LEADERSHIP IN SCIENCE

"PhD leading to Specialists or Intellectuals with Thinking Cap"

(01.09.2022)

Here is a brilliant article by Gundula Bosch, PhD, MS, MEdHP that simply hits the nail... It is a must read for all the academia and research guys in the developing and developed industry of higher education.

Good idea to create leaders over followers! However, more often than not thinkers find themselves having a really hard time blending in with the trending followers.

No matter what kind of baby steps we take in this direction of making our researchers as future leaders and not just experts in India or elsewhere, it's time we at least initiate the processes. Research without thinking and imagination doesn't deliver any value and usefulness.

Research in any field including STEM, should lead to hunger for new knowledge rather than hunger for expertise or perfection. A lot depends upon the mentors and teachers, who may not be perfect experts, but are a happy lot to raise the Joy and Excitement Quotient (JEQ) of the PhD mentees, for inspiring and performing the quality research.

As far as PhDs are concerned, they have onus to assess their own aptitude for research through psychometric tests before they choose this noble and novel career of research. Often, even in our own Indian scenario, being a PhD student is more of a compulsion (because of lack of job opportunities after postgraduation) rather than a well-considered career option.

Isn't it so! Do you agree? Or you have some alternative point of view, else useful value addition further.

WORLD VIEW *A personal take on events*

Train PhD students to be thinkers not just specialists

Many doctoral curricula aim to produce narrowly focused researchers rather than critical thinkers. That can and must change, says **Gundula Bosch**.

Under pressure to turn out productive lab members quickly, many PhD programmes in the biomedical sciences have shortened their courses, squeezing out opportunities for putting research into its wider context. Consequently, most PhD curricula are unlikely to nurture the big thinkers and creative problem-solvers that society needs.

That means students are taught every detail of a microbe's life cycle but little about the life scientific. They need to be taught to recognize how errors can occur. Trainees should evaluate case studies derived from flawed real research, or use interdisciplinary detective games to find logical fallacies in the literature. Above all, students must be shown the scientific process as it is — with its limitations and potential pitfalls as well as its fun side, such as serendipitous discoveries and hilarious blunders.

This is exactly the gap that I am trying to fill at Johns Hopkins University in Baltimore, Maryland, where a new graduate science programme is entering its second year. Microbiologist Arturo Casadevall and I began pushing for reform in early 2015, citing the need to put the philosophy back into the doctorate of philosophy: that is, the 'Ph' back into the PhD. We call our programme R3, which means that our students learn to apply rigour to their design and conduct of experiments; view their work through the lens of social responsibility; and to think critically, communicate better, and thus improve reproducibility. Although we are aware of many innovative individual courses developed along these lines, we are striving for more-comprehensive reform.

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Our offerings are different from others at the graduate level. We have critical-thinking assignments in which students analyse errors in reasoning in a *New York Times* opinion piece about 'big sugar', and the ethical implications of the arguments made in a *New Yorker* piece by surgeon Atul Gawande entitled 'The Mistrust of Science'. Our courses on rigorous research, scientific integrity, logic, and mathematical and programming skills are integrated into students' laboratory and field-work. Those studying the influenza virus, for example, work with real-life patient data sets and wrestle with the challenges of applied statistics.

A new curriculum starts by winning allies. Both students and faculty members must see value in moving off the standard track. We used informal interviews and focus groups to identify areas in which students and faculty members saw gaps in their training. Recurring themes included the inability to apply theoretical knowledge in statistical tests in the laboratory, frequent mistakes in choosing an appropriate set of experimental controls, and significant difficulty in explaining work to non-experts.

Introducing our programme to colleagues in the Johns Hopkins life-sciences departments was even more sensitive. I was startled by the oft-expressed opinion that scientific productivity depended more on rote knowledge than on competence in critical thinking. Several principal investigators were uneasy about students committing more time to less conventional forms of education. The best way to gain their support was coffee: we repeatedly met lab heads to understand their concerns.

With the pilot so new, we could not provide data on students' performance, but we could address faculty members' scepticism. Some colleagues were apprehensive that students would take fewer courses in specialized content to make room for interdisciplinary courses on ethics, epistemology and quantitative skills. In particular, they worried that the R3 programme could lengthen the time required for students to complete their degree, leave them insufficiently knowledgeable in their subject areas and make them less productive in the lab.

We made the case that better critical thinking and fewer mandatory discipline-specific classes might actually position students to be more productive. We convinced several professors to try the new system and participate in structured evaluations on whether R3 courses contributed to students' performance.

So far, we have built 5 new courses from scratch and have enrolled 85 students from nearly a dozen departments and divisions. The courses cover the anatomy of errors and misconduct in scientific practice and teach students how to dissect the scientific literature. An interdisciplinary discussion series encourages broad and critical thinking about science. Our students learn to consider societal consequences of research advances, such as the ability to genetically alter sperm and eggs.

Discussions about the bigger-picture problems of the scientific enterprise get students to reflect on the limits of science, and where science's ability to do something competes with what scientists should do from a moral point of view. In addition, we have seminars and workshops on professional skills, particularly leadership skills through effective communication, teaching and mentoring.

It is still early days for assessment. So far, however, trainees have repeatedly emphasized that gaining a broader perspective has been helpful. In future, we will collect information about the impact that the R3 approach has on graduates' career choices and achievements.

We believe that researchers who are educated more broadly will do science more thoughtfully, with the result that other scientists, and society at large, will be able to rely on this work for a better, more rational world. Science should strive to be self-improving, not just self-correcting. ■

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