Critical Point

Probing potential PhDs

What is the best way of judging the ability of prospective PhD students? Robert P Crease outlines his thoughts – and asks for your ideas

“You have two square potential wells of the same width,” my Stony Brook colleague Xu Du said to the candidate. “One is infinitely high, the other finite. Which has the higher ground-state energy? Explain the answer as you would to an undergraduate, in two or three minutes and without doing any calculations.” Du then added that as he was an experimentalist, the answer should be intuitive – no formal derivation was needed.

Du and I were in China interviewing students who had applied for admission to Stony Brook’s graduate programmes in physics and in several other disciplines. The admissions committees had found that many of the qualities that they were looking for in candidates – including knowledge, motivation and experience – could be assessed from the students’ records and recommendations. But one important duty of graduate students is to tutor undergraduates and serve as teaching assistants. To do this well, sheer knowledge of physics and a good command of English are insufficient. Gauging the promise of candidates in tutoring was therefore one task that Du and I had in conducting these interviews.

But how do you test the tutoring ability of a student from another culture, especially when we had only 15 minutes in total to talk to each candidate?

Du, who is a condensed-matter physicist, had devised a clever solution. He selected a set of special physics problems, and towards the end of each interview would randomly select one – asking the candidate not to solve it, but to explain how we would find the answer if we were undergraduates. They looked and sounded like ordinary textbook problems. They weren’t quite; they were deceptively challenging. To explain them in two or three minutes involved a little more speed than the typical textbook problem, a little more cleverness in identifying the conceptual issue, and a little more fluidity in couching the explanation.

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The critical point

A few Chinese candidates startled us by referring to “plumbum”, “kalium”, “natrium” etc, using the ancient Latin names of elements (lead, potassium and sodium in this case) from which their current symbols are derived. Still, we found that, if we compensated for language difficulties among some students and nervousness among others, the Chinese students exhibited about the same range of abilities in successfully answering the questions as US students. Some, that is, had an extraordinary ability to explain principles and their application clearly and succinctly, while others had difficulty even when their general physics knowledge was outstanding. A good test question, it seems, is equally effective the world over.

The challenge questions that one looks for are those that do not involve calculation but conceptualization, or a general sense of the physics involved. The student must then convey the conceptualization and how it settles the problem swiftly and succinctly at the undergraduate level. These questions therefore test what I like to call “impedance matching”, or the ability to match the “load” of one’s explanation to the environment in which it must be understood. I imagine that there must be many such questions, and I invite you to send me your favourite challenge problems – or other means of evaluation. I shall discuss your responses in a future column.

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What are your best methods for evaluating prospective PhD students? Send your thoughts to Robert P Crease at the address or e-mail above.