

WA1

Teaching Medical Physiology in Finnish Universities: Five Faculties, Five Practical ApproachesL.M. Peltonen¹, M. Narhi² and J. Leppaluoto³¹*Biomedicine/Physiology, University of Helsinki, Helsinki, Finland,*²*Physiology, University of Kuopio, Kuopio, Finland and* ³*Physiology, University of Oulu, Oulu, Finland*

Medical education is available in five Finnish universities: Helsinki, Turku, Tampere, Kuopio and Oulu. While the core of physiology is shared and well defined in all units, greater academic freedom flourishes in the practice of teaching. In Helsinki, physiology (12.5 ECTS) is learned concurrently with anatomy, developmental biology, biochemistry and pharmacology. Some of the courses are integrated ("Introduction to medicine"), but most of them are not, e.g. "Neurobiology". Major learning method is problem-based learning (PBL; 42 h) along with self-learning. Traditional (39 h) and interactive lectures on specific topics (6 h) are given and there are nine hands-on practicals (27 h) included in the curriculum. For effective self-learning, a facility ("Bazaar"), equipped with computers and a library with recommended and supplementary literature, is available all hours. Graduate courses (15 ECTS) on functions of steroids in hormone-dependent cancers, sleep physiology, neurophysiological research on memory, attention, and pain, are offered. Currently, physiology has only one professor and two senior lecturers for 160 medical and dental students/year. In Kuopio, there is a 10.5-ECTS course, divided into nine subcourses representing different fields of general physiology. Each course starts with a case introduced by a clinician and ends with the case closure. An integrated 6-ECTS course is given in neurosciences. Learning methods include lectures (135 h), group work and hands-on practicals (17 h). Special importance is given to self-learning which is supported by a multimedia studio equipped with the latest technology ("Medistudia"). Evaluations show that self-learning facilities are in especially active use. There are two professors and five senior lecturers for 140 students/year. In Oulu, physiology proper is a 14-ECTS course. At the beginning of the term, there is an orientation period during which the students visit health centres. The level of integration with other preclinical disciplines is low. Lectures (108 h) and traditional hands-on practicals are emphasised as teaching methods. Oulu differs from the other units by teaching scientific writing and requiring two research papers on major physiology topics (2 ECTS). There are two professors and three senior lecturers per 180 students/year who comprise medical, dental and medical engineering students. In the "Tampere-model", physiology is fully integrated with other medical studies, thus being unique among Finnish medical faculties. As patient contacts are "allowed" only after preclinical studies in the more conventional curricula, these are included in Tampere already at the beginning of the studies. PBL is the major learning method (150 cases) accompanied by self-learning, lectures (42 h), several kinds of group work (14 h) and evaluations. Physiology has its share in eleven multidisciplinary courses (e.g. "Movement" and "Chest pain and shortness of breath"). There are two professors and two senior lecturers for 105 students/year. In Turku, physiology is learned in three courses. All of these have a different level of integration with other medical studies. Teaching comprises PBL (24 h), group work, seminars

(5 h) and health centre visits. Depending on the course, either lectures (119 h totally) or PBL is favoured. Special importance is given to hands-on practicals (42 h). Turku also offers elective and graduate courses, some of them in English. There are three professors and several senior lecturers teaching physiology to 170 medical and dental students/year.

Taken together, physiology education is comparable at all medical faculties in Finland. With the exceptions of Helsinki and Tampere, lectures comprise about 100 hours. Major hands-on practicals deal with blood pressure, electrocardiography, auscultation, spirometry, physical exercise, sensory physiology and electroencephalography. Student feedback has an important role in assessment of teaching. The major differences are seen in the integration of physiology with other disciplines, and in the use of PBL and early patient contacts as teaching methods. Students find physiology very useful and they have experienced the integration to clinical physiology in particular very inspiring. It seems, however, that integration and new technology have not changed the outcome of evaluations for better. In Finland, there are seven recommended physiology books for self-learning. All institutions have web sites.

Narhi M & Leppaluoto J (2004). Teaching Medical Physiology in Finnish Universities. Newsletter 4, Finnish Physiological Society, Helsinki.

Where applicable, the experiments described here conform with Physiological Society ethical requirements.

