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EDITORIAL

The quality of students in Ph D programmes

Recent reports in the popular press have expressed concern about the quality of Ph D students in India (<http://www.thehindu.com/features/education/parliamentary-panel-raises-questions-about-quality-of-phd-holders-in-india/article7166920.ece>). In addition to concerns raised by parliamentary standing committees, I have heard my colleagues around the country complain about graduate students in their programmes. The specific complaint is that the quality of students has dropped over the years; it used to be much better 'in the (not so) dim and distant past'. I must confess that I am a little bemused when I hear these comments as I have not encountered this 'drop' in quality. While every student is different and each one of my students has/had problems that I have/had to address, I do not see an overall drop in quality. However, given that this view has been expressed by a number of people whose opinions I respect, I wanted to take a look at both sides of the argument and see if I could provide possible causes and (hopefully) solutions to address this conundrum. This is important for faculty who work in Indian institutions and universities as our major work force consists of graduate students and it is their effort that drives the research in our laboratories. I will confess that my experience is limited to graduate programmes in the biological sciences, but hope that this exercise will be useful for other programmes as well.

If one accepts that the quality of students has dropped over the years, what could be the causes? There are possibly two major contributing factors, though readers might add more. One possible contributing factor is our education system and how it influences career choices. The majority of our educational institutions, beginning with primary school, rely on rote learning rather than comprehension and problem-solving for student assessments. This attitude towards learning results in the generation of students that have not learnt to think for themselves, which is a problem if you want a career in research. Teaching that is geared towards testing basic concepts and the ability to think would prepare students for any career they choose to pursue, not just a career in research. The ability to think and reason can be taught, but it is better to teach this early rather than late, i.e. when students enter a Ph D programme. This has to be addressed from the ground up as setting up another 20 IITs

or IISERs will not solve the problem. The effort needs to begin with teaching the teachers, all the way from the primary school level to ensure that we provide the coming generations with the best possible education. While it could be argued that teaching standards have not changed much over the years, the reasons outlined below might explain why student quality is declining despite teaching standards remaining the same.

The second contributing factor is that we might just not be getting the best students in graduate programmes. When I was doing my Bachelor's degree in the 1980s, the major options available to students post the standard 12 examination were medical school or an engineering programme. The limitations of number of seats and alternative career opportunities meant that a large number of bright students were funnelled into the basic sciences programme and into the limited number of Ph D seats available at institutions around the country. This has changed. In addition to the increase in the number of seats in public and private medical and engineering colleges, there are several other career opportunities available for young people, and the number of institutions granting a Ph D as well as the number of Ph Ds being granted each year have increased exponentially. While this is a positive development in some ways, what it does mean is that the number of bright students entering the basic sciences is dropping. Further, due to our rules, students with a Bachelor's degree cannot register for a Ph D (the number of students doing an integrated Ph D is minimal), and so several of our brightest students go abroad after a Bachelor's degree to enrol in graduate programmes. Further, the rules often preclude someone with an MBBS or BDS degree from joining a Ph D programme. These are some of our brightest students and even if a very small minority of them is interested in a career in research, it is not possible. These rules need to change as, in my opinion, a Master's degree is not essential for enrolment in a Ph D programme.

The alternative to the arguments presented above is that the quality of students is not really dropping and that this perception is incorrect. There are, in my opinion, a few factors that contribute to this notion. First, often mentors have unrealistic expectations of a student with a Master's degree, especially given the problems with

teaching discussed above. We are constantly searching for this (probably) mythical creature, the perfect graduate student. We expect the student to be well read, have wonderful hands, work extremely hard and think critically, often from day one. Personally, I do not think that I ever met these criteria (at least to my satisfaction), even upon completing my Ph D, and definitely did not meet them when I began graduate school and am reasonably certain that none of us did. We all learnt this as part of the process of getting a Ph D degree and have continued to learn over the course of our careers in academia. To expect students to get this right from day one is counter-productive and often results in unrealistic expectations for the students leading to them being demoralized. This needs to change. We cannot look back at our own careers through a rose-coloured lens and imagine that we were the epitome of what a graduate student should be.

This brings me to the issue of mentoring in a graduate programme. Graduate programmes need to focus on preparing students for a career in research. I use the word 'programme' rather than mentor (this is a distinct issue) as I believe that the quality of a programme is crucial to turning out well-rounded and educated Ph D students. The mentoring includes designing appropriate courses, assessing the students and monitoring the research conducted by them. Courses should be designed to teach the students to think critically about science. Students that have gone through a particular course should be able to critically read and assess a paper from the field covered in the course. Student assessment is crucial as it needs to be harsh (but fair), and students should be provided with the assistance that they need to improve. This is especially true of their ability to present their work (or even a paper) to an audience and their ability to write a scientific document. Most of the documents I get to read are poorly written, and the presentations I sit in are superficial and are not sufficiently critical in terms of analysing the data. This is particularly true when it comes to analysing their own data and students learning to be their own critic. This was true in my case when I first began graduate school; however, the constructive criticism provided by my mentor and thesis committee helped me improve my presentation and writing skills, and taught me to be my own worst critic. In addition, the rest of the department also critiqued my work and presentations every year, which led to a dramatic improvement in a skill set that is important for every graduate student. The thesis committee should also serve as a mediator when the student and mentor disagree about either experiments or the direction of a project. This is important as generally in the mentor–student relationship, the former holds most of the cards and the thesis committee should ensure that the mentor is being fair to the student. While some graduate programmes in this country have robust systems that work towards these goals, many do not and this needs correction.

The last point that I want to make is about the interaction between student and mentor. It seems strange to have to state that the student–mentor relationship should be of one between equals, with the caveat that that mentor due to his/her experience has a store of knowledge that will benefit the student. It cannot be a didactic relationship where all the mentor does is tell the student to do a particular set of experiments and expects him/her to stick to these defined sets of experiment and not explore problems that he/she might be interested in. I do realize that in this day and age, funding is short and is predicated on publications being churned out so that the next grant will be funded. This is especially true in the Indian system, where there is a long lag between submitting a grant and getting the funding. This often leads to a situation where students are not allowed to make mistakes and are given a list of designed experiments to do exactly as outlined. However, I am not sure that treating the students like technicians, rather than training them to be independent scientists, is the right way forward. This will only hurt science in India in the long term. In turn, the students should bring ideas to their mentors and discuss with them before trying to open a new line of enquiry. This process of dialogue between student and mentor should be established early and must occur often if the relationship is to be productive and produce well-trained scientists. This is something we all need to try; it might not be successful in every student–mentor relationship, but it should help most graduate student–mentor relationships. I might add that I do not know if I fulfil all of the criteria listed above as a mentor, but I think that we all should aim to meet them.

I have not answered the question I set out to address about the quality of Ph D students in graduate programmes. I have tried to offer some opinions as to why this perception of a drop in quality exists and maybe some solutions to address them. While this Editorial is rather open-ended and does not provide a resolution, I hope that it helps to initiate a conversation about graduate programmes and what can be done to improve their quality. My personal opinion is that there has been no dramatic decline in the quality of graduate students since I began my career as an independent scientist or when I entered a Ph D programme. There will always be some students who are highly motivated and intelligent and some that are less so. It is the responsibility of the graduate programme and mentor to get the best out of these students and prepare them for a career in research.

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