

Concept Paper

## Heterogeneity of Pharmacy Education in Europe<sup>†</sup>

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<sup>†</sup> This article is dedicated to the memory of Bart Rombaut, co-ordinator of the PHARMINE project, who passed away in January 2014.

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**Abstract:** The 1985 European Economic Community (EEC) directive on the sectoral profession of pharmacy assumed that the comparability of pharmacy education across Europe could provide a basis for the mutual recognition of diplomas. A study by the European Association of Faculties of Pharmacy (EAFP) in 1994 showed, however, that there was large variability in course content. The 2011 PHARMINE study investigated whether such variability had decreased. Information from across the EU countries on the number of contact hours in specific subject areas was compared for the years of 1994 and 2011. Data was obtained from the original 1994 Bourlioux/EAFP study and the 2011 PHARMINE survey. As the latter was based on the 1994 survey, the questions and categories were similar. Results show that there has not been a fall in the variability of course content. Furthermore, EU pharmacy courses have become more “clinical” with an increase in contact hours in the subject area of medicinal sciences.

**Keywords:** pharmacy; education; clinical; policy; EU

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### 1. Introduction

Pharmacy education and practice in the EU are under the auspices of the directive on sectoral professions that aims at bringing education in line with practice, and ensuring that education throughout the EU is harmonized leading to mutual recognition of diplomas by member states.

The 1985 European Economic Community directive [1] pertained to “the coordination of provisions laid down by law, regulation or administrative action in respect of certain activities in the field of

pharmacy” and this “...with a view to achieving mutual recognition of diplomas”. The 1985 directive set out the organizational aspects of pharmacy studies (overall duration, duration of traineeship) and the subject areas of a European pharmacy degree course (see annex), this with a view to fulfilment of the specific activities of a pharmacist in the EU, the latter also set out in the directive.

The 1985 directive stated that “the broad comparability of training courses in the Member States enables coordination in this field to be confined to the requirement that minimum standards be observed, thus leaving the Member States freedom of organization as regards teaching”. Thus based on the assumption that courses in Europe were broadly comparable—with little variation in the subject matters treated—recognition of qualifications for sectoral profession of pharmacy could be automatic.

In the early 1990s, the European Association of Faculties of Pharmacy (EAFP) [2] questioned this assumption. P. Bourlioux and others from the EAFP surveyed pharmacy courses in the 11 European Economic Community member states (Belgium, Denmark, France, Germany, Greece, Ireland, Italy, The Netherlands, Portugal, Spain, and the United Kingdom) with pharmacy faculties [3]. They found that although globally the emphasis was on chemical sciences (CHEMSCI), there was wide variation in contact hours in other subjects, for example, medicinal sciences (MEDISCI).

In 2011, the PHARMINE (*PHARMacy Education IN Europe*) EU-funded project [4] in preparation of the 2013 revision of the European directive [5], revisited this problem to see whether the variability in contact hours in specific subject areas had diminished over the previous decades. Using the methodology of the 1994 Bourlioux/EAFP study, the 2011 PHARMINE study gathered data on the contact hours in specific subject areas in the EU member states with pharmacy faculties: the 11 of the 1994 study (see above) plus the 14 countries that had joined the EU at a later date (Austria, Bulgaria, Czech Republic, Estonia, Finland, Hungary, Latvia, Lithuania, Malta, Poland, Rumania, Slovakia, Slovenia, Sweden); the data were revised for this paper with the addition of those for Croatia that joined the EU in 2013.

This paper looks secondly at whether the changes in pharmacy education with a shift towards more clinical activities (an increase in the importance of MEDISCI) correspond to changes in policy (as finalized in the 2013 EU directive).

## 2. Methods

Information from across the EU countries on the number of contact hours in specific subject areas was compared for the years of 1994 and 2011. Data was obtained from the original 1994 Bourlioux/EAFP study and the 2011 PHARMINE survey, which is described in previous publications. As the latter was based on the 1994 survey, the questions and categories were similar with the main difference being that the PHARMINE survey added a topic on generic subjects.