WA2

Teaching physiology in context with clinical medicine becomes obligatory in the new German medical curriculum

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In the middle of the 19th century independent Institutes (Departments) of Physiology were founded in Germany, e.g. 1844 in Wuerzburg and 1858 in Berlin. Since that time, they have been usually part of the Medical Schools (mostly Medical faculties of Universities), where they are responsible for the education of medical and dental students. The close ties of Physiology to Medicine are also reflected in the fact that virtually all German textbooks of Physiology of the last 150 years concentrate on human physiology. More recently, however, more and more graduates of biology and other natural sciences (Dr. rer. nat. or PhD) are entering medical physiology, initially as postdoctoral associates. This is excellent for basic research in Physiology, but sometimes creates problems when pathophysiological and clinically applied aspects of physiology have to be taught.

The tremendous growth of knowledge in Physiology was probably the main reason that most experiments disappeared from the lecture hall in the 1950s, and separate laboratory courses (64 hours), where small groups of students could do their own experiments, were established. In the 1990s, however, it was felt that Medical education in Germany needed more changes for several reasons:

- The physiology then taught was often too far away from the needs of practical medicine, a situation made worse by the fact that more and more teachers of physiology had no in-sight into practical medicine.

- Listening to “one-way” presentations in lecture halls did not teach the students sufficiently how to solve problems and how to analyze specific cases.
- In classrooms still crowded with groups of 50 or more students, interactive teaching and learning among students was very difficult;
- In the traditional curriculum, there was too little room for bridging the gaps between physiology, pathophysiology and clinical medicine.
- Examinations based on multiple choice questions did not test well enough the ability of the students to analyze complex situations and to integrate their knowledge to solve multifactorial problems.

In Germany, the Medical curriculum has to meet the federal regulations for the education of physicians. These regulations were changed in 2002 and became effective in 2003/2004.

Some of the major changes in the curriculum of the first two years are as follows:

- The teaching of the systematics of anatomy, physiology, biochemistry, medical psychology and sociology (usually by lectures and/or laboratory courses) is now supplemented by two types of obligatory seminars (maximum of 20 participants) in which the student is expected to learn the meaning and application of his/her theoretical knowledge for clinical medicine. Thus, in physiology for instance, there are now (i) pathophysiology-oriented, interactive seminars (56 hours), and (ii) case-oriented, so-called integrated seminars (96 hours) in which a patient is usually present, and the physiologist is accompanied by one or more clinical colleagues to demonstrate and analyze the case.
- Besides the curriculum common for all students, each student now has to make her/his choice for an elective with a separate examination.
- The state examination after the first two years now has two independent and equally counting parts: (i) a country-wide written examination (multiple choice questions, now with more emphasis on pathophysiology), and (ii) an oral and practical examination by the local faculty members.

It is hoped that these and other changes in the curriculum will improve the quality of Medical education in Germany.

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WA3

Teaching Physiology in Hungary. Are the problems local or general?

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This is an overview of the recent situation and problems of physiology training at Hungarian medical faculties. Hungary, a country with about 10 million inhabitants, has four Universities with medical faculties, where about 800 medical doctors graduate yearly. The Physiology departments are in a particular position. While interest in and funding of dwindling traditional research in system physiology are dwindling, the importance of the subject in medical training keeps these departments among the

most prestigious ones at the faculties. This is manifested in the fact that these departments employ a relatively high number of teachers. The proportion of medical doctors is among physiology teachers still conspicuously high in Hungary. Physiology departments, however, have to cope with numerous problems, primarily with the meagre financing of their activities. Further, problems have arisen in connection with the recent establishment of unified Universities in Hungary, and the introduction of the Credit System, and among others the introduction of a new animals rights law has made the life of physiology Professors more difficult. On the other hand, the advent of computer-controlled teaching systems, the Internet and the widening international relationships offer hitherto unavailable possibilities in physiology teaching. Not only demonstration methods, but also examination techniques are continuously developing. These and the introduction of new quality control assessment methods are opening up new prospects in our teaching work.

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WA4

Medical Physiology Teaching in Italy and New Experiences in the Bari Medical School Francesco Vitiello and Carlo Di Benedetta Dipartimento di Farmacologia e Fisiologia Umana, Medical School of the Bari University (Italy)

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In Italy the duration of M.D. degree studies is six years. Medical Schools students, who are selected on the basis of a numerus clausus dictated by community needs and availability of both facilities and teaching and technical personnel, are usually subdivided into groups (channels). The curriculum is made up of 360 credits (60/year), each credit consisting of teaching as well as self-learning for a total amount of 25 hours. Teaching activities include formal lectures, practical demonstrations and tutorial group activities.

