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Educating spectrocopists

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"And the light shineth in darkness; and the darkness comprehended it not."
King James Bible, John 1:5

Health warning!

Now maybe I'm going to be a little controversial in this month's column and I might just touch a nerve in the readership. If you are of a nervous disposition or are easily upset, this column may damage your health! However, I can't stop worrying about the miss-match between what we teach undergraduate students about spectroscopy and what they will be expected to understand about our subject when they finally end up in gainful employment.

Obviously I have a passion for spectroscopy; maybe this is rather a strange statement, but I believe that we have a fantastic range of tools at our disposal with which to study, observe, diagnose and monitor the world around us. This extends from the material to the biological world, from the mechanical to the astronomical, from the steel plant to intensive care wards. But does the content of the spectroscopy syllabus allow this breadth and power to be conveyed in such a way as to enthuse and motivate undergraduates or are we putting off the next generation of recruits to our cause by not evolving to meet their needs in a modern world?

First, a disclaimer! Obviously, my own experiences are limited to what I have observed in the UK, Germany, USA and from what I have gleaned from students I have had the pleasure to help from various parts of the world. However, to make up for my own limitations I hope you will contact us with your own views, and I have also put together a short survey in order to give you the opportunity to let me know your own experiences, as students, students who have entered employment, educators and employers.

Breadth vs depth

There are obviously certain analytical spectroscopic techniques which are found in almost all undergraduate courses which include spectroscopy around the world. Infrared, nuclear magnetic resonance, mass spectrometry (I can't resist the question whether this should actually be a separation science—just to annoy the MS experts!?). However, they are often taught to a mind numbing level of detail where the students have increasing difficulty in grasping not only the complexity of what we are teaching but more fundamentally have problems in following the advanced mathematics involved.

In the workplace, almost all of this depth is not used. It is far more likely that a range of spectroscopic techniques are available and the newly employed graduate will be called upon to decide which technique is the most appropriate to employ—or even which technique or combination of analytical techniques from the range at their disposal is the least inappropriate and the one most likely to deliver a result which is fit-for-purpose.

It is obviously a good thing that far more people have access to higher education in the 21st Century than 30 years ago, but this does mean a far broader spectrum of people are feeding our universities and the current school timetable has in many areas evolved out of all recognition from what the university lecturers experienced when they were at school.

Additionally, the students sitting in front of us are increasingly not studying purely Chemistry and Physics, but have been assigned modules which include analytical spectroscopy by course organisers who recognise the importance of our subject across a wide spectrum (pun intended) of scientific education. To what degree should we be adjusting our teaching to meet this wider audience, both in terms of the prior knowledge they posses and their more diverse long-term goals?

I see far more students than in the past who have come later in their lives to further education. Their demands and expectations from their educators are sometimes subtly and quite often not so subtly different from their younger peers. They bring to the courses a far more "grounded" approach to higher education, with a requirement that what we teach is more closely linked to their employment prospects! In this respect I believe we must look closely at the relevance of what we are presenting and weigh our content more closely against the backgrounds of our students and the uses to which our content will be put when they leave our organisations.

Differing approaches

In many universities educators like to teach the subjects which are closest to their hearts. These are often the subjects

