OPINION
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Science in Thailand at a Crossroads

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THE FIRST OF TWO PROBLEMS

I have had two nagging problems. The first one arose last year when I was making preparations to teach a graduate course in classical electrodynamics after taking a year of sabbatical leave. I had taught this course twice over the past twenty years. The first time was in the early eighties and the second time was in the late nineties. The text that has long been considered to be the "bible" of this basic course is "Classical Electrodynamics" written by J. D. Jackson. Those who have undertaken their physics graduate education in the US will always remember the time they had to struggle through "Jackson's". The book is now in its third edition.

The first group of students who took up the challenge of the second edition of "Jackson's" twenty years ago did quite well. They worked together solving the end-of-chapter problems (difficult by any standard). Only a few failed to pass the examinations. The second group of students took up the third edition of "Jackson's" about twenty years later working only half-heartedly. Many refused to think physics and just gave up doing homework assignments. They just copied solutions of problems from other students or from other texts. Few of them passed the course with the required "B". Nobody was happy. I was not happy, the students were not happy. Neither the Physics Department nor the Science Faculty was happy. What has gone wrong with our physics education over the last twenty years?

Admittedly, I was partly to blame for introducing "Jackson's" when most of the students could not master "Griffiths's", another but easier electrodynamics text for undergraduates. Nevertheless, the few top students could handle "Jackson's". My analysis revealed some interesting findings about our country's physics graduates. Firstly, most students have little problem-solving skill. They are not taught how to think physics but just how to memorize facts. Secondly, they have been inadequately prepared in basic theoretical and experimental physics (quantum and classical mechanics, electrodynamics, and statistical mechanics). Thirdly, the majority of them are not able to write a computer program.

I therefore resolve to teach the two semester course this academic year using a text that "attempts to fill a special niche in the undergraduate curriculum lying between a one-semester course in electromagnetism and the canonical first-year graduate course". This

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excellent book, "Classical Electromagnetic Radiation", is written by M.A. Heald and J.B. Marion.

THE SECOND PROBLEM

The second problem occurred when I started supervising a new Ph.D. student a few years ago. My co-supervisor was a colleague from the Department of Biology. We decided to combine the expertise of physicists and biologists in the hope of learning how ion beams could induce DNA transfer in living organisms. We had a very bright female Ph.D. candidate who sailed through all the physics courses. The trouble started when she wanted to take some biology courses. I always want my students to enroll officially in any course that they want to take. I do not believe in just attending a course as a "visitor" and not participating in the normal student-teacher interaction. To my amazement, our Ph.D. student could not find a single biology course in which she could enroll without having to take a series of prerequisite courses. Our graduate curricula in the Science Faculty are so rigidly structured that they do not allow for genuine interdisciplinary research. Now I have a request from another graduate who wants to do his Ph.D. thesis on a new type of polymer membrane for fuel cells. Naturally, I want him to study electrochemistry and polymer science. But he is a physics graduate and the academic road through chemistry is so dimly lit that he cannot find any chemistry courses without going through another ten prerequisites. It seems to be almost impossible for a graduate from one field to do graduate work in another. In this context, it is worth noting that the Nobel Physics Laureate Paul Dirac completed his undergraduate work in the field of mechanical engineering while the famous string theorist, Ed Witten, did his in history.

Compounding this problem, most newly-established interdisciplinary graduate programs in Thailand do not require students to take more basic science courses, as is normally required for graduate training. We are creating a new breed of researchers who have no depth of knowledge in any field.

Why can Thailand not establish strong graduate programs that have more than one track? By "strong" I mean for those candidates who possess good solid backgrounds in both of the fields they want to combine. We could reduce the number of required courses to a minimum. For example, a student could take only one semester for each of quantum mechanics, classical mechanics, electrodynamics, statistical mechanics and mathematical physics. Course loads could be maintained by substituting courses from other disciplines, provided that other departments were willing to cooperate. By this means, we could maintain strong and coherent interdisciplinary graduate programs.

The technological challenges that require immediate as well as long term attention demand teams of specialists as well as experts with solid multidisciplinary backgrounds. It seems to me that we can provide neither with our present educational system.

ADDITIONAL ANALYSIS

The idea of prerequisite courses started out as a means of preventing students from taking an easy way around difficult courses. However, this intervention in the free selection process ends up as a means of protecting certain courses by guaranteeing enrollments. An unintended effect may be to protect weak courses that might be strengthened by free competition with others. Departments would be well advised to ensure that weak courses are not given prerequisite status. Faculty Deans could play a more active role in encouraging two or more Departments to collaborate in support of interdisciplinary research.