

Essay

## Biology Before and After Bologna

Charles Susanne

Free University of Brussels, Pleinlaan 2, 1050 Brussels, Belgium

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### Abstract

*Biological Science has widespread implications in medicine, biotechnology, agriculture, the environment, and so on, and is also an exponentially-growing subject area. The training of biological science graduates in Europe is a matter for concern since within the European Community ('EC', which is also about to expand) there is free movement of labour, which means movement of graduate and postgraduates between universities and into industries. The Bologna Process aims to standardise training and qualifications within the EC, so as to facilitate this movement and employability. There are also implications for the autonomy of universities as the number of people entering increases but governments are less and less willing to fund the institutions. This paper deals with the challenges faced by biological science at the present time, considers what a basic training in Biology might entail, likely consequences of deregulation and 'privatisation', and goes on to analyse the implications of recent EU directives and the role and aims of industry.*

**Keywords:** Bologna process, training in biological sciences, credit accumulation and transfer

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### Introduction

As a result of the signing of the Treaty of Maastricht, the European Union has taken on responsibility for some of the collaborations between member states (126 programmes in education, 127 in vocational training, and 130 in research). The programme SOCRATES came out of the evolution of the ERASMUS programme and is taking into account experience with previous ICPs, but is also centralising much of the university level effort.

Biology now encompasses a wide diversity of discipline areas, and there is increasing international concern about global change, degradation of natural resources, reduction in biodiversity, water- and air-pollution, long-term disposal of hazardous wastes, and the decrease in the ozone layer, for example. Biological knowledge is important for local and/or global solutions to try to provide a healthier environment. Other global biological issues are linked to health (e.g. cancer, cardiovascular disease, AIDS), malnutrition, population growth, as well as concerns about biotechnology and gene therapy.

In the biological sciences, universities will need to adapt if they want to maintain their relevance to traditional vocations in the 21<sup>st</sup> century as well as their relevance to Society in general. Indeed, the knowledge and know-how

possessed by university people will be essential in the many societal changes we face. Therefore teaching should not only consist in giving information, but should train students to seek information for themselves. New concepts must be incorporated into the Biology curriculum as the science develops and grows – but not at the expense of maintaining a broad scientific base. New discoveries have meant that there has been a tendency for specialization, and polarization between, for example, molecular biology, organismal biology and ecology, whereas in fact the biologist has to understand the whole of Biology in order to function properly in research. However, the increase in specialization in the biological disciplines has had the result that no single university can cover the whole range. Consequently collaboration and networking are vital, and this problem can only increase.

There are other challenges which are of industrial, ethical, educational and even political origin. *Industrial* challenges come from an increase in the attraction of biotechnology and business to biology graduates and *ethical* because biologists get drawn into ethical discussions about the limits and/or dangers of certain techniques and may have to explain them. In *political* terms, the general public is increasingly aware of the problems associated with the deterioration of the biosphere, the effects of pollutants and acid rain, the thinning of the ozone layer and global warming. Biologists have a role to play in drawing attention to these issues, and initiating policies as well as assisting in the formulation of long-term policies. There is also an *educational* role because biologists need to help in educating the general public about the underlying principles in biotechnology or about ecological problems and the ethical issues involved in these.

A European network in Biology will have a number of different responsibilities [Susanne, 1995], including joint meetings within a given discipline as well as supporting meetings across sub-disciplines; promoting common graduate and postgraduate courses, proposing curriculum development especially at the MSc and PhD levels, and regulating the European PhD. It will also participate in the development of a European Credit Transfer System (for Biology), facilitate exchanges of staff and students, contribute to public education and continuing education and the creation of distance teaching materials, generally promote the application of biological knowledge for the advancement of human well-being, promote geopolitical cohesion, and facilitate the mobility of scientists. Of course, EURO BIO already aspires to some of these aims [[www.vub.ac.be/gst/eurobio](http://www.vub.ac.be/gst/eurobio)].

