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COMMENTARY

Integrated interdisciplinary training in the radiological sciences

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ABSTRACT

The radiation sciences are increasingly interdisciplinary, both from the research and the clinical perspectives. Beyond clinical and research issues, there are very real issues of communication between scientists from different disciplines. It follows that there is an increasing need for interdisciplinary training courses in the radiological sciences. Training courses are common in biomedical academic and clinical environments, but are typically targeted to scientists in specific technical fields. In the era of multidisciplinary biomedical science, there is a need for highly integrated multidisciplinary training courses that are designed for, and are useful to, scientists who are from a mix of very different academic fields and backgrounds. We briefly describe our experiences running such an integrated training course for researchers in the field of biomedical radiation microbeams, and draw some conclusions about how such interdisciplinary training courses can best function. These conclusions should be applicable to many other areas of the radiological sciences. In summary, we found that it is highly beneficial to keep the scientists from the different disciplines together. In practice, this means not segregating the training course into sections specifically for biologists and sections specifically for physicists and engineers, but rather keeping the students together to attend the same lectures and hands-on studies throughout the course. This structure added value to the learning experience not only in terms of the cross fertilization of information and ideas between scientists from the different disciplines, but also in terms of reinforcing some basic concepts for scientists in their own discipline.

The two main fields of radiation medicine, radiology and radiation oncology, are both becoming increasingly interdisciplinary, both from the research and the clinical perspectives. Just to consider a few examples, and every reader will no doubt be able to think of others:

- to assess the utility of single nucleotide polymorphisms as predictor of treatment response, a reasonable knowledge of biostatistics is essential
- to assess the rationales behind different approaches to chemoradiation, a working knowledge of molecular biology is important
- to understand what we know of the risks (or lack of risks) associated with CT scanning, a reasonable knowledge of epidemiology is required
- to understand the pros and cons of proton and/or carbon ion radiotherapy, a working knowledge of nuclear physics is needed.

Beyond such clinical and research issues, there are very real issues of communication between scientists from different disciplines. Discussed below, and much commented on in the literature,[1] there is little doubt that interdisciplinary communication can be a major barrier to effective basic and clinical research—in short, different disciplines frequently talk different languages!

From all these perspectives, there is an increasing need for interdisciplinary training courses for practitioners in the radiological sciences. Of course, training courses are common in biomedical, academic and clinical environments, but they are generally targeted to scientists in very specific technical fields. In the era of multidisciplinary biomedical science, there is a need for highly integrated multidisciplinary training courses that are designed for, and are useful to, scientists who are from a mix of very different academic fields and backgrounds. Whilst there have been reports[2] of a few interdisciplinary "partners", such as radiology and anatomy, being taught in an integrated way, most have not.

We briefly describe here our experiences in running such an integrated training course for researchers in the field of radiation microbeams, and we draw some conclusions about how such interdisciplinary training courses can best function. These conclusions should be applicable to many other areas of the radiological sciences.

The field of biomedical microbeams[3] is highly multidisciplinary, involving physicists and engineers, who design, build and operate sources of submicrometer radiation beams, and biologists in a variety of very different subdisciplines, who use these machines to address a wide variety of different biological questions. Over the past 20 years, there have been a series of highly successful biannual microbeam workshops[3–8] attended by scientists from all these (and several other) disciplines. Nevertheless, one aspect that this workshop series has repeatedly highlighted is the difficulties that physicists have in talking to biologists, and even that engineers have talking to physicists.

In this light, we initiated a multidisciplinary 3-day annual training course in the field of biomedical microbeams. This course has now been run for 3 years, and extensive formalized feedback from the participants has provided some insights to what is and is not effective. The broad goal was for physicists and engineers to understand a variety of biological concepts and issues and for the biologists to understand a variety of high-tech physics and engineering issues. In summary, we found that it is highly beneficial to keep the scientists from the different disciplines together. In practice, this means not segregating the training course into sections specifically for biologists and sections specifically for physicists and engineers, but rather keeping the students together to attend the same lectures and hands-on studies throughout the course. This structure added value to the learning experience not only in terms of the cross-fertilization of information and ideas between scientists from the different disciplines but also in terms of reinforcing some basic concepts for scientists in their own discipline, which may have been forgotten or not fully appreciated in the context at hand.

In our training course, it is not feasible to teach physicists all relevant aspects of biological theory and practice, nor to teach biologists all aspects of beam transport, radiation physics, etc. Our goal has been to find the optimal balance between the basic scientific concepts in each discipline and the practical issues relating to microbeam use. Central to finding this balance has been an extensive course evaluation programme, based on a standard reaction/learning/behavior/results model,[9] and through these evaluations, the training course has been significantly modified during the first 3 years of its offering. Based on participant feedback, for example, we increased emphasis on "hands-on" training (both engineering and biology), but again where physicists, engineers and biologists are working closely together during the training sessions.

Online training is, of course, becoming increasingly utilized,[10] and we have initiated a virtual online version of the microbeam training course (raraf.org/educationalmaterials.htm). Here, the issues are slightly different in that there is less direct motivation for, as an example, physicists and engineers to virtually attend the biology segments, or vice versa. Our solution has been to strongly interlace the different online course segments, so that it becomes apparent to the student that there is added value in taking all the segments. We have set up site monitoring software to assess our success in this regard, but this aspect remains a significant challenge.

It is important to note that these considerations are in the context of trainees who already have some working knowledge of each of the disciplines involved. One could not necessarily apply these approaches to the teaching of undergraduates or medical students, who have a more limited background knowledge of the relevant disciplines—and indeed mixed results have been reported for integrated training programmes in these contexts.[2,11]

Finally, it should be pointed out that, despite the utility of our course evaluation programme, we do not have objective criteria to quantify the benefits of an integrated training approach relative to more segregated models. Standard course evaluation theory,[9] while useful in improving a given training course, is not designed to compare one training technique with another, and, indeed, it is hard to see how such an objective comparison might be accomplished.

In summary, the demand for interdisciplinary training for scientists and clinicians in the radiological sciences will undoubtedly increase over the coming years. Our experience has been that strongly integrating scientists from different disciplines within such training courses will result in a significant increase in effectiveness. The end product should be both better scientists and better communication between scientists.

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