In the Medical Schools, disciplines are distinguished into two categories (i.e., basic and clinically-related). Physiology teaching pertains to the basic sector. The number of credits assigned to physiology teaching varies between 13 and 21 among the several Italian medical schools, while the semesters devoted to this teaching range from 2 to 3 within the 2nd and 3rd year of the curriculum. Sometimes physiology is taught also in the successive academic years as propaedeutic to clinical teaching. The number of students in the different schools varies according to the size of the medical school and its numerus clausus.

The Dentistry School and several three-year courses, covering different topics of medical education like Nursing, Dietetics, Laboratory Test Medicine, etc., as well as many postgraduate curricula, like research doctorates and postgraduate schools of specialization are attached to the Medical School; all of them include physiology teaching, even though with different amount of credits.

As regards physiology teaching within the Bari Medical School, two students groups exist which include a total of 327 students. Twenty credits are assigned over three semesters (second semester of the second undergraduate year, and the first and second semester of the third year).

The programme of the first semester (6 credits) covers the following topics: Physiology of Nerve and Muscle, Interactions between Excitable Tissues, Spinal Cord Physiology, Digestive System Physiology and Nutrition. The second semester (6 credits) deals with Respiratory, Cardiovascular and Renal Physiology, and Body Fluids, Blood Pressure and pH Regulation. During the third semester (6 credits) Central Nervous System and Vegetative Physiology, Interactions between Central Nervous and Endocrine Systems and Sense Organ Physiology are taught. One credit is assigned to the teaching of Bioengineering and one more credit is earned in the 4th and 5th year, in the Cardiology and Neurology courses (half credit each). Finally some elective courses are offered to the students.

The assessment is based on written (multiple-choice questionnaire) and oral examinations.

The didactic organization of the course of physiology relies upon giving students detailed information regarding the functioning of the molecules and structures (cell and organ physiology) before discussing the systemic regulations of body functions. A similar organization is also adopted, as a whole, in the other Italian Medical Schools.

Participation of physiology lecturers in the Cardiology and Neurology courses is a starting point of an approach, which is likely to be enlarged in a subsequent phase, intended to foster a closer cultural collaboration between physiology and clinical teaching. Such a cooperation is deemed necessary to give students the essential information for a better and deeper understanding of clinical notions.

New experiences have been explored at Bari Medical School. The University of Bari Medical School has built up a parallel track and adopted and experienced the methodologies regarding the PBL (Problem Based Learning) and COE (Community-Oriented Education).

Problem-Based Learning is a method by which learning is achieved through solving biomedical or clinical problems. All the activities performed during the curriculum (and the way they are performed) allow students to be also capable of organizing their own learning skills in order to continue their education in the future professional life.

Community-Based Education is a learning activity carried out in health and social services. This implies attending hospitals' emergency wards and general practitioner offices, and participating in family attachment programmes, in community health education activities, etc.

These methodologies allow students to acquire not only the capability 'to know', but also 'to know how to be' and 'to know how to behave'.

Ec Tempus Programme-Co.Le.M. Project JEP-1756 - Don't get nervous from nerves (1994) 1-56.

Berlucchi G & Di Benedetta C (1999) The harmonization of physiology teaching: a tool for its recognition in European countries. *Pflugers Archiv Eur. (J. Phys.)* 1-3.

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WA5

Medical Physiology Teaching in Romania

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This is a report of how medical physiology is taught in Romania. Questions on courses structure, courses content, personnel teaching the courses, materials available to the students and assessment of students were asked to all Physiology Departments of Universities or Faculties of Medicine from Romania. Staff of these departments represents the majority of the members of the Romanian Society of Physiological Sciences. Since now 8 out of 11 departments replied the questionnaire. This report is for now only a cross section onto the status of Medical Physiology Teaching in Romania but it is intended to be the start of a comprehensive survey.

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WA6

Medical Physiology Teaching in the United Kingdom

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The standard programme in the United Kingdom (UK) leading to the award of a medical degree (MB ChB) lasts for five years with shorter, four year "fast-track", programmes available for graduate entry. Students may also elect to pursue a further year of study to gain an Intercolated Bachelor of Science (B.Sc) degree in Physiology or a related subject.

In the UK medical curricula have been modified to meet the recommendations set out within the General Medical Council's document *Tomorrow's Doctors* (GMC 1993). The document called for medical schools to reduce the factual overload of their curricula and suggested that the traditional divide between the pre-clinical and clinical components was a significant factor in perpetuating the overload. The document did not define a national core curriculum but allowed each institution to develop its own syllabus and encouraged the incorporation of special study modules to allow students to explore their individual academic interests. The majority of medical schools developed a systems-based approach with teaching delivered by both biomedical scientists and clinicians throughout the programme whilst a small number have adopted problem based learning (PBL). Since 1997 there has been a 60% increase in the number of students entering UK medical schools without a corresponding increase in academic staff. This expansion has required the development of computer-marked assessment and greater utilisation of computer-aided learning (CAL). The assessment techniques include multiple-choice questions (MCQs), data interpretation questions (DIQs), short answers and extended matching questions (EMQs) with the examinations constructed using the blueprinting technique. In order to share good assess-

ment practices, and develop a database of examination questions, several medical schools have collaborated to form the Universities Medical Assessments Partnership (UMAP).