### **Basic training in Biology**

The content of Biology taught in the first years of university courses in universities throughout Europe is rather similar, although there is a great deal of variation in the weight given to the different methods of teaching, i.e. lectures, seminars, team work, interactive work in groups, project work, laboratory work, field exercises, computer work and thesis writing. The study of Biology requires an adequate background in mathematics and statistics, IT skills (for analysis and modeling), physics and biophysics, chemistry, especially organic, biochemistry, geology and paleontology, and the different

levels of organisation from biomolecules, through cell structure, organisms, populations and biosystems. In addition, there should be an awareness of the responsibilities, in other words, of ethics and the philosophy of science. Therefore, courses should include cell biology (ultrastructure of cells and organelles, cell division, the nature of prokaryotes and eukaryotes), the biology of organisms (i.e. histology, embryology, growth and development, general and comparative physiology), systematics (taxonomy and taxonomic principles, phylogeny, classification of flora and fauna), genetics (DNA and the genetic code, protein synthesis, gene action, mutagenesis, patterns of inheritance, etc) as well as population genetics (i.e. evolution, selection, migration, genetic drift, mutation, speciation, etc), ecology (the biosphere, ecosystems, population growth) and evolutionary biology and anthropology.

A broad education is now more than ever needed in order to avoid to prevent misunderstandings. We need to nurture, through education, a humanistic approach, establish basic human rights, and a respect for democracy. In an uneducated consumer society not accustomed to critical ways of thinking the only dominating features are the acquisition of wealth, and technology, which set the rules of the game. Thus a basic training should aim to build bridges between different disciplines and should focus on a range of techniques and skills. All universities should endeavour to present this core programme although inevitably there will be some variability because of institutional specialisms.

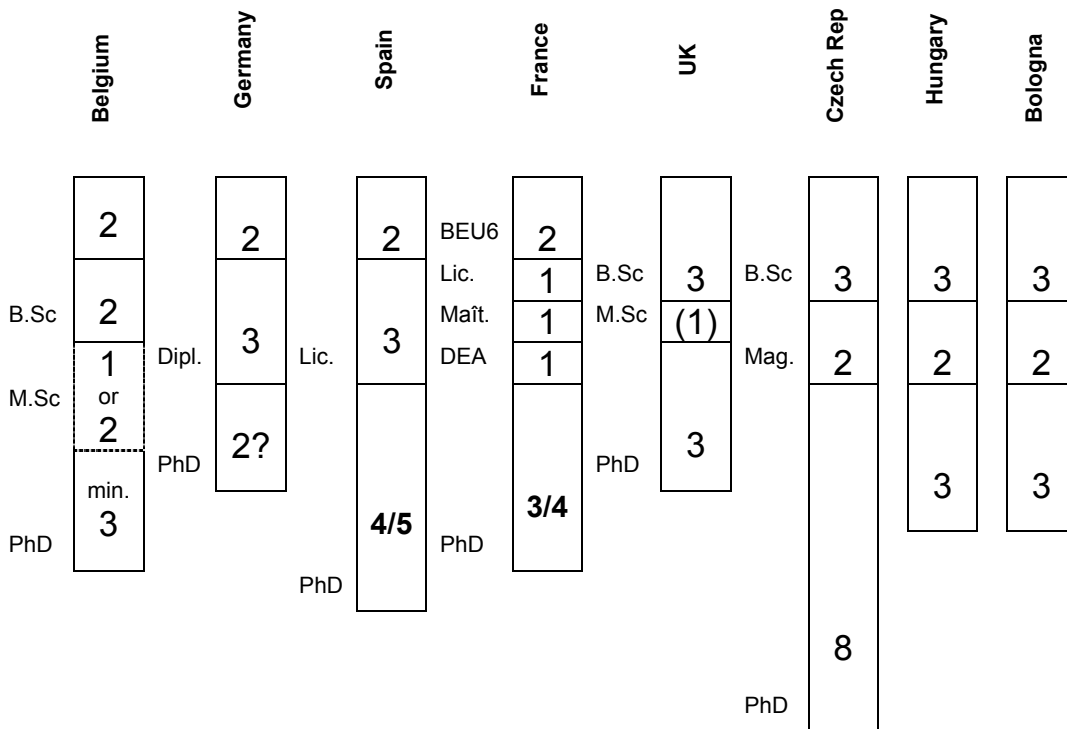
The teaching should not only include lectures but also laboratory work, seminars, research projects, field studies, and technical training. Furthermore, the amount of practical work should be sufficient to give students real experience and training because Biology is an experimental subject [Susanne, 1995]. The basic training for the degree of BSc should occupy three years and in it there should be some professional goals.

