IN THE OCEANOGRAPHY CLASSROOM

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UNDERGRADUATE OCEANOGRAPHY EDUCATION IN A GLOBAL WORLD

When I joined The Oceanography Society in its first year I did so because the society promised an international outlook on all issues of marine science. As it turned out, our society has struggled to keep that promise; it has been more successful in some areas (particularly with conferences) than in others. But I must confess that when I looked at recent issues of our magazine I felt disappointment about the regional imbalance of articles and contributions.

Our esteemed columnist of these pages, Dean McManus, retired at the end of last year. His insights and admonitions for educators and students alike were based on intimate knowledge of the North American education system and particularly on familiarity with latest initiatives of the US government and the National Science Foundation. His regular contributions are an act hard to follow, and our editor rightly decided that it requires more than one voice to replace him.

I am writing these lines before I hold the first issue for 2003 in my hands, so I do not know what issues will concern my co-columnist in volume 16 number 1. But I know that he is based in a North American educational institution; so I may define my role for these pages as the member of the team that provides a complementary view and talks about oceanography in the classrooms of the rest of the world.

There can be no doubt that the teaching of science is in crisis not only in the USA but in many countries around the world. As an attentive reader of Dean's column I got the impression that the US government recognized this and is trying to address the problem at primary and secondary school level, and the same appears to be true elsewhere: Soso-called K-12 education packages for marine sciences are available or being developed in the USA, in Australia and in other developed countries. As a teacher in the tertiary education system I am painfully aware that nothing similar is undertaken to address the situation in universities.

It is true that the situation in universities will improve if the situation improves in the secondary schooling sector. But the question is: Is is the situation of the USA (and for that matter, Europe or Australia) typical for the world? My own experience suggests otherwise, and it may be worth dwelling on this point with a few lines.

Over the last decades the western school system has moved away from rigid acceptance and memorizing memorizing of facts to a mode of instruction that promotes independent thought and development of one's personality. The degree to which this has occurred varies between countries, but I became acutely aware of the shift when I compared my son's Australian education during the 1990s with my own upbringing in Germany of the 1950s and 1960s. At least in Australia, today's high school students learn not to believe everything the teacher says, and they are taught to develop their own opinion about the truth and balance of newspaper reports.

Hopefully, this clearly positive paradigm shift in education will equip students with the skills of independent thinking required in a rapidly changing world, in which the dissemination of information is increasingly controlled by a few media conglomerates. Unfortunately it comes at a price. The "hard part" of the learning process, the tedious exercising of dull but necessary numerical skills has gone out of fashion because it is not seen to contribute to personality-building. But much of modern science is based on applications of numerical and analytical skills, tools that took scientists centuries to develop and that should not be discarded lightly.

My experience with university students indicates that primary and secondary school education in Africa, South America and Asia still follows the model inherited from colonial times. Students from these countries still find it hard to accept that the professor might be wrong, but they do not have a problem when it comes to using complex number notation in a differential equation. The result—unfortunately, and this is not a recommendation for the Australian education system—is that when I think of my good graduate students I find more of them in the Philippines, Tanzania or Brazil than in Australia.

It would of course be wrong to conclude that we should all return to the colonial education system. The challenge for the secondary school system is how to combine the promotion of independent thought with the acquisition of the skills required to perform well in fields such as physics or oceanography. The various initiatives at K–12 level are designed to meet this

challenge, and hopefully we can expect to see positive change during the next decade.

The challenge at university level is of a different kind. While the preparedness of students in mathematics has decreased, enrollment numbers have increased. At undergraduate level this has lead to very heterogeneous classes. Thirty years ago an undergraduate physical oceanography class consisted of a handful of students, who all aimed at a career in physical oceanography or a related area of science. In today's university environment such classes would be considered uneconomical and would be cancelled. Instead, a similar handful of oceanography students are now dispersed in classes of sixty or more students, drawn from various courses across the university including archaeology, ecotourism, aquaculture, law and others to make the teaching process economically viable. The lecturer faces a class with great variation of skills and preparedness, and the challenge is how to satisfy the intellectual needs of all students in the class. The lecturer cannot go over the head of the less scientifically inclined, but if the aim to train physical oceanographers is still one of the objectives of the class, the lecturer can also not afford to bore the better prepared students until they drop out of the course.

The change of course management from decisions based on socio-economic needs (where the teaching of a small class of physical oceanographers is justified as an investment of society into its future needs) to decisions based on microeconomic gain (where a course is only justified if the income derived from the class justifies employment of the lecturer) has changed the role of the lecturer dramatically.

During my own student days lecturers concentrated on transferring the skills of their particular science discipline to the students. Whether the students found the process entertaining or painful was not considered important and did not, in any case, impact much on the students' decision to take the course. In today's universities the lecturer has to "perform". The university cannot afford to lose a single student; so the administration monitors drop-out rates and grade distributions, and an unpleasant interview with the Dean awaits any lecturer who cannot keep students in a course. But an undergraduate course in oceanography brings together students from archaeology to fluid dynamics, and keeping students of such diverse background and expectations in the same course does not come naturally to someone who was never trained in the performing arts. Universities therefore offer training seminars, where the young scientist who, for some reason or other, chose to apply for a university position, is taught the rudimentary skills of the educator's trade.

Again, it would be wrong to conclude that I am suggesting a return to the days of lecturers with no educational skills, when students sometimes failed only because of unintelligible presentation of the material. Good university lecturers love to teach and derive job satisfaction from the success of their students. But the change from teaching a small homogeneous group to teaching a large heterogeneous class is not only a change of quantity, it is change of quality as well. When I talk about geostrophy or the Sverdrup equation in a small well prepared class I derive satisfaction from observing how each student absorbs the ideas and can derive them from Newton's Second Law. When I talk about the same material in front of a class of sixty or eighty students of varied background I have to concentrate on keeping their attention, so I restrict my presentation to the basic underlying principles, embellish them with anecdotes from my days at sea during WOCE[1] and derive satisfaction from the attentive faces in the audience. The result is that less science is transferred, and the question remains: Is this the best use society can make of an oceanography lecturer?

The laboratories that accompany the lectures pose other challenges. In addition to the obvious logistic problem of organizing laboratories for large classes, it is in the laboratories that the heterogeneity of a class becomes really manifest. But the laboratories also offer an opportunity to tailor the material to the capabilities of the individual students. Making laboratories interesting and challenging without overtaxing the students is therefore an important means to keep a heterogeneous class together. My own answer to both the logistics and the educational challenge has been the introduction of computer based laboratories with different levels of mathematical explanation and content, which allows students to choose how deeply they want to dive into the underlying theory of each exercise.

Because I made the exercises and other teaching material available on the web they have been taken up by university teachers in all continents. While I can easily understand the motivation of colleagues in the USA and Europe to make use of them, I always suspected that universities in South America, Africa and Asia use my material more because of a shortage of resources rather than a conviction that it is particularly suitable for their students' needs. My suspicion was confirmed a year ago when the South East Asian START[2] Regional Center asked me to prepare a special version of my material with focus on South East Asian waters. I was told that Asian students could handle more theoretical background and that I should therefore include more mathematical derivations. I just wish I receive a similar request from my own university one day!

I filled my space for this issue, and I have not even touched on the situation of graduate teaching. I see these pages as an invitation to debate and a collective quest for solutions and hope that they will spill over into the Letters to the Editor pages.

[1] WOCE: World Ocean Circulation Experiment
[2] START: Global Change System for Analysis, Research and Training