

What is a PhD?

This might seem like an unusual topic, as most scientists seem to know exactly what a PhD is and for what it stands. But on closer inspection, a PhD has as many meanings as there are educational systems. It is not—and has never been—a single, well-defined qualification. As research practices and funding change, the situation becomes even more confused, with consequences for the quality of both scientific training and research.

I received my PhD from a British university. After three years of research, I submitted a three-centimetre-thick thesis that addressed a specific problem. Being awarded my doctorate meant that I knew my topic, I understood enzymology, I could work with proteins and I was able to navigate the complexities of enzyme kinetics. I was not qualified for the title until I was able to demonstrate all these things. In essence, my PhD showed that I developed from a dependent student into an independent scientist.

Since then, PhDs in the UK seem to have changed. More often than not, a PhD is now awarded after the completion of a fixed term of research. Of course, there is an overall topic, but if the student does not reach a hypothesis-based conclusion within a timeframe of about three years, this is no longer a hindrance to earning the degree. Increasingly, the thesis has become a report with an emphasis on training rather than the detailed description of a scientific project.

Other countries have different systems. In the USA, the PhD phase is a genuine period of postgraduate training that includes both theory and research, with a greater emphasis on course work and the possibility of rotating through different laboratories. In Nordic countries, the situation is more complex: some universities adopt the US model, whereas some focus on publication output,

and others are variations of these. In Germany, it is necessary to spend up to two years on a diploma degree before moving on to a PhD. Many other countries require their PhD students to teach undergraduates. In some systems, the final examination is a mere formality with an inevitably positive outcome; in others, it is a rigorous cross-examination by jury.

Against this background of different systems, new aspects have arisen that are moulding the PhD into a different entity to what it was. For example, the concept that a student must carry out an individual piece of research seems outdated. Most publications list many authors, each of whom contributed to the overall content of the paper. In fact, scientific research increasingly demands teamwork, and the PhD system must adapt accordingly; indeed, an important lesson for a young scientist is to learn how to work in a team. But if the thesis is a cooperative effort, then it becomes even more difficult to judge the input of each individual—yet a PhD is awarded to an individual.

Finances are another matter. In some countries, there is only a limited amount of money available to support a PhD student. Once that is spent, the student must survive by the most precarious means: relying on parents or partners to cover the gap, finding a grant to stay afloat, or taking a part-time job, even if this eats into the precious time and energy needed to complete the thesis. If we accept these realities, it makes sense that a PhD is awarded on the basis of time and effort spent, rather than on scientific work alone. But in that case, a PhD is merely an apprenticeship and no longer represents a stamp of achievement.

Is this really a cause for concern? Even if all PhD programmes followed the same rules and regulations, there would still be many theses chronicling failure rather than

achievement. But if we collectively become unconcerned about what a PhD is, then we have little basis for expecting the pre-doc students in our laboratories to go through the diligent work that ultimately enables experiments to work and provides robust results. The 'three years and out' mentality concentrates on time and investment rather than quality, and runs the risk of producing substandard scientists.

Thus, there might be real consequences for research if we lower the standards for earning a PhD. Perhaps one of the reasons behind the success of the US research system is the quality and structure of their PhD training. Maybe one reason why European countries produce such a high number of papers of more moderate quality is the frequent requirement for a defined number of first-author publications to complete a PhD. Perhaps the concept of writing a thesis on the basis of a well-defined body of work is so foreign to today's students that they prefer the easier route of collating a few papers on which they contributed.

If we change the standards and requirements for obtaining a PhD, this will inevitably shape the next generation of scientists. Thus, we should know more and ask more about what a PhD really means. Instead of treating the degree as an 'access card' to the laboratory, we should ask for more information: how the candidate was examined, who sat on the jury, and what comprises training in the applicant's country or university. Most importantly, we should insist that a PhD is not merely a vague title but actually means what it implies: it is an award to an expert who has proven their scientific worth and not to someone who stayed in a tolerant group for long enough.

Frank Gannon

doi:10.1038/sj.embor.7400842