EUROPEAN FEDERATION OF
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Education and Training in Biotechnology: A Concerted Approach

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Introduction

One of the central elements within the scope of this project is a study of the core curriculum of undergraduate and postgraduate courses and programmes of study. From such a study common elements would be identified for a variety of programmes of study and such information could be utilised beneficially in a number of diverse ways as will be discussed. Having in this way identified what should be in the curriculum, the next area of interest in this project was to ensure a high quality of delivery facilitated by the design and implementation of relevant resource based teaching/learning materials for both core and non-scientific support areas. This, in turn, leads to the final strand which is concerned with monitoring, maintaining and enhancing the quality of provision through formal quality assessment and control mechanisms, thus closing the loop. Each of these three constituent elements will be discussed in the present communication.

Curriculum Review

The approach which was adopted was to invite a number of universities and institutions Europe-wide to submit printed copies of their curricula. The content of these have been analysed using a number of specific, broad topic headings together with over 150 sub-headings.

The preliminary overview or summary results to date for both undergraduate and postgraduate courses will be fully discussed. The full analysis describes the following aspects of the study in detail including problems in obtaining information, problems in deciphering the information, reliability of the data, problems with the definition and scope of biotechnology, general matters relating to the analysis and data interpretation.

Multidisciplinary Support Elements

As indicated earlier, the curriculum review represents one element of a much larger integrated project and the results are being used to inform the work of the other activities within the project and with other related projects.

One such area is concerned with the need for biotechnology graduates to acquire additional skills in non-scientific discipline areas. A recent report released by the US National Academy of Sciences (NAS) advocated the inclusion of elective courses in business, law, education, and public policy into the curriculum for all scientists seeking doctoral degrees. In every segment of society, not just science, the notion of an education that leads to a single lifelong career has virtually disappeared. Analysts expect the jobs of the future to go to those who embrace *lifelong learning* in order to adapt to changing market needs.

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In reviewing the skills that will be required by postgraduate life scientists as we move forward in a new millennium, the focus has moved from subject specialisms (which are largely catered for through regular curriculum review and quality assessment) to what has been referred to elsewhere as *parascientific education*. This global term encompasses a broad range of multidisciplinary skills in order to better prepare the science graduate to be more adaptable/flexible to a fast changing and complex job market. The broad topic areas deemed essential for this purpose are business, law, education and public policy which subsume such considerations as communication skills, formulating professional goals, mentoring, data management, fiscal issues, technology transfer, licensing, entrepreneurship, assessment of commercial potential, business plan development, venture capital, stock market issues, strategic management, corporate decision making, deal structures *etc.*.

The EFB Task Group on Public Perception of Biotechnology agreed to develop a series of short, credit-bearing 'elective' units which could be used and promoted as a formal element of the PhD programme in a series of European universities. Each unit would be the equivalent of 40 hours of learning, comprising of ~10 hours of formal material (could be presented in a variety of formats from lecture, block summer school to distance or open learning), with about 2 hours assessment (summative or continuous) and the remainder being self study (possibly directed, in part). Delivery of the units could be supported by local lecturers who would deal with the relevant assessment strategies and associated seminar and practical classes. Each discrete programme of study would be extensively trialled before the formal launch of the material. The unit on Entrepreneurship has now been fully developed as a pilot for the other units and is formally incorporated into the Eurodoctorate in Biotechnology (EDBT) scheme as developed and promoted by the European Association for Higher Education in Biotechnology.

Enhancing Teaching Delivery

Since the early 1970s, there has been a vast and unrelenting increase in the knowledge base in the subjects encompassing biotechnology. Because of this we have tended to concentrate on factual information and to over-emphasize this with our students - one only has to look at final exam papers to see that this is indeed the case! This has resulted in *information overload* and has been shown to be a disservice to our students, particularly since the average half-life of the information that we are exposing them to is of the order of 4-5 years - hardly sufficient to see them through their subsequent careers.

Clearly, what is required is for us to teach our students 'how to learn' from the vast array of information that is available. In this way they have the opportunity to develop their own processing, problem-posing and problem-solving abilities and it is these skills which will serve them well in incorporating further new information and concepts as these arise and in adapting to inevitable and inexorable change.

The way we present information to our students is critically important to the success of education - teaching and learning, content and process represent an inseparable whole. It has long been held that the most effective learning comes as a result of 'doing', of using the information, and therefore we should be promoting active learning with our biotechnology students. A distinction is now made between what are termed *deep* and *surface* learning and it is generally accepted that a key element which impacts the approach adopted is the nature of the assessment methodologies. Interestingly, this has recently been recognized and accepted and has become a key issue with a number of academics and with a very diverse group of professional bodies which have an interest in education and training.

Quality Assessment, Control and Enhancement

The adoption of formal quality assessment procedures for graduate courses continues to be on the increase. The primary purpose of these systems of quality assessment are to inform funding agencies/Government bodies and potential students, employers and the general public of the quality of teaching and learning in the full range of subjects offered by the universities. This is being achieved through a variety of methodologies, often resulting in a final report which highlights the strengths and weaknesses of teaching and learning in a specific discipline area for each of the universities offering relevant courses in this discipline. The methodologies include the generation of a self-assessment document, formal visits, teaching observation, meetings with students, meetings with select and variable groupings of staff (academic, technical and administrative), and assessment of facilities which support the teaching and learning process. An equally valuable and important aim for the process is to

help to disseminate good practice amongst all institutions and so encourage continuous quality improvement.

Conclusion

From such diverse activities it has been possible to identify the educational and training requirements for the modern biotechnology industry and the challenge now is to ensure that the quality of provision and delivery are sustained and enhanced in order to maintain a high quality workforce capable of steering the biotechnology industry to high impact and high value successes in the future.