This policy is quite ambitious, very healthy, but it has challenges. First of all, since it has come after 34 years, obviously it had to cover many gaps. Education had changed so fast in last 3 decades that many things were not being attended to, and when all those had to be compiled in one document, everything needed to be addressed. I think the biggest contribution of this policy is that it has documented all the shortcomings of the system till date. Whether it was school system or the higher education system, whatever we felt was lacking, has at least come in one policy document.

This policy, for the first time, talks about education before the child goes to a formal school, and after he has completed Ph.D. So, the entire spectrum of youth, the age, which has been covered for the first time, from 3 to 30 years, is vast. That is again an opportunity because you weave the thread between different stages, and to have so many stakeholders come together in unifying that thread is a challenge in itself. In the school education, the entire school structure is being revamped, from senior secondary school, we are looking at a 5+3+4 kind of system. The entire schooling system is, therefore, changing quite dramatically.

I may mention, first of all, that compartmentalization of school education is being done away with. Earlier we used to segregate the science student and the humanities student, which will cease. I say this because it has a strong bearing on higher education. At the moment, we are very rigid. If someone wants to join a medical college, they need to study PCB, and if they want to be an engineer, they must study PCM. Now once PCB and PCM will not be defined so rigidly at the school level itself, it is a challenge. Secondly, vocational education will start at a much earlier age in schools. For those interested in vocational training, it will continue at the higher education level as well. So at least these two changes in the schooling system will have a direct bearing on college education.



In the university system, there are some landmark changes. For one, the policy will be, by default, inter-disciplinary. There will not be a very rigid compartmentalization of degrees. Depending on the interest of the student, the location and capability of the institution, the student can choose a variety of subjects. For example, it will be possible, for the first time, to choose some subjects of arts and others of science, and design a degree for oneself, which was not possible hitherto. Similarly, in engineering, instead of studying just mechanical engineering, the student will be in a position to learn about electronics etc. too, thereby being able to specialize in mechatronics and to design drones and robotics. Hence the student



will be able to do some reverse engineering for their degree depending on what they wish to pursue. That is being made possible in the document.

Moreover, the first degree will be of four years, keeping with the trend all over the world. At present in India, BA and B.Com are of three years duration, whereas in advanced countries it is of four years, with a vast bouquet of courses. The reason is very simple. It is now widely believed that, while the depth of specialization is important, the breadth of knowledge is equally important, adding to general knowledge. If, therefore, you wish to cover general education as well as specialized education, then 3 years is too short a time. The basic aim is that the student must be able to pick up all that they wish, to design themselves into whatever they desire, which was completely lacking so far.

How far it would be possible to transform this in real terms, given the fact that we have 50,000 higher education institutions in the country, remains to be seen. While we have world class colleges, there are also sub-standard ones. With this kind of diversity, how far we will be able to meet such challenges, only time can tell.

The third major change is that the system of affiliated colleges will be done away with. In India at the moment, university education is still being imparted, not in the campus of the universities, but through affiliated colleges. The teaching is done in college and the university only conducts the examination and confers the degree. Teachers in the colleges



have no control over the design of the syllabus or the design of the question paper. They have no control over the expected standards of evaluation, and the college just hands over the degree. It is universally agreed that this is the least desirable system of education, and other countries have given it up decades ago. The British gave it to us, while they themselves gave it up more than 50 years before we became independent. For 125 years we have continued this legacy. At the moment it exists probably only in India, Nepal, and a handful of countries, and nowhere else in the world. As per the new policy, by 2035 this will change. We are hopeful that we will get rid of a very undesirable system. World over the higher education system believes that unless the teacher is the custodian of the course, there cannot be a meritorious delivery of the program.

These are some salient features of the changes in the university system, a lot of flexibility will be permitted. A student will be able to study physics and philosophy, mathematics and music. We are thinking totally of diverse combinations. We believe that we will be able to meet the aspirations of the youth, in the way they wish to design themselves. Basic philosophy according to me is that 'you be the master of your career, be the designer of your life', and we will facilitate. I see that as a major change.