Data on contact hours in specific subject areas (expressed as a percentage of total hours) for the 1994 Bourlioux/EAFP study were obtained from previous publications [6]. In the 2011 PHARMINE survey [7] an electronic questionnaire was sent out to at least two faculties per country (excepting countries with only one faculty, e.g., Estonia). The departments surveyed in the two studies were not necessarily the same.

Work Programme 1 of the PHARMINE survey centred on the organisation of the activities of pharmacists and professional bodies. It revealed the national background pharmaceutical situation in each member state. Work Programme 2 gathered data on departments, their status (public or private), and their organisation (link to a medical or science faculty...) and on staff and student numbers, entry requirements, courses, and fees. Work Programme 3 looked at data on teaching and learning methods (hours spent on lectures/tutorials/practicals/ independent project work; traineeship; electives). The results of these three work Programmes have been published [8]. Work Programmes 5 and 6 studied the impact of the Bologna declaration and of the EU directive on pharmacy education [9], respectively. Work Programme 6 examined quality assurance in pharmacy education in the EU [10]. (Work Programme 4 dealt with dissemination of the PHARMINE results).

Work Programme 7 looked at the contact hours in specific subject areas shown in the annex. The subject areas were similar in the two studies with the exception of the introduction of a specific chapter for generic subjects in the PHARMINE survey.

The results of Work Programme 7 are presented here with, firstly, separate descriptive analyses of the 1994 and the 2011 studies to determine if there were consistent differences across all countries in the number of hours dedicated to the topic areas. Secondly a comparison of the results of the two studies was carried out to see if there were any differences. Thirdly results from the 2011 PHARMINE study were analysed to see whether the subject area MEDISCI was predominant.

### *Statistical Analysis*

As normality of distributions is unknown for the type of data presented here the Kolmogorov–Smirnov test for deviations of distribution from normality [11] was performed. This showed that only 7%–14% of the data showed significant deviations from normality of distribution (results not shown), thus it was assumed that parametric tests would be robust enough [12].

Results are expressed as means  $\pm$  standard deviations, and coefficients of variation (%) = ((mean/standard deviation)  $\times$  100). Comparisons were made using one-way ANOVA followed by the Tukey test for multiple comparisons [13], two-way ANOVA followed by the Holm-Šídák test for multiple comparisons [14], or linear regression ANOVA. Statistical analysis was performed using GraphPad<sup>®</sup>, [15] programs.

Complete data for each country can be obtained on the PHARMINE website [16]. These profiles were written by the various members of the PHARMINE consortium (see acknowledgements). Data were checked by the author with that available on the department website, where possible.

### **3. Results**

Contact hours in specific subject areas in the 1994 Bourlioux/EAFP and in the 2011 PHARMINE survey (n = 11 countries):

In the 1994 study, subject contact hours were ranked as follows: CHEMSI >> BIOLSCI > MEDISCI > PHARMTECH >> PHYSMATH > LAWSOC (subject areas: Appendix Table A1).

The Tukey test for multiple comparisons showed significant differences ( $p < 0.05$ ) amongst contact hours in subject areas as follows: CHEMSCI greater than the other five; MEDISCI greater than

PHYSMATH, PHARMTECH and LAWSOC; and LAWSOC smaller than all others except PHARMTECH. Coefficients of variability were high ranging from 21 to 83% (Table 1).

In the 2011 study, subject contact hours were ranked as follows: MEDISCI > CHEMSI >> PHARMTECH > BIOLSCI >> PHYSMATH > LAWSOC.

The Tukey test for multiple comparisons showed significant differences ( $p < 0.05$ ) amongst contact hours in subject areas as follows: CHEMSCI greater than the other six except MEDISCI; MEDISCI greater than the other six except CHELSICI; and LAWSOC smaller than all others except GENERIC (Table 1). Coefficients of variability were high ranging from 29 to 60%.