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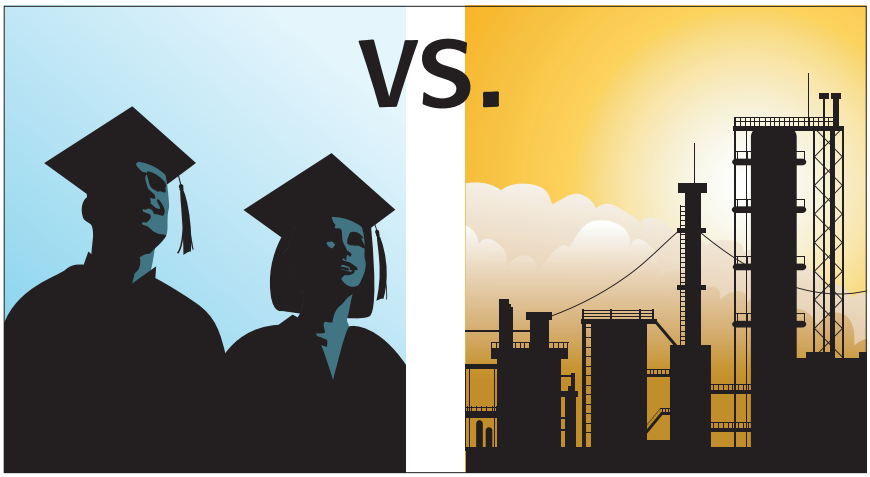
in which they themselves are actively involved in advanced research and therefore know in great depth. This is obviously a huge advantage for those students who are contemplating going on to advanced study to get the best these experts can offer, often including insights into the latest developments in their respective fields—but I would like to pose the question whether this superb in-depth knowledge is in fact a hindrance in teaching the ~98% of our students who will not go on to research in spectroscopy?

Now obviously I am on dangerous ground and dealing here in very unsubtle generalities. Clearly we have excellent educators whose personal styles and experience arm them with the techniques to bring across their course content without "blinding their audience with science" but it might just be better to have courses and modules presented by educators less intimately coupled in their own lives to the subject matter they are teaching. I would hope that we would see a more balanced approach to the topics and an impartial discussion of the merits and drawbacks of the spectroscopic techniques being taught.

Maybe more emphasis should be made on sampling and the chain of custody, including how robust each technique is against poor sampling. Hyphenated techniques where quantitation and identity can be determined by one instrument should have a higher profile. More detail should be provided about the financial aspects involved in purchasing and maintaining the equipment. Why are we not discussing the return on investment for spectroscopic equipment? Why do our graduates not have any idea about the long-term maintenance burden of spectroscopic systems when, in their new roles in industry, they may well be involved in influencing purchasing decisions?

Polishing our image

Several years ago we organised in Germany an excellent public demonstration of all the wonderful uses to which spectroscopic research was being put—various projects were exhibited and some superb public lectures from eminent



invited speakers were well attended and generally well understood by the general public, as the link between the academic and applied research to their daily lives was made clear. We were very happy that the local television channel decided to feature our event. But were horrified when it was finally broadcast, as the piece closed with the interviewer wandering around the local university campus capturing sound bites from arts students about why none of them had decided to study a science subject and the almost unanimous response was that it was far too hard a subject!

Maybe you would agree that we are trying to teach a subject which is hard, but I would challenge this as fundamentally inaccurate. Most spectroscopy can be put into a context which has direct relevance to the daily lives of our students. The actual uses to which our spectroscopy is put and the information which the different techniques generate make it much easier to comprehend than some obscure theoretical treatment of the works of Friedrich Nietzsche where your grades are often more influenced by how close your opinions match those of your lecturers rather than on your understanding and application of facts!

Conclusion

I hope I haven't alienated the entire spectroscopic *(and philosophical—Ed.)* community, but I would like to try to stimulate some debate. Obviously the study of advanced spectroscopy requires that a great depth of specialist knowledge is taught to those embarking on this course, but I am increasingly worried that this should not be the norm amongst the vast number of students whose use of their spectroscopy education will be as generalists.

On a final note I believe that we currently are observing a less than overwhelming uptake of the more advanced spectroscopic techniques in fields such as medicine and various areas of process analysis, where they would be of clear benefit due to the progress of modern, non-invasive and real-time techniques. Is it possible that this may also lie in our own inability—and the inability of those whose education lies in our hands—to "sell" spectroscopy in terms which make sense to those who control the purse strings?

Have your say

Anyway, I hope that this discussion has at least driven you to think about experiences you had during your own spectroscopy education, or what you yourself are currently teaching. Maybe you fundamentally disagree and believe everything is fine with the world as it is—or believe that the graduates you are employing know everything they should when they enter your laboratories? Whatever your opinion we would like you to let us know by taking two minutes to drop us a quick e-mail (feedback@spectroscopyeurope.com) or complete the short response form available at http://www.alis-consult.com/education.html.

Thank you in advance!