**So, with the affiliated colleges system going, what will be the alternative?**

There are several alternatives being suggested. One is that some very good colleges can be made autonomous, and will be able to award degrees. So far, the number of autonomous colleges in the country are very few, barely around 100, out of 50,000. The second alternative is to make a cluster of colleges and form a university. For example, some colleges that are close, not just in terms of







geographical proximity, but in terms of subjects and specializations offered, can be combined. Or maybe a group that owns several colleges can turn them into one university. Hence colleges will be allowed to cluster themselves and award degrees. We are thinking in terms of three types of higher education institutions. One is research dominated institutions, that will do teaching but the dominant part will be research. Second is teaching dominated universities, where research will also be done, but teaching will be dominant. And third will be autonomous colleges that will be able to award degrees. So, the cluster level of colleges, to begin with, will be the second level of colleges, but the policy also lays down that if you excel in research, you will be shifted from class 2 to class 1. That is how we propose to solve this problem.

#### How ready is the industry to accept this type of change in multidisciplinary studies?

Industry is more than ready to accept the change, because for many years it has been felt that the knowledge imparted is more bookish than practical, and industry needs skills. For example, industry does not want artificial intelligence only to be known to computer science engineers, they want it to be known to finance students, doctors, and media professionals. This will now be possible in such a policy framework. For instance, in the media there is a lot of dependence on IT, but in media courses IT is hardly taught. Industry is happy that there will be flexibility. Secondly, industry always wanted the system to go beyond the rote learning, as it wants people to be creative and innovative. The reason is very simple. Industry is changing so fast that we do not know what it will require 10 years hence. A study found that in a decade, 65% of our graduates will be working in a job, the title of which none of us knows at present. When we don't know, where do we scale it in. We will, therefore, have to teach the students to skill themselves. This is known as meta skill, how to skill oneself when the need arises. That will be the thrust and that is what industry wants. Even today, when the best of the industry recruits people, they do not give too much importance to what they have studied or know. They want to know if

a person will be able to adapt to the new situation by some imaginative skill, because that is the real risk. So I think industry is ready to accept the changes. Challenge is for the universities to change fast enough to come up to the expectations of the industry.

**How has the role of the NBA evolved over the years and what changes does it need to bring in to keep aligned with the NEP 2020?**

I believe that we are a member of the Washington accord, which is an MoU of 21 countries, including Canada, Australia, New Zealand, France, Malaysia, UK, etc. We have to follow the same standards for accreditation. Therefore, NBA had some concept of NEP already built into the system, like when we define what we expect from an engineering student, we emphasize much less on the subjects per se. We emphasize on twelve attributes that an engineer must have, for example, communication skills, ethics, understanding science, understanding society, professional communication, sustainability etc. The general attributes of an engineer were, therefore, highlighted much more.

India became a member of the Washington accord ten years ago. There is a review every six years, and last year we had a review. A very strong review is done. We had a team of three experts from Malaysia, Ireland and UK who reviewed our system. They went to two universities with board members for review, participated in meetings to see how the industry guides us, and on this basis submitted the report. The report was circulated to all the other 20 countries. They all voted for it. The requirement is for 2/3rd of the countries to vote in favour in order to remain a part of the accord. I am happy to say that in the case of India, all the countries voted for us. They said that India's system is robust and they accept it. Every graduate from an accredited institution, therefore, stands to be accepted in all these countries for potential employment.