**Table 1.** Contact hours in specific subject areas (expressed as a percentage of total hours) in the 1994 Bourlioux/EAFP and in the 2011 PHARMINE survey (n = 11). See annex for explanation of subject areas.

|                              | CHEMSCI | PHYSMATH | BIOLSCI | PHARMTECH | MEDISCI | LAWSOC |
|------------------------------|---------|----------|---------|-----------|---------|--------|
| 1994                         |         |          |         |           |         |        |
| Mean ± standard deviation    | 33 ± 7  | 8 ± 3    | 21 ± 6  | 13 ± 5    | 19 ± 7  | 6 ± 5  |
| Coefficient of variation (%) | 21      | 38       | 29      | 38        | 37      | 83     |
| 2011                         |         |          |         |           |         |        |
| Mean ± standard deviation    | 26 ± 11 | 7 ± 2    | 13 ± 5  | 14 ± 5    | 28 ± 8  | 5 ± 3  |
| Coefficient of variation (%) | 42      | 29       | 38      | 36        | 29      | 60     |

Contact hours in specific subjects in the 2011 PHARMINE survey (n = 26 countries):

Minimum and maximum percentages for CHEMSCI were 14 and 44; for PHYSMATH 2 and 11; for BIOLSCI 2 and 24; for PHARMTECH 6 and 23; for MEDISCI 16 and 42; for LAWSOC 1 and 16; and for GENERIC 1 and 24 (Table 2).

Ranking for mean percentages in subject areas was MEDISCI > CHEMSCI > PHARMTECH > BIOLSCI > GENERIC > PHYSMATH > LAWSOC.

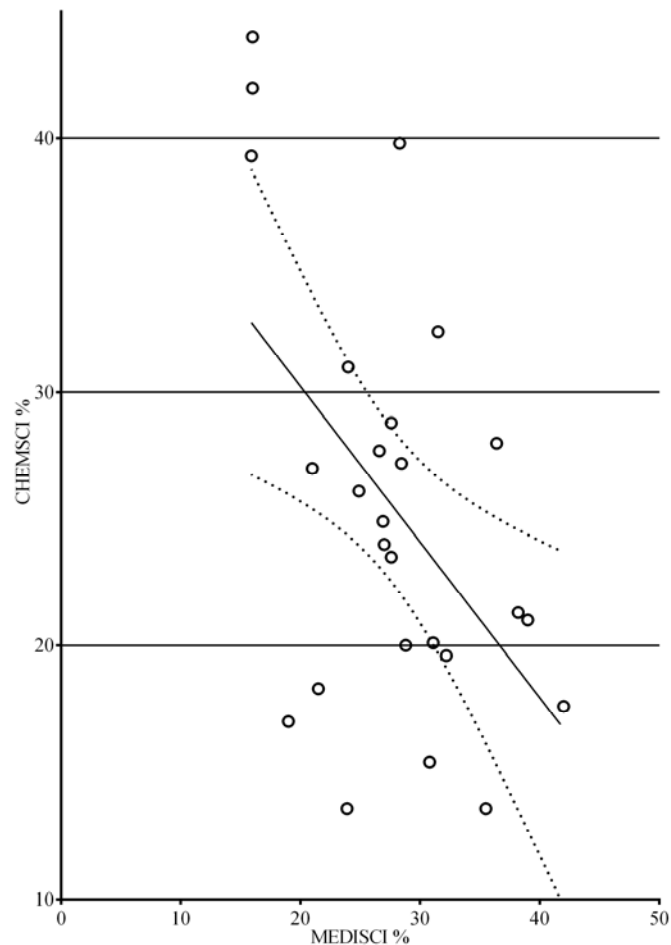
The Tukey test (columns = subject area) showed that there were significant differences in that CHEMSCI was greater than all others except MEDISCI; MEDISCI was greater than all others except CHEMSCI; and that PHARMTECH was greater than PHYSMATH, LAWSOC and GENERIC. Two-way ANOVA (columns = subject area, rows = countries) showed a significant effect of subject areas but not of countries.

