How Broad is Your Course?

By Simon Boxall

Within my faculty, at present, we have a bit of a dilemma. Some of my colleagues feel that students should focus much more on a specific area of oceanography at the undergraduate level. If, for example, marine biologists don't do much more animal physiology and genetics, they might be excluding themselves from potential careers in other walks of biology. Physical oceanographers should do far more mathematical theory and equation derivation, and be fluent in a number of programming languages, to ensure that they are ready for a research career in modeling. Chemists—well, the list would entail a set of courses the length of which would make a degree in medicine look simple. The balancing argument to this narrowing of focus is that oceanographers (including marine biologists) are scientists of the sea and as such should have an appreciation of the wider picture before narrowing down to a specialization at either the master's or the PhD level. From talking to other educators, it is dilemma that is under discussion at many universities around the world.

In an earlier article in this journal, I discussed how students coming up through the school system into university now have a broader education base than was the case maybe 20 or 30 years ago. They are less able to determine what career path they may take in the future, so a broad science degree in one of the key disciplines may be best for them (biology or physics, for example) or, if they are determined to stay in marine science, then having a broad overview of the science of oceanography still keeps doors open for them. It is difficult to make a switch from physics to marine biology without significant new learning, but (to avoid a stream of letters from those who have done so) not impossible.

Worldwide, it is estimated that about 70% of graduates do not practice the field in which they earned their degrees. Instead, they go into business, accounting, teaching, and so on. Before you ask "where's the evidence?" as I would of a student's essay, I will admit that I picked up this factoid from a number of different places without the full facts behind it, so C– for me. However, a report by the UK Office for National Statistics (2013) shows that 50% of graduates end up in jobs that do not even need a degree, so that 70% is not far off the mark. The experience of our own undergraduates, however, is that over 70% stay in marine science, and so undertaking an alternative degree in a single science subject such as physics or biology would seem less critical to keeping job opportunities open in, for example, astrophysics or biomedical science, as they stay in marine science anyway.

When I did oceanography as a degree, the focus was very much on physics, which was great in many ways and certainly was not an issue with continuing in oceanography. However, it took me some years to be able to put what I was doing into a bigger picture, and it was only by working in ocean color for a few years that I developed a wider appreciation of subjects such as plankton biology and suspended sediment dynamics. Current undergraduate courses offer a broader understanding in the finer points of, say marine chemistry or marine biology—I would find it difficult to pass an exam at today's final year level in many areas not directly related to my research or area of study without quite a bit of reading and revision. Students will often assume when asking one of their professors a question outside his or her area of expertise that the professor is being obtuse or is trying to get the student to figure it out for his or herself, when in reality the professor really may not know the answer!

Not having covered particular areas or subjects at the undergraduate level does not exclude bright scientists from working in those areas. They will be able to study around the topic, and, at a research level, a degree only provides the skill set needed to study and learn aspects of the wider subject area. A student came to see me recently in a panic that his chosen final year research project involved Fourier analysis, and he was concerned as he had only a brief understanding of the technique. I pointed out that no one is born with this ability (even Fourier) but if it was the only new technique he had to learn this year, then that was a reasonably easy task for even a moderately bright student.

Not having mastered the breadth of a subject can lead to errors and mistakes at the research level. A few years ago, a paper was released in a *very renowned international science journal* relating to a finding that phytoplankton levels in the world ocean changed significantly between the 1980s and 1990s. The study relied heavily on remotely sensed ocean color data collected over a 25-year period. The findings were so significant that another (or the other) *very well renowned international science journal* asked a few people to review the paper, myself included. Within the first page, it was obvious where the error in the findings were. In the 1980s, the Coastal Zone Color Scanner (CZCS) was the ocean color sensor of choice—in fact, the only one. The late 1990s brought a new generation of sensors, but there was a big time gap since CZCS, and much of the older CZCS data needed recalibrating to give a more accurate measure of chlorophyll in keeping with those from the newer instruments. To anyone working in remote sensing (and to all those asked to review the published article after the fact), it was an obvious issue with the findings, but to anyone else (authors and initial reviewers), it was a paper worthy of publication in a top journal.

There are many aspects of the work I do where I rely substantially on colleagues to fill in knowledge gaps, and I still revert to undergraduate texts to boost my own understanding of aspects of marine science that I never studied. The very nature of oceanography makes it a field where collaboration is key. This is because it is an expensive subject to study, needing multinational and multi-institutional collaboration to afford the fieldwork. It is because we work in other nations' waters and need permissions from those nations. It is because our ships work 24 hours a day, but we cannot (or at least most of us cannot). But, critically, it is because individually we cover one scientific aspect of what is a vast subject field, and we need collaborative science to achieve the outcomes we do. In a big international project called Fluxmanche that I was involved in some years ago, I provided input to physical measurements of flow and temperature-salinity (T-S) structure, but the project also needed modelers (numerical and physical), chemists (radionuclide, organic, and inorganic), biologists (zooplankton, phytoplankton, fish, benthic, pelagic…)—in all, a team of about 50 scientists.

This is all an argument for saying we should specialize and we should rely on specialists in a particular field. For big research programs, this is possible. Ask many of my fellow physical oceanographers at Southampton, and they would opt for a PhD candidate with a degree in mathematics or physics over a general oceanographer most of the time. But having examined a fair few PhDs, it is telling that often it is these students who produce outstanding numerical results but miss the key applications to the real ocean. Their lack of four years of working with ocean data and the broader environment as an undergraduate shows. In industry, the broader picture becomes more vital. Projects are individually more focused on the outcome—with little or no scope for blue skies research—but are also more varied from project to project. A scientist may be undertaking a side-scan survey in the North Sea for a wind farm one month and looking at flux of a potential contaminant out of an estuary the next. Here, a degree in mathematics or physics is significantly less applicable on its own.

Over time, my experience is that it makes limited difference whether a scientist trained in oceanography or biology or mathematics—10 years on from a first degree, that first degree becomes far less critical if a person has worked in marine science in the post-degree years. Some of those individuals will tend to stay in their narrow chosen field and produce outstanding research. Show a numerical modeler a microscope, and then spend hours of fun watching that person try to use it. Similarly, show a plankton ecologist 300 lines of Matlab code, and then watch the head scratching for a similar length of time. Some will have a broader appreciation of oceanography—I can use the microscope, but producing a detailed analysis of what I can see is another issue… I can produce the Matlab code but, unless it is processing observed data, the modeling of El Niño-Southern Oscillation (ENSO) events is more of a mystery.

I still have no real feel for what works best, and after many years in oceanography I tend to think we need both. The broader oceanographers act as the essential glue that brings the finely focused experts together. So whichever science degree you might be thinking of embarking upon, or have completed—we need you all.

REFERENCE

UK Office for National Statistics. 2013. *Graduates in the UK Labour Market 2013*. Office for National Statistics report dated November 19, 2013, 31 pp., http://www.ons.gov.uk/ons/rel/lmac/graduates-in-the-labour-market/2013/rpt---graduates-in-the-uk-labour-market-2013.html.

AUTHOR

Simon Boxall (srb2@noc.soton.ac.uk) is Associate Fellow, University of Southampton, National Oceanography Centre, Southampton, UK.

ARTICLE CITATION

Boxall, S. 2015. How broad is your course? *Oceanography* 28(3):228–229, http://dx.doi.org/10.5670/oceanog.2015.74.