Edukacija magistara medicinske biokemije na Farmaceutsko-biokemijskom fakultetu Sveučilišta u Zagrebu: kako smo se uklopili u Bolonjski proces

Education of Masters of Science in Medical Biochemistry at the Faculty of Pharmacy and Biochemistry, University of Zagreb: How did we fit in the Bologne process

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Sažetak

Reforma visokog obrazovanja na sveučilištima u RH temelji se na prihvaćanju Bolonjske deklaracije, koja kao osnovnu zadaću postavlja stvaranje cjelovitog europskog prostora visokog obrazovanja i istraživanja. Ovaj cilj zahtijeva da sve zemlje potpisnice izrade nacionalni okvir komparabilnih i kompatibilnih kvalifikacija u vlastitim sustavima visokog obrazovanja.

Nova koncepcija Studija medicinske biokemije posebnu važnost daje multidisciplinarnom karakteru struke da bi se osigurali temelji za kvalitetnu primjenu znanstvenih spoznaja u kliničkom okruženju. Program je usklađen s preporukama koje su prihvaćene u većini zemalja Europe za rad u medicinsko-biokemijskim laboratorijima, a predviđa jedan petogodišnji ciklus edukacije koji završava titulom *magistra medicinske biokemije*. Multidisciplinarnost se postiže tako da se kroz studij stječu: temeljna znanja iz prirodnih znanosti, biomedicinska znanja kao što su anatomija, fiziologija, patofiziologija, histologija i citologija, imunologija, mikrobiologija i parazitologija, te stručna medicinsko biokemijska znanja - klinička biokemija, hematologija s koagulacijom, transfuziologija, analitička toksikologija, molekularna dijagnostika, racionalna laboratorijska dijagnostika i sl., te znanja i vještine iz komunikacijskih disciplina, laboratorijskog menadžmenta, te informatizacije laboratorijskog sustava. U ukupnom petogodišnjem studiju ima 28 % temeljnih, 12% biomedicinskih, 45% stručnih i 15% izbornih predmeta.

Program predviđa maksimalno povezivanje osnovnih i stručnih predmeta, stručna praksa se provodi već od prve godine. Predmeti su ocijenjeni prema ECTS sustavu tako da student može dio studija obaviti i na nekom drugom sveučilištu. Nastavni plan se izvodi u suradnji s kliničkim bazama Fakulteta, posebno se to odnosi na *Stručnu praksu* i *Integrirani kolegij laboratorijske dijagnostike* koji se u cijelosti organizira u kliničkim laboratorijima.

Novi program studija omogućava diplomiranom stručnjaku stjecanje cjelovitog znanja iz medicinske biokemije te stjecanje kompetencija da organizira rad i primjeni suvremene tehnologije u laboratorijsku praksu, da kompetentno interpretira laboratorijske nalaze, čineći ga bitnim članom stručnog medicinskog tima koji zbrinjava bolesnika, ili kompetentnim znanstvenim radnikom. Suvremeno obrazovanje medicinskih biokemičara omogućuje uspješno sudjelovanje u razvoju struke koja se širi prema sveobuhvatnim laboratorijskim znanostima - medicinskoj biokemiji i laboratorijskoj medicini.

Abstract

The recent reform of the university education in Republic of Croatia is undertaken to attain the main objectives set up by Bologna Declaration on promoting global competitiveness of European Higher Education. The Declaration that was signed by 29 countries is the common commitment to reform the structures of respective higher education system in a convergent way and to produce the national framework of readable and comparable degrees.