To some extent we had brought in NEP much earlier. Now we will have to make some more changes when students take much more interdisciplinary courses. So far we concentrated on the numbers of teachers and students in a department,

but now with so much cross migration I think these will become more flexible. With new initiatives like academic bank of credit, students might change universities. We might have to even device a system that if a student moves from an unaccredited institution to an accredited institution, how much leeway can be given. We cannot expect a student to do 75% of the course from an unaccredited institution, and get the final degree from an accredited one by completing the remaining 25% there, taking advantage of the accreditation. All these norms will have to be made keeping in mind the changes. Our system will also have to be made more flexible. For example, instead of asking for all teachers in the mechanical engineering department to be mechanical engineers, if a higher number of students are taking up music or sports, there will have to be flexibility.

**In terms of international education collaborations, how well is India currently poised and what steps need to be taken? How does the world perceive advancement in higher education in India and are the global universities ready to be a part of it, as is provisioned by the NEP?**

At the moment, I am not satisfied with the internationalisation of higher education in India. Presently, it is more or less one way; our students are going to other countries and very few students of other countries are coming to us. That has to change. Bulk of the institutions are still not accredited, and our average perception of quality in the world is perceived to be low. There are some high-quality institutions, but mostly the perception is low, and I tend to agree with this. Unless we move the average quality up, the world will not perceive us as a centre of quality higher education institutions. Those such as All India Institute of Medical Sciences, IITs, JNU and Delhi University, are close to being the best institutions in their subjects, but when one counts the high-quality institutions from the 50,000, there will be barely 500. As the world does not perceive our average higher education system very positively, we will need to work on it. The name of the game for internationalisation is quality.





Quality comes at a cost. If we are able to give the same quality of education here in our institutions as in the United States, the expenditure will be about 40%. So there will be no reason for the student to go there if we give the same quality. We have to bring quality at an affordable cost, and India will be uniquely placed. We can give the quality because we have quality benchmarks, and our cost is low. So my thrust is affordable cost and good quality, which is feasible.

Why are highly-ranked foreign universities not keen to set up base in India? While we cannot allow them to fleece our students, we must permit them to make reasonable amount of money and repatriate it abroad. They would want to come to India because of the sheer number of students here, but we too need to be flexible. If they do come, it will raise the quality of our own institutions. Collaboration works in an atmosphere of give and take. This, I think, will happen over a period of time.

Personally, I feel knowledge is now universal. It does not matter too much where you study. Earlier it used to take years for knowledge to travel, now it takes seconds. Quality education can be provided nearer home, and that will be for the better. Further, COVID has created a situation where education nearer home will be preferable. The keyword will be creating quality at an affordable cost. Once we are able to do that, internationalisation will happen.

### What are the best avenues for students seeking history/ culture/ tourism as an area for specialization or research?

I think avenues are increasing, but they are still far too little. Earlier, engineering and medicine were the only career options, as people used to think that if they could not get into either of these, they were doomed. That has changed, and I can take some credit for it, by the establishing of the Indraprastha University in Delhi, whereby we started numerous courses for the first time in the capital. While engineering and medical

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courses are important, they are not the only ones which the country needs. Vocational education was almost looked down upon, and parents and teachers were not in favour as well. Now with this policy, we are alloying combinations. I have submitted a paper about this. Every year, we have three lakh people competing in IAS exams for 100 posts. But then, you have to do BA or B.Sc courses, and nothing else. Now I have suggested that IAS does not require just these particular subjects; why cannot we have a BA which encompasses History, Geography and Tourism? This is a combination of academic and vocational subjects. Now if one is not able to make it to the IAS, and becomes a tourist



guide, one will be among the best in the country because of knowledge of history and geography. So we have to design things in such a way that we do not have youth miss out on opportunities, and also expand the opportunities in other ways. For example, why can B.Sc not have chemistry, pathology and medical lab technology as well? If one is a medical lab technician, by understanding chemistry one will be able to do much better. We, therefore, have to design several combinations, of traditional with vocational, or science with arts. I believe these opportunities will open up, and we will be able to synthesise the wishes of students and parents in the new policy. What the child aspires to be, and what degree the parents want him to achieve, will get a point of convergence too.