The majority of Physiology departments in the UK are based within the Universities and are primarily involved in research and teaching rather than provision of clinical services. The vast majority of physiology teaching staff are therefore basic scientists who are not medically qualified, although our "integrated" curriculum provides opportunities for collaborative teaching sessions that also involve clinical colleagues. The Bristol department is involved in teaching an annual intake of over 250 medical students (as well as dental, veterinary and physiological science students) and is quality assured by visitations of the Quality Assurance Agency for Higher Education and the General Medical Council. The increasing emphasis in the UK for achieving research targets and a demise in systems research has resulted in a decrease in the number of staff with the appropriate background for teaching systems Physiology. In response to these changes the department employs medical demonstrators, these are medical graduates with several years of clinical experience who join the department for six months to participate in systems teaching in practicals and tutorials.

General Medical Council (1993). *Tomorrow's Doctors: Recommendations on Undergraduate Medical Education*.

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WA7

New experiences in teaching Physiology through a PBL approach

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Problem Based Learning (PBL) has been forwarded as a more favorable way of teaching medical curricula than more classical, discipline oriented way of knowledge transfer. From 1974 on PBL has been introduced in the curriculum of the Medical Faculty of the Maastricht University. In the latest, reviewed form of the curriculum (start in 2001) a more gradual transition from pure theoretical knowledge transfer to patient oriented learning approach has been introduced. In the first 2 years, 6 teaching blocks of 6-8 weeks each were constructed. Emergency care and general homeostatic mechanisms were key issue in the first year, and stages of life and diagnostics were the leading issues in the second year. Basic physiological principles were transferred via integrated patient cases to be discussed in small tutorial groups. Integration of knowledge was evaluated in a summative manner. From the 4th year on clinical clerkships were preceded by an introductory week in which, among others, the pathophysiological background of the patients to be encountered was discussed. At the end of the clerkship student were asked to present the pathophysiological background of the diseased patient. Ongoing internal and external evaluation will learn whether PBL is a better knowledge transfer carrier than the more classical discipline oriented transfer. At present, comparison of the summative evaluation, as carried out at medical faculties in 3

Dutch universities does not provide exclusive evidence for a better learning result of PBL. However, in a comparison between the results of Maastricht and Groningen students, the latter of which still follow a more classical discipline oriented curriculum, Maastricht students obtain significantly better results on OSCE (Objective Structured Clinical Encounter) tests. Aside from this, annual interviews of students learn that PBL is preferred over the more classical way of learning.

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WA8

Development of Human Patient Simulators for use in physiology practical teaching

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In April 2005, the medical science departments at the University of Bristol were designated by the Higher Education Funding Council for England (HEFCE) as a Centre for Excellence in Teaching and Learning (CETL). As a result we were awarded funding of 4.5 million pounds in order to establish the AIMS Centre (Applied and Integrated Medical Sciences). The award was part of a competitive, national initiative by HEFCE to establish around 70 CETLs nationwide in order to "...recognise and reward excellent teaching practice, and to further invest in that practice...".

The Department of Physiology has played a leading role in establishing the AIMS Centre, which will focus on practical teaching in the fields of anatomy, physiology, pharmacology and histology.

One major initiative within the CETL is the integration of our existing undergraduate practical teaching in physiology and pharmacology with the use of high fidelity, computer-controlled Human Patient Simulators or manikins. The latter can be used to simulate physiological responses in extreme environments (such as high altitude), intense exercise and pathological situations such as haemorrhage and airway obstruction that cannot be demonstrated using healthy students. Manikins can also be used to illustrate the changes that occur in homeostatic mechanisms throughout the ageing process.

We plan to incorporate the manikins into our existing teaching in ways that will enable undergraduates to continue to make physiological measurements on themselves and each other at rest and during exercise, but to enable them also to record the simulated responses that might be obtained if the same measurements had been obtained, for example, from normal subjects exposed to a range of extreme environments or an intensive exercise regime. We also plan to develop case studies and scenarios that simulate pathophysiological situations in order to reinforce understanding of normal physiological processes.