### **Masters level degrees**

Because of the exponential increase in biological knowledge, specialisation within programmes is inevitable: it is impossible to cover adequately the whole of Biology at an advanced level, and therefore a choice has to be made. The Masters phase should take two years, and should also be orientated towards development for professional activity or research. This phase will be very diverse within the institutions of the EU not only because of their pedagogical decisions about what they wish to teach but also because there are a limited number of specialist professors in each institution thus limiting the topic areas that can be taught at this level. Differences between universities in the EU will result in there being a great variety in the curricula in terms of topic specialisation, preparation for a range of professions, preparation for careers not needing a PhD and preparation for research careers (normally PhD). This system has many advantages with respect to internationalisation and the complementation of curricula. Some documents imply that a specialised staff of about 30 are required for mounting a Masters degree programme and as many as 80 are required for operating a graduate school for PhD. Clearly for

each postgraduate programme it may be necessary to organise collaborations and look for synergies within Europe.

The joint declaration of the European Ministers of Education emanating from Bologna in June 1999 affirmed support for universities' central role in developing European cultural dimensions and supporting the citizens' mobility and employability. The following proposals were made: that there should be an easily understandable system with comparable degrees, based on two main cycles: an *undergraduate* cycle (BSc) lasting a minimum of 3 years, followed by a *graduate* cycle consisting of a Masters degree (2 years) and a Doctoral degree (3 years). However, as Fig. 1 shows, actual practice within Europe is extremely diverse. Table 1 shows some examples of how things are, with the length of some degree programmes being determined at ministerial level (as in Italy) or in some countries such as Belgium and Spain, at the level of individual universities.



**Figure 1** Times spent on BSc/MSc/PhD in various countries in comparison with the Bologna suggested times.

### Critical analysis of the EU directives

Commencing in the 1980s, organizations of industrials, the OECD, the IMF, the World Bank, and the EU “discovered” new resources – those of the public services, health, social security, pension funds, teaching, that could be taken over by the private sector. ‘Public education’ [i.e. by state schools and universities] would be replaced by ‘private education’, which would be a commodity to be sold. Indeed, private industry is already looking at the enormous public education budget. In France for example, it represents about

1200 billion Euros or 5–8% of GDP and employs ten million teachers. By comparison the automobile industry employs five million workers for almost the same annual budget.

**Table 1:** Some examples of the teaching system in Biology with respect to the new Bologna system (3 years BSc + 2 years MSc + 3 years PhD)

Country	Duration
Austria	probably 3 + 2
Belgium	3 + 2 + 3 in September 2004
Czech Republic	3 + 2 + 8
Germany	probably 4 + 1 + 3
Denmark	3 + 2 + 3
Spain	in some universities 3 + 2 + 3, in others 4 + 1 + 3
France	3 + 2 + 3 in September 2004 or 2005
Greece	probably 4+1(or 2) + at least 3
Croatia	4 + 1 + 3 or 3 + 2 + 3
Hungary	universities are opposed to the changes because it would be linked to a decrease of education finances
Ireland	3 + 2 + 3 or 4 + 1 + 3
Italy	3 + 2 + 3 already in use
Poland	3 + 2 + 4
Portugal	4 + 1 + 3
Slovenia	probably 4 + 1 + 3
UK:	most of the time 3+0+3, although sometimes 3 + 1 + 3, and in Scotland the BSc may be 4, and PhD moving towards 4