New concept for the university degree in Medical Biochemistry is particularly emphasising the multidisciplinary character of the profession in order to enable application of scientific knowledge in the medical context. Curriculum is harmonised with the recommendations that are accepted in the majority of European countries, and consists of an integral five years programme leading to the degree of *Master in Medical Biochemistry*. The multidisciplinary approach is achieved by introducing various disciplines into curriculum: 1. Fundamental natural sciences; 2. Biomedical disciplines (anatomy, physiology, pathophysiology, histology, cytology, immunology, microbiology and parasitology, etc.); 3. Professional medical biochemistry disciplines (clinical biochemistry, haematology, coagulation, clinical immunology, blood banking, analytical toxicology, molecular diagnostics, etc.; and knowledge, competences and skills in communication, laboratory management, automation, and informatization of laboratory system. The relative proportion of the subjects during the five year study is: 28% fundamental natural sciences, 12% of biomedical, 45% professional and 15% elective subjects.

The fundamental and professional subjects would be intensively correlated, and training in the hospital laboratory will start already from the first year. The ECTS credits will be assigned to the each subject, and student mobility would be encouraged. There will be great cooperation with the teaching hospitals related to Faculty, in particular for the courses *Integral laboratory diagnostics and Professional laboratory practice.*

At completion of the new Medical Biochemistry curriculum the graduate would have a through knowledge of all aspects of medical biochemistry science relevant to the discipline, and competences to organize laboratory practice and apply current techniques, to evaluate the diagnostic data and to provide an expert opinion in the medical team, or to pursue a career in the fundamental and applied scientific research. The new concept comprises relevant knowledge in clinical cytology, microbiology, clinical immunology, blood banking, analytical toxicology, molecular diagnostics thus concurring with the current trends in Medical Biochemistry and Laboratory Medicine.

Magna Charta Universitatum – temeljni dokument Bolonjskog procesa

Značajne promjene koje se zadnjih godina događaju u europskom visokoškolskom sustavu utjecale su na sveobuhvatnu reformu obrazovanja na svim hrvatskim sveučilištima. Ishodište reforme predstavlja Bolonjska deklaracija u kojoj je kao osnovna zadaća zacrtano uspostavljanje cjelovitog europskog prostora visokog obrazovanja i istraživanja. Ovaj bi se cilj trebao ostvariti do 2010. godine.

U današnjem globaliziranom svijetu znanja i istraživanja prave učinke može dati samo suradnja utemeljena na jasno definiranim načelima, koja će prihvatiti sve europske nacije i države. Budućnost sve više ovisi o kulturnom, znanstvenom i tehničkom razvoju, koji se stvara u središtima kulture, znanja i istraživanja kao što su to sveučilišta.

"*Magna charta universitatum*" je povelja proizašla iz ovakvih promišljanja, i u njoj su zacrtani principi razvoja europskih sveučilišta. Na sastanku rektora održanom u Bolonji 1988. godine, na devetstotu godišnjicu osnivanja najstarijeg Sveučilišta u Europi, donesena je odluka da sveučilišta moraju osnažiti svoju 9 stoljeća staru temeljnu misiju da ustrajno čuvaju znanja na kojima se ranije dosegnute spoznaje produbljuju, nadopunjuju ili nadomještaju novima, te kritički prenose na generacije koje dolaze. Za čuvanje i prijenos znanja nisu dostatne samo knjižnice, bilo tradicionalne ili elektroničke. Potrebna je živa ljudska kritičnost, neprestano provjeravanje i istraživanje u kojem se tekovine novog vremena i iskustava susreću s nasljedstvom prethodnika.

Važno je uočiti da je Bolonjski proces jednako akademski koliko i politički projekt. Zemlje članice Europske unije su prepoznale važnost i potrebu cjelovite integracije kao preduvjeta stvaranja savršenije i utjecajnije Europe, sposobne da ravnopravno sudjeluje u globalnom procesu izgradnje i jačanja intelektualnih, kulturnih, društvenih, znanstvenih i tehnoloških vrijednosti novoga svijeta. Deklaracijom potpisanom 19. lipnja 1999. u Bolonji vlade 29 zemalja su preuzele obvezu da podupiru i omoguće globalnu transformaciju strukture vlastitog visokoškolskog sustava. Naša je zemlja