There were large coefficients of variation ranging from 25% for MEDSIC to 74% for GENERIC.

**Table 2.** Contact hours in specific subject areas (expressed as a percentage of total hours) in the 2011 PHARMINE survey (n = 26).

|                              | CHEMSCI | PHYSMATH | BIOLSCI | PHARMTECH | MEDSCI | LAWSOC | GENERIC |
|------------------------------|---------|----------|---------|-----------|--------|--------|---------|
| Austria                      | 44.0    | 2.0      | 22.0    | 14.0      | 16.0   | 0.6    | 1.0     |
| Belgium                      | 24.0    | 9.0      | 11.0    | 18.0      | 27.0   | 2.0    | 8.0     |
| Bulgaria                     | 31.0    | 7.0      | 11.0    | 13.0      | 24.0   | 7.0    | 7.0     |
| Croatia                      | 24.9    | 4.2      | 9.2     | 8.9       | 26.9   | 2.5    | 23.3    |
| Czech Republic               | 17.0    | 5.0      | 8.0     | 22.0      | 19.0   | 13.0   | 16.0    |
| Denmark                      | 42.0    | 7.0      | 7.0     | 16.0      | 16.0   | 9.0    | 3.0     |
| Estonia                      | 21.0    | 4.0      | 2.0     | 21.0      | 39.0   | 10.0   | 3.0     |
| Finland                      | 20.0    | 5.6      | 2.5     | 21.9      | 28.8   | 15.6   | 5.6     |
| France                       | 17.6    | 9.5      | 17.9    | 5.9       | 42.0   | 2.2    | 5.0     |
| Germany                      | 39.8    | 4.5      | 10.9    | 13.4      | 28.3   | 2.1    | 3.8     |
| Greece                       | 39.3    | 5.8      | 14.2    | 8.2       | 15.9   | 2.7    | 14.0    |
| Hungary                      | 27.2    | 5.2      | 5.2     | 16.0      | 28.5   | 3.9    | 14.2    |
| Ireland                      | 13.6    | 11.1     | 7.1     | 18.3      | 35.5   | 7.3    | 7.1     |
| Italy                        | 32.4    | 7.2      | 10.4    | 9.1       | 31.5   | 4.8    | 2.2     |
| Latvia                       | 27.7    | 6.4      | 6.4     | 20.2      | 26.6   | 8.5    | 6.4     |
| Lithuania                    | 21.3    | 2.0      | 8.9     | 8.9       | 27.7   | 7.4    | 23.8    |
| Malta                        | 15.4    | 7.2      | 12.7    | 15.4      | 30.8   | 3.6    | 15.0    |
| Netherlands                  | 20.1    | 3.9      | 10.6    | 14.2      | 31.1   | 8.3    | 11.8    |
| Poland                       | 21.3    | 4.1      | 8.0     | 15.9      | 38.2   | 6.2    | 6.2     |
| Portugal                     | 19.6    | 6.8      | 14.6    | 14.9      | 32.2   | 12.0   | 1.2     |
| Rumania                      | 26.1    | 8.7      | 15.8    | 14.1      | 24.9   | 3.7    | 6.6     |
| Slovakia                     | 28.8    | 8.8      | 10.9    | 14.4      | 27.6   | 3.4    | 6.0     |
| Slovenia                     | 27.0    | 8.5      | 8.5     | 22.0      | 21.0   | 8.5    | 4.7     |
| Spain                        | 23.5    | 5.5      | 19.9    | 11.0      | 27.6   | 5.5    | 7.0     |
| Sweden                       | 18.3    | 11.3     | 12.8    | 19.5      | 21.5   | 11.8   | 5.0     |
| United Kingdom               | 13.6    | 5.7      | 23.9    | 22.7      | 23.9   | 3.4    | 6.8     |
| Mean                         | 25.3    | 6.4      | 11.2    | 15.3      | 27.4   | 6.3    | 8.2     |
| Standard deviation           | 8.6     | 2.5      | 5.4     | 4.8       | 6.8    | 3.9    | 6.1     |
| Coefficient of variation (%) | 33.9    | 38.4     | 48.5    | 31.2      | 25.0   | 61.8   | 74.3    |