The European Round Table of Industrials considers that education is a vital strategic investment and the private sector would aim to have influence over teaching programmes. Students would be clients [customers] and the 'products' of courses. The EU has stated that "if these objectives were realised then the educational systems would be constructed according to the needs of the *customers* . . . potentially resulting in an improvement in the quality of the 'products'" [CE, 1991]. As the G7 countries have stated "education must be considered as a service [to be] provided for the world economy." [ERT, 1995]. "The participation of industrial companies in the governing bodies of schools and universities would need to be explored.", and of course, "students would be expected to pay for a large part of their education" [OECD, 1996].

Bologna is to some extent a result of this thinking because it would mean a decrease in the average length of study in order to allow students to obtain "directly relevant and valuable qualifications" more rapidly [Hirtt, 2001]. For many students the first cycle (BSc, BA) would be the only cycle. The White Paper from the European Commission recommends shorted study periods and more practically oriented experiences coupled with flexibility [CE, 1993]. Thus our university teaching may be driven towards a new educational model, one with stronger links to the industrial world, one with a more selected group of students ("centres of excellence" can only survive with smaller numbers of students), and one where there is more autonomy (including in high schools) and run on a larger scale, but run more economically.

We are now quite a long way from the concept, which originated between 1955 and 1975, of “equal opportunities for everyone” and of “democratisation” of universities, when industries were looking for sources of more, and more highly qualified, workers. From the 1990s onward, austerity is the only leitmotiv according to the European Round Table of Industrials: “In funding the educational system we are losing the finance that we need to support the economy.” Industry is not asking for a more ‘democratic’ educational system but instead it wants a limited number of highly specialised graduates who have a high degree of flexibility and mobility, along with a large number workers with relatively low level qualifications. Hirtt [1996] has said that we are now confronted with a ‘bi-polarisation’ of our education system.

The majority of European governments, the EU and the OECD, will follow these trends and suggestions and will respond to the European Round Table of Industrial’s wishes. The consequences are that:

- (1) There will be a decrease in the number of teaching staff and an increase in student-staff ratios (over 80% of the educational budget goes on staff salaries);
- (2) ‘Flexibility’ means responding to the wishes of industry. “Europe authorises and even encourages universities to continue teaching all sorts of subjects without regard to the job market and with no apparent practical application.” “There are graduates whose diplomas are useless in practical terms.” [European Round Table, 1995].
- (3) Selection means that there will be more selection of students and the application of *numerus clausus*. The message for the universities is that “fewer is better” we need fewer intellectuals, less democratisation of studies and the development of a learning process based on self-directed learning and critical thinking.
- (4) Autonomy of the universities must be regarded as an important step towards privatization. The OECD is cynically clear on this point: “if one decreases the budget, one has to try to avoid a decrease in the quantity of the services [education] provided, even if the quality decreases. Families will not react to the decrease in quality, and autonomy means that universities will decrease their activities in their own individual ways and of their own accord.” [Morrisson, 1996]. The decrease in the budget also means that universities will need to co-operate with and seek sponsorship from industry. Autonomy inevitably increases competition between universities and leads to privatization (the example of the USA is clear here) and ‘merchandising’ of courses (in the US tuition fees range from \$4000 to \$200,000 and in general they increase more rapidly than inflation). Moreover, there is a risk that the governing bodies of universities could be taken over by political groups or even extreme groups (such as right wing fundamentalists in the USA) who will impose their views on the teaching programmes. Autonomy has many objectives. These include reducing the budget and giving control of the cost reductions to the institutions themselves, diminishing the resistance of the teaching staff to the economies, allowing universities to develop and differentiate, and allow a more rapid accommodation of the wishes of industry.
- (5) Privatization, accelerated by the use of communication and information technologies, opens up a very large market and allows participation in the world education market. “Efficiency and quality of education would undoubtedly be encouraged if the universities were managed as enterprises rather than having the character of public institutions.” [Kredietbank, 1994]. “The sector is resistant to new technology, is unconcerned about cost increases, and there is not enough

