

USP Teaching Excellence Award 2010

recipient - Dr Rajesh Parwani

Dr Parwani is a Physicist whose teaching demonstrates a remarkable range. Not only does he introduce Physics itself to large groups of Engineering students, but he offers three more innovative modules in USP: *Simplicity*, *How Technology Works* and *Complexity*. To all this teaching, he brings exceptional energy and flair, as well as a distinctly individual perspective which makes students sit up, listen, respond and think.

Simplicity is a module which invites students, in Dr Parwani's words, to "explore the world through the eyes of a physicist." It takes rules and principles for relatively simple phenomena and looks at the ways in which they might be applied to questions about complex situations not traditionally addressed using physics. For example: how to choose marriage partners, how corporate boards make decisions, what is the social value of smiling. From this, students learn far more than a few examples of how the physical world works. The subject matter is non-linear dynamics which is rather mathematical even for science upperclassmen. However, the students in Dr. Parwani's class are not simply taught the mathematical solutions of non-linear equations. They are actually led to think about what the essential physics is in complex phenomena, thus enabling them to learn to formulate simple models that capture the essential physics in any complex phenomena, even one as unlikely as Love. They practice, and reflect upon, scientific method, and think about how that might be applied to fields beyond Physics. Indeed, part of the enquiry concerns how and whether these methods might be applied to human as well as to physical phenomena. Above all, then, the students are encouraged to learn to think critically about how to ask questions and arrive at answers.

There is one point which it is important to emphasise here. Dr Parwani is not teaching exclusively or primarily Science students. Nor is he teaching a module which would fit in a Science major. But despite that, he has not compromised on the sophistication of what he teaches. His examinations, for instance, force students to think, and to apply the principles they have learnt to unfamiliar and unexpected situations. In one test question, he has students create a mathematical equation for the love plot in the romantic comedy, *When Harry Met Sally*, and to predict from that the likely outcome of the relationship. Students learn to apply simple physical principles to unexpected situations, essentially armed with only creativity and curiosity.

The combination of scientific rigour and its application to unexpected problems allows Dr Parwani to elicit a great range of different kinds of work from his students. Last year, his groups investigated: avian flu, culture, fires, herd behavior, metro stations, rebellions, sales forecasting, self views and skyscrapers. Most of the projects involved a critical review of a paper on the topic, in which the students looked carefully at questions and methodology. Once again, the emphasis was on critical engagement.

Dr Parwani's success as a teacher is attested to by his student feedback. The scores themselves are not as high as those of some. Last year, he averaged 4.158 for *Simplicity* with 36 students, 4.229 for *Physics 1E* with 236, and 4.333 for his Freshman Seminar with 15. More important than scores are the comments he receives. There is, for one thing, a notable absence of compliments on his warmth or other purely human qualities.

Instead, students remark on the connections he is able to draw between disciplines, on his ability to relate abstract principles to real life, and on his encouragement of "curiosity and creativity." Students and professors, from NUS and elsewhere, have expressed great interest in Dr. Parwani's module website, and in the approach he takes in the teaching of complexity.

The FTEC was able to witness the kinds of quality Dr Parwani brings to the classroom by attending one of his classes. The session dealt with emergent properties, and Dr Parwani concentrated on three examples in the first hour: Benard cells, BZ reactions and Turing structures. Since he was dealing with quite complex phenomena, he simplified them in order to make them accessible to students, but he simplified without sacrificing their essential important lessons. His approach in the class was highly interactive. He proceeded by posing questions of three kinds. First, he drew from the students inferences and conclusions about the particular example at hand. Second, he prodded for connections with examples from other sections of the module. Third, he pushed towards the drawing of some larger conclusions. Students responded well to this, answering questions, suggesting possibilities, raising doubts of their own. Dr Parwani's peer reviewers from the Faculty of Science have been as impressed by his teaching as has the USP FTEC. His most recent peer review, conducted by the two experienced professors (Lee Seng Luan and Zhou Wang), gives him an overall evaluation of 5. The reviewers commend, as we do, both his classroom teaching, and his development of teaching materials. They were particularly struck by his ability to arouse interest and enthusiasm among a large class of Engineering students, for whom Physics can easily become a chore rather than an engaged learning experience.

Outside the class, Dr Parwani supports student learning with electronic resources, and in this, he goes well beyond the standard employment of IVLE. To be sure, he opens forums and chatrooms, as do the rest of us, and these are very actively used by the students in his classes. But he also points students towards videos to support their learning, and in some cases, he archives projects from earlier iterations of the module. This last is perhaps the most innovative and useful of his varied approaches. Students are allowed to see what earlier students have produced, the kinds of questions they have asked, the kinds of conclusions they have drawn. So, they experience the module as something with a history. Each new group can look back upon what other students have wondered about and learnt.

In sum, nothing about Dr Parwani's teaching is run of the mill. He teaches Science in a way that is seldom found, pushing students to think about the big questions, to consider the appropriateness of different methodologies and to make connections between fields. His teaching is energized by lively questioning and dry humour, and supported by a range of web materials, some from others some his own. The result is students enthused to an unusual degree to question and learn.