The CETL funding will enable us to purchase two Human Patient Simulators that will be used in all of our undergraduate degree programmes - medical, dental, veterinary science and BSc.

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WA9

Real-time Competition Among Teachers and Students - a Method for Improving Teaching and Assessing Physiology

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Every University consists ultimately in relationship between students and professors and probably every University is concerned on students to improve performances and on professors to actualize courses to the last achievements of the domain or to some new curricula. We developed our own concept of real-time competition among teachers and students and also software to support this concept. We developed software for easy editing physiology courses and tests, software for teaching, individual studying and smart performing tests with multiple choice answers. Finally we developed software for evidence of individual or group results evolution and classification. Tests control student knowledge and improve access to gained information and, if questions in tests are of high quality, they will help student even to think. Unfortunately student's desire to perform tests isn't strong enough to determine professors to generate permanently revised material to be tested and tests on low quality questions won't bring significant results. An attempt to improve performances and desire of student to test himself is to give him opportunity to make a self-evaluation, that is self-evolution and comparison with others. Professor has to feed this assessing process with some criteria, preferably unique in time and for all competitors and also has also to obtain feedback of how good are these criteria, how many students and how deep are they implied in performing tests. Until now students were evaluated in classical exams performed at too large interval of time to rise the spirit of competition but today, when time runs faster, we have to give students the opportunity of any time testing and instant evaluation. This real-time competition among students improves students' results and lead to reachable goals for professors giving them reasons to generate more material to be studied and tested. This repeating circle considerably improves teaching and assessing physiology.

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WA10

Confidence-Based Marking: Encouraging rigour through assessment

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Students, especially medical students, have a lot to learn and a lot of assessments. Many able students find that they can do well without much thought - since the first idea they think of

in answer to a question usually has a good chance of being correct, and this approach can get them good marks in exams. This tends to reward rote-learning, and a superficial approach. Confidence-based marking (CBM), in which a student must indicate confidence in each answer and be graded according to a properly motivating mark scheme, helps to encourage reflection, justification and rigour. It rewards both justification to the point of high confidence and the ability to identify reasons for reservation about an answer, and it therefore encourages a more rigorous approach both to learning and assessment. Experience at UCL and Imperial College over many years has shown that students find the concept and our marking scheme easy to understand, fair, and a stimulus to learning. Our dissemination programme is designed to encourage uptake in other universities and other disciplines, wherever students encounter questions to which the answers can be marked as right or wrong.

Our scheme for CBM is simple: confidence is rated 1, 2 or 3 and the marks awarded for correct answers are the same: 1, 2 or 3. Incorrect answers receive penalties of 0, -2 or -6. This graded negative marking rewards a student who can discriminate reliable from uncertain knowledge. Highest marks are obtained by choosing C=1 if the probability of being correct is <67% and C=3 if it is >80%. The features that students appreciate are that it correctly distinguishes sound knowledge from a lucky guess, and it deservedly penalises confident misconceptions more than ignorance. In summative assessments it has greater reliability and validity than marking based simply on the numbers of correct answers (Gardner-Medwin & Gahan, 2003). It improves signal-to-noise ratios by reducing the weighting of answers based on uncertain knowledge, which are associated with high variance. It shows no evidence for gender bias in practised students — a concern sometimes volunteered by people on first hearing of CBM. CBM avoids a serious hazard that arises with use of a conventional fixed negative marking scheme (+/-1) with true/false questions, which can disadvantage students who have the insight to see when there are reasons for reservation, or who are simply diffident, or who take too literally advice that they should refrain from guessing (Gardner-Medwin, 1999).

There are simple arrangements for staff and students in new institutions to experience CBM in practice and to develop, adapt and run existing exercises based on their own material. The software can either be used via the UCL website (www.ucl.ac.uk/lapt) or can be copied elsewhere. For summative tests requiring invigilation we prefer to use Optical Mark Reader technology, for which cards implementing CBM for either True/False or multiple choice (pick one from A-E) questions are available from UCL and can currently be processed by UCL. Other question types (e.g. extended matching sets) can be handled with cards available from Speedwell Computing Services (www.speedwell.co.uk). Gardner-Medwin, AR (1999) Rational and irrational marking schemes. *J Physiol* **515P**, 48P

Gardner-Medwin AR & Gahan M (2003) Formative and Summative Confidence-Based Assessment. Seventh International Computer-Aided Assessment Conference Proceedings, Loughborough University, UK, pp. 147-155 (www.caaconference.com)

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