There was a significant inverse linear relationship between MEDSCI and CHEMSCI ( $\text{CHEMSCI} = -0.61 \times \text{MEDSCI} + 43$ ,  $R^2 = 0.26$ ,  $p < 0.05$ ); Figure 1.

**Figure 1.** Linear relationship between MEDISCI and CHEMSCI (n = 26 countries).

## 4. Discussion

### 4.1. Methodology.

In both surveys all the participants were members of the EAFP. Thus this study does not involve randomly drawn departments. In addition the departments surveyed in the second study were not necessarily the same as those surveyed in the first. The impact of this on results is unknown. In 1994 the European Economic Community was composed of a small number of member states most with a large population (> 10,000,000): Belgium, France, Germany, Greece, Italy, The Netherlands, Portugal, Spain, and the United Kingdom). In 2014 the EU has more than doubled in size as many countries with smaller populations have joined. In larger countries there are several pharmacy departments (> 20 in France, Germany, Spain and the UK) and national bodies fix courses. In smaller countries there may be only one or two departments and these tend to look more towards EU organisations for guidance on courses. Thus the contexts of the 1994 Bourlioux survey and of the PHARMINE survey are different. Finally, Scotland represented the UK in the 1994 Bourlioux/EAFP survey, whereas as England represented the UK in the PHARMINE study. Organisation of pharmacy education in the two countries is not identical but similar. In most cases each member state was represented by data from a single department, in a few cases by two departments. There was no attempt to survey a number of departments relative to the size of the country.

The organisation of the subject areas used in the 2011 PHARMINE study was that used by the 1994 Bourlioux/EAFP survey, the latter being based on the EEC 1985 directive (see Appendix Table A1). This allows comparison between the two studies and evaluation of possible evolution. However, other patterns of organisation are possible. In some faculties of pharmacy, “Pharmaceutical Sciences” contains the core subject areas in pharmaceutical education and research. This encompasses pharmaceutical technology, pharmacological sciences (including pharmacology–basic and clinical–pharmacokinetics, pharmacotherapy, toxicology, *i.e.*, all drug action and use-related subjects such as medical devices, drugs in veterinary medicine, *etc.*) and social pharmacy. All the other subjects pertain strictly speaking to biomedical sciences and are grouped in what is called “Medicinal Sciences”. In other words anatomy, physiology, *etc.* are in fact “Biomedical Sciences” (not “Biomedicinal”) and the drug-related subjects (even though they are included in medicinal sciences) are within “Pharmacological Sciences”. In particular, for example radiochemistry may be included in CHEMSCI and pharmaceutical care in LAWSOC.

Finally, there are also organisational differences between the EU directive 2013/55 and modern-day pharmacy education and practice. Thus, for example, clinical chemistry (or clinical biology) exists as an area of pharmacy practice and education in many member states but is not included in EU directive 2013/55.

#### 4.2. Evolution in Subject Areas between the 1994 and 2011 Surveys

Percentages for PHYSMATH, BIOLSCI and PHARMTECH showed little change. CHEMSCI decreased from 33% to 26%, that for BIOLSCI from 21% to 13%, and that for MEDSCI increased from 19% to 28%.

The coefficients of variation for means of hours in subject areas were similar in the two surveys. Thus the variability between member states has not decreased since the 1990s in spite of the staff and student exchange between countries via the Erasmus [17] and other programmes, and course harmonization tools such as the European Credit Transfer and Accumulation System (ECTS) [18].

It could be argued that the differences (variability) among the pharmacy curricula are not necessarily negative. Variability in educational procedures can be useful as it allows academic freedom to try other approaches, and prevents departments from all making the same mistake.