Moreover, our folk music, dance forms, languages, literature, diversity of flora and fauna in the country, are all great things, but they were not studied because a higher status was accorded to engineering and medicine. Now there is a possibility that along with the sciences, one can take up a course in agriculture or environmental study. That makes for a very good combination. Once there is better education, economics will be taken care of.

I want to approach economics via growth in education and culture. If everyone becomes more competent, the country will automatically become richer.

**Engineers must be able to serve the society.**

**Ultimately, our power and food requirements are increasing every day. The sustainability requirement is increasing; the carbon footprint has to go down. For all this, engineers are needed; but you have to make the right kind of engineers who understand these things and produce them at an affordable cost. At the moment the situation is a bit dire for engineering education.**

**India is making progress in the IT sector as a service provider. What is the scope of becoming a manufacturer and attaining patents, and thus being able to target a bigger market?**

As far as IT services are concerned, we are number one in world, to a large extent. We have got the logic and are performing well. But as far as products are concerned, we were lagging behind, though we have made up to some extent. There are reasons for this. Firstly, we did not have policies that encourage this. Products have a lot of developmental cost, and unless we increase the volume and scale, the product cost becomes prohibitive. What we had to do was to estimate the products that can be consumed in bulk, or be marketed around the globe, and produce those. That kind of policy thought was missing. For example, VLSI chips are a very costly phenomenon. But if there is a market for only 100 chips, one is headed for bankruptcy. There has to be a market for one million chips. That is possible by policy intervention.

Things are improving now because of offshore; onsite things are changing. But we have to do a lot more. This is technology, knowledge, and planning

put together to see that we will beat the world in all these fields. We cannot beat the world in everything. We have to strategically decide our core area, our niche area, and what we can produce in billions. Though I see change, I agree it should have been faster. We are already making some mobile phones in India, as well as chips. We are, thus, on the right track.

**However, the acceptability and competitiveness of the products manufactured here has good scope for improvement. How do you suggest that we fill that gap?**

Quality is also a matter of perception. I have published over 150 papers on quality and I feel we not only have to make quality products, but also change the perception of the world for our products. After all, if the USA took all the software services from our engineers, it means they were confident of our quality. But quality again comes at a cost. First you have to generate the volume so that the cost can be recovered. We have quality capability, but the world's perception has to be changed, our volume will have to change. Our capacity is good enough for any benchmark across the world. As regards the education system, in the top-ranking universities globally, 20% of the faculty are from India. These professors had their education right here in India.

So quality is possible, but we never consciously worked for it, because whatever we produced, even low quality, would sell. We have to create a situation where low quality will be doomed and high quality will win the prize. We have to strategically work on this. But technically we are capable of giving quality, of that I am certain.

**Tell us about the research facilities for students in the Government institutes, especially the libraries and incubation cells? Are they sufficient for supporting the advanced research work by the students?**

Well, our research infrastructure in some areas has improved by a long way. For example, in space research we are comparing with the best. I was one of the designers of PSLV with ISRO. In defence and atomic energy, we have done exceptionally well. But in general, the facilities are not satisfactory. For one, our research expenditure has been far too low. You need infrastructure for research and we have not been able to invest in it, apart from a few institutions. We have to take care of that.

Secondly, in other countries, industry has heavily invested in research. In India, industry has invested very little, and we are highly dependent upon the government. We expect that the onus is only on the government to provide facilities. So we did not invest on research. Abroad, many of the companies are run by professors of universities. In India, we never allowed professors to earn well, except over the last few years. Research expenditure and infrastructure have to improve. Psychologically too, we somehow believed that knowledge should not be monetised. So patenting was not in our blood, and we never focused on it. It was a blatant misplaced philosophy. But now we are improving, and the department of science and technology are making very conscious efforts for facilitating patenting and providing the infrastructure. But the budget allocation for research has to increase.

The new Science and Technology Policy is on the anvil. I think that part will also be taken care of soon enough. It will be a long-term projection. You cannot think about the next election and make a policy. Policies need a long-term perspective, and

that has to be kept in mind. You invest in research, and in five years you will not even know whether it has yielded any returns. Rather, you may feel that it is a waste of money. So, we have to believe in our system and put in our best efforts, as there is no scope to be careless about it. Then I am sure we will be able to deliver.

The number of research publications in this country has increased significantly, but once again, quality publications are far too few. So, while we are competing in terms of quantity fast enough, we are not competing

they should earn. But I believe focusing too much on earning may also not be a desirable thing. First we have to come to a level of quality where industry is ready to invest. At the moment we want industry to invest, but industry asks what there is to invest in? In a democracy, good quality education, health and delivery of justice are the responsibility of the state. Once we come up to a certain quality, then industry will be ready to invest.

Even foreign industry might invest

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in quality at the same pace. We will have to reduce the emphasis on quantity and increase the focus on quality. A policy shift will also have to come about. Industry will also feel that if they invest in research and give money to a university to establish a research lab, the graduate from there will be more beneficial to them. That mind-set will have to come about. It is happening but happening all too slowly.

**Is there a scope for Indian Universities to earn substantial income through research funding and patents?**

First of all, they have a scope to earn,

here, because our manpower costs much less. Imagine, some industry setting up a lab in a US university, as compared to an Indian university! Initial expenditure is the same but the worker cost will be one-third here. So they will be much happier to do it here. But we have to give them the confidence that we are capable of using this infrastructure with efficacy. Unless they have that belief, they will not invest. It is, therefore, a bit of a chicken and egg situation. Money will come provided we have the quality. We tend to say that quality will come if we have the money. I think we will have to take the first step of spending, getting the right quality, and then money will come.

**Recently there was some news about low admission to engineering courses. Do you see a shift in the trend of admission pertaining to courses that students want to take up?**

We had grossly over-rated engineering vis-a-vis other courses. I see no reason why elitist status should go only to engineering institutions. Looking at the world-wide ranking of universities, we find only in India that out of the first 10 ranks, 8 are engineering institutions. It does not happen in the US, France, Germany or England, only in India.

Engineering institutions are much coveted, we spent on them, and built them. The number increased rapidly, but with low quality. Now applicants feel why they should pay such heavy fees when the quality of education is not good and employment is not likely to be attractive? It is a mismatch between the cost of education and its quality. I have a simple point. Seven to eight lakh students appear for the JEE exams. So when we have less than 7 lakh seats, why are seats vacant? That means though students want to be engineers, they want to do so from the right kind of institutions. Engineering has not lost its charm. But to provide the desired quality at the fees charged has become an issue. Parents feel that if their ward will get a job of say Rs. 15,000 per month, why not get them to do a BA or B.Sc? Why push for engineering and spend Rs. 10 lakhs? That's the serious problem, quality of education. I have been able to accredit less than 20% of the engineering colleges in the country, and I have not rejected many of them. They are not confident enough to apply for accreditation. That means they know that they are below par. Hence if we increase the quality of engineering education, things will get better.

Also, we have to diversify

engineering education. This state of specialisation, that if you know electrical engineering, you know not much else, and as a matter of fact, in the process of providing specialisation, we forgot to make them engineers. I think this building has to be a pyramid. First, you make a good human being, then a good engineer, then a good mechanical engineer, and then a good air-conditioning engineer. We made a good air-conditioning engineer, with a reasonable mechanical engineer, forgetting whether he has become a good engineer, or whether he is a good human being. We were thus trying to make second and third storey of a house, without the foundation and the first floor. That is my diagnosis. If we take care of this, engineering will pick up.

Engineers must be able to serve the society. Ultimately, our power and food requirements are increasing every day. The sustainability requirement is increasing; the carbon footprint has to go down. For all this, engineers are needed; but you have to make the right kind of engineers who understand these things and produce them at an affordable cost. At the moment the situation is a bit dire for engineering education.