competition. . . for these reasons entrepreneurs look on education as a large market to be taken over.” [CE, 1995a]. One may ask whether e-learning is more efficient? Does it facilitate better access to information? While the Internet gives students access to a huge variety of resources, these are of a very heterogeneous quality. Without a good basic background to a given topic it is almost impossible for students at the university level to distinguish between facts and opinions, to analyse and make proper judgements, to understand scientific rigour and recognise prejudices, and to be aware of ‘misinformation’. So far there has been no proper investigation nor any evaluation of the advantages of these technologies [OECD, 1998]. One may ask what sort of miracle is required for a student unable to read a book suddenly becoming an expert in handling a dense and continuously changing mass of information. Should we use multimedia to modernize pedagogy, or should we modernize pedagogy in order to service the multimedia industry?

- (6) Employability is to some extent opposed to the idea of qualification which encompasses rounded knowledge and competence, recognised or certified, with guarantees of employment. Employability is essentially a flexible catalogue of competencies or skills and attitudes, knowledge being considered a secondary. The EU would like to see an electronic “Skills Card” listing accumulating competencies. “The White Paper suggests . . . that we should recognise partial competencies by a system of accreditation . . . outwith the institutions awarding the diplomas and degrees. There should be a non-governmental Agency responsible for external evaluation . . . this would contribute to the transparency of the accreditation system. The skills accreditation card would ultimately work for and be controlled by the market [CE, 1995b].

Graham Hills said that “Universities must give priority to their presence in the market”: [Hills, 1999] teaching and research should neglect all topics that do not result rapidly in profitable applications. In fact, in many universities, even where the staff are paid largely by the state, there is more and more commercial style competition and staff are trying to find complementary sources of funding. The imperative is to produce more, with fewer staff, and to produce only what can be ‘sold’ [Wolfensohn, 1999]. This implies opening the door to more innovative styles of education [OECD, 1998], and deregulating education as a public and state-controlled system. The driver for such policies is, of course, the decrease in funding available to universities, pushing them to look for potential commercial sources of funding. The World Bank is clear that it “will give priority to countries disposed to adopt a legislative framework for universities . . . where the private sector would be able to intervene more.” [World Bank, 1995]. Furthermore, the World Trade Organisation is working to promote the privatization and marketing of education, along with a system of certification of competencies that is more flexible than the traditional university degrees and diplomas [WTO, 1998].

So, let us be critical – as universities have to be by definition! ‘Employability’ means that some education would become irrelevant – and this might include the sciences such as Biology, Anthropology, and Geography, History, Philosophy, Literature! Consequently we must continue to struggle for a good level of education for everyone as far as possible, education to understand the world and society, perhaps indeed to transform it. This is provocative certainly in the light of what has been said above, but is it realistic? Learning how to learn is a key feature – what a seductive idea! – but it is a universal idea of

*education*, rather than of *training* for a job. Industry in contrast wishes only to use education to provide the skills it needs in its workers: it is not interested in what it regards as 'futile' studies, knowledge for its own sake, for intellectual enrichment or personal fulfilment [Hirtt, 2002].

Deregulation of the schools and universities is the the EU's goal ("the time for education out of school is coming"): it means autonomy, students paying realistic tuition fees, and representation of industry on university governing bodies [CE, 1996]. This seems to me to be a strange autonomy! Liberalisation from bureaucracy, but submission to a stronger authority – industry and the financial market. This is a strange contradiction: there is a "cognitive society" and there is "life long learning", but yet more and more voices are asking for shorter study times with fewer possible topics that may be studied.

**Communicating author:** Free University Brussels, Pleinlaan 2 , 1050 Brussels, Belgium. Tel.: 32 2 629.34.08: e-mail: [scharles@vub.ac.be](mailto:scharles@vub.ac.be)

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