Finally it remains to be seen if variability in pharmacy curricula is really producing significant variability in pharmacists’ competences for practice.

#### 4.3. A More “Clinical” Education and Practice in Pharmacy?

There is a shift in pharmacy education over the previous decades from courses oriented towards CHEMSCI to those oriented towards MEDSCI. In the 1994 study MEDSCI was ranked third in number of contact hours, far behind CHEMSCI, whereas in the 2011 study MEDSCI was ranked first.

The above change in pharmacy education to more “clinical” courses is in line with the main changes in the directive between 1985 and 2013 and the inclusion of notions of:

- (1) safe and efficacious medicinal products
- (2) provision of information and advice on medicinal products...including on their appropriate use

- (3) reporting of adverse reactions of pharmaceutical products
- (4) provision of personalised support for patients
- (5) contribution to local or national public health campaigns

Thus the list of specific activities of a pharmacist given in the 1985/432/EEC directive has been extended by additions (in bold below) in the 2013/55/EU directive:

- (a) preparation of the pharmaceutical form of medicinal products
- (b) manufacture and testing of medicinal products
- (c) testing of medicinal products in a laboratory for the testing of medicinal products
- (d) storage, preservation and distribution of medicinal products at the wholesale stage
- (e) supply, preparation, testing, storage, **distribution and dispensing of safe and efficacious medicinal products of the required quality** in pharmacies open to the public
- (f) preparation, testing, storage and dispensing of **safe and efficacious medicinal products of the required quality** in hospitals
- (g) provision of information and advice on medicinal products **as such, including on their appropriate use**
- (h) **reporting of adverse reactions of pharmaceutical products to the competent authorities**
- (i) **personalised support for patients who administer their medication**
- (j) **contribution to local or national public health campaigns**

The above changes in the directive underlie a shift in the practice of pharmacy towards a more “clinical” role with involvement of more MEDISCI elements. This ties in with the trend towards courses with a higher MEDISCI percentage noted above.

Albeit, the linear relationship between CHEMSCI and MEDISCI (Figure 1) reveals that there are exceptions with some countries (e.g., Austria, Denmark, Germany) giving more “chemical” courses as judged from the relative hours dedicated to CHEMSCI and MEDISCI. This inverse relationship also shows that alongside countries like Poland, Estonia and France with a more “clinical” course, there are countries like Romania, Hungary and Slovenia with a “balanced” curriculum.

The change to a more “clinical” approach is not a uniquely EU phenomenon as judged by the increase world-wide in the number of publications on, for example, “pharmaceutical care” from 1 in 1990 to 104 in 2011, with 50 citations to articles on pharmaceutical care in 1995, and 1300 in 2011.

## 5. Conclusions

The conclusions to this study are:

- Since the 1990s there has been no decrease in the variability in pharmacy courses amongst departments in different countries. This raises the question of the difference between the notion of “*the broad comparability of training courses in the Member States*” as outlined in the 1985 EEC directive, and the reality of the variability of EU pharmacy education systems.
- In the EU, there has been a shift towards more “clinical” courses with a greater MEDISCI content. This global shift from courses oriented towards chemical sciences to those oriented towards medicinal sciences coincides with the recognition—in the latest version of the EU directive—of a more important “clinical” role for pharmacists.



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### Conflicts of Interest

The author declares no conflict of interest.

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## Appendix

**Table A1.** Subject areas in the 1985 EEC directive together with additions in 1994 Bourlioux/EAFP survey (non-italic) and in the 2011 PHARMINE survey (italic).

| Subject Areas in Directive<br>85/432/EEC                                | Additional Subjects   |
|---|---|
| 1. Chemistry<br>(CHEMSCI)   |   |
| General and inorganic chemistry   | Medical physico-chemistry   |
| Organic chemistry   | Pharmacoepia analysis   |
| Analytical chemistry  |   |
| Pharmaceutical chemistry including<br>analysis<br>of medicinal products |   |
| <i>Structure-activity relationships / drug design</i>                   |   |
| 2. Physics / Mathematics /<br>Computing / Statistics<br>(PHYSMATH)      |   |
| Physics   | Mathematics / Computing / Statistics<br><i>Pharmaceutical calculations</i><br><i>Information technology, information technology applied to<br/>community pharmacy, information technology applied to<br/>national healthcare</i><br><i>Experimental design and analysis</i> |

Table A1. Cont.

| Subject Areas in Directive<br>85/432/EEC  | Additional Subjects   |
|---|---|
| 3. Biology / Biochemistry /<br>Pharmacognosy<br>(BIOLSCI)   | Phyto-chemistry   |
| General and applied biochemistry<br>(medical)<br>Plant and animal biology<br>Microbiology/Pharmacognosy | <i>Mycology</i><br><i>Molecular biology</i><br><i>Genetics</i>  |
| 4. Pharmaceutics / Technology<br>(PHARMTECH)  |   |
| Pharmaceutical technology   | <i>Finished medicinal products</i><br><i>Drug disposition and metabolism / pharmacokinetics</i><br><i>Novel drug delivery systems</i><br><i>Pharmaceutical research and development</i><br><i>Drug production</i><br><i>Quality assurance in production</i><br><i>Drug / new chemical entity registration and regularization</i><br><i>Common technical document: pharmaceutical quality, safety</i><br><i>pharmacology and toxicology efficacy (preclinical and</i><br><i>clinical studies)</i><br><i>Ophthalmic preparations</i><br><i>Medical gases</i><br><i>Cosmetics</i><br><i>Management strategy in industry</i><br><i>Economics of the pharmaceutical industry and of research</i><br><i>and development</i> |
| 5. Medicine / Pharmacology /<br>Toxicology<br>(MEDISCI)   |   |
| Anatomy, physiology, medical<br>terminology   | <i>Pathology / Histology / Nutrition</i>  |
| Pharmacology / pharmacotherapy<br>Toxicology  | <i>Haematology / Immunology</i><br><i>Parasitology / Hygiene</i><br><i>Emergency therapy</i>  |

Table A1. Cont.

| Subject Areas in Directive<br>85/432/EEC        | Additional Subjects   |
|---|---|
| Pharmacology / pharmacotherapy<br>Toxicology    | <i>Non-pharmacological treatment</i><br><i>Clinical chemistry / bio-analysis (of body fluids)</i><br><i>Radiochemistry</i><br><hr/> <i>Dispensing process, drug prescription, prescription analysis (detection of adverse effects and drug interactions)</i><br><hr/> <i>Generic drugs</i><br><i>Planning, running and interpretation of the data of clinical trials</i><br><i>Medical devices</i><br><i>Orthopaedics</i><br><i>OTC medicines, complementary therapy</i><br><i>At-home support and care</i><br><i>Skin illness and treatment</i><br><i>Homeopathy</i><br><i>Phyto-therapy</i><br><i>Drugs in veterinary medicine</i><br><i>Pharmaceutical care, pharmaceutical therapy of illness and disease</i> |
| 6. Law / Social Aspects of Pharmacy<br>(LAWSOC) |   |
| Legislation / professional ethics               | <i>Philosophy / Economics</i><br><hr/> <i>Management / History of pharmacy</i><br><hr/> <i>Public health</i><br><hr/> <i>Social sciences</i><br><i>Forensic science</i><br><i>Public health / health promotion</i><br><i>Quality management</i><br><i>Epidemiology of drug use (pharmaco-epidemiology)</i><br><i>Economics of drug use (pharmaco-economics)</i>   |
| 7. Generic Competences (GENERIC)                |   |
|   | <i>General knowledge</i><br><hr/> <i>Academic literacy</i><br><i>Languages</i><br><i>First aid</i><br><i>Communication</i><br><i>Management</i><br><i>Practical skills</i>  |