**Lastly, you have had a long and exciting journey. Do share something that you remember from your visits to other countries as a professor.**

Primarily, I am a teacher. After getting first rank in engineering, I opted to be a teacher, which was very rare. I appeared for an interview, where my own head of department was an expert panellist, and I was rejected. Later, when I asked my head of department, he said that everybody wanted me to be taken in, but he said I would do much better elsewhere other than being a teacher. Anyway, I loved being a teacher, and I am very happy about it. When I became the youngest professor in the world, that very professor came to my house, to say that I was evaluating myself correctly, but they were evaluating me wrong. So that is a compliment.



I believe teaching or professorship is a wonderful profession, because one can transform some lives. I have been able to completely transform perhaps half a dozen students. That is the real crux of life. Comparing the Indian system with the 20 to 25 countries across the world where I have travelled, I found that the focus on the quality of education was much better there. The inter-disciplinarian application was much more. In our country, there is still a lot of rote learning and emphasis on the examination system. Once, when I set the question paper, one of the brightest students was perspiring. I called him after the exam and asked what the matter was. He said, "Sir, for the first time I have seen an examination paper where we had to think in the hall. Otherwise, we were always just pouring out automatically what we had learnt by heart. We were not used to this." That was a prominent difference between other countries and our country, barring some very good institutions here. As a professor I think that teachers will have to be very innovative and creative, only then can students too be so. Sometimes students are brilliant but we suppress them. Suppressing the creativity of students is a serious error that teachers in this country have been doing for quite some time. That has to be undone.

I was reading that Dr. C V Raman was very fond of the musical instrument Mridangam. In one of his researches he stated that if a Mridangam is made of jackfruit wood, it is the best. Now, if a physicist comes to this conclusion, then that research has a lot of credibility, about the vibrations that makes it the best. That kind of inter-disciplinary research has to come about. My experience in interacting with the industry has been that it loves professors who can deliver results, solve their problems, be useful to them. Why should we expect otherwise? I have been consulted by some of the best in the industry and I am delighted with it.

As a professor, I believe, we have to first imbibe NEP. For NEP to be successful, teachers have to first forget what they know they have to teach; they have to learn what the student wants. It has to be other way around. In the process, we may not be perfect

but that is fine. I don't have to impress my students about my knowledge; I have to turn my students into better citizens. We have to imbibe that aspect.

Lastly, I must say that the kind of affection I get from all the students I have taught, makes me extremely joyous. I will narrate an incident. On one of my trips to San Jose, there were about 50 of my students there. When one of them learnt about my presence, I promised to spend a whole day with them, and asked him to inform all the others. When I went to his house, there were only two students. I said, "There are 50 students in the city, how is it that only two of you are here?" They smiled and said that they did not want my 24 hours to be shared with 50 of them. They wanted only two to take advantage of this limited time. This says a lot. I think if you wish to inculcate that kind of bond with your students, then this country has a great future. I have seen students as well as teachers like this. I am a hard-core optimist and I believe that this can happen. We have to take care of our universities. Pay scales are reasonably good now. We have to upgrade in terms of infrastructure and rules.

Now with online teaching, I think the best teachers will be recognised automatically. If one is not forced to study a course only from one's university, and is free to study anywhere, then the best teachers will be gain recognition, accepted and in demand. I think in a decade we may have a system where the professors work in a university, in the manner doctors work in hospitals. They are not employees of the hospital, but visit various hospitals as consultants. If I am a good teacher, every university will invite me. Once that kind of model is adopted, students would own the teacher and teachers would own the students. If the students believe you are their well-wisher, then the teaching profession is very satisfying. Everything will follow from there, rather than just from knowledge of the subject. The world over, students are very open with their teachers. The fear psychosis must dissipate and working togetherness must be imbibed. If that happens, I shall be most happy, and certainly things will improve by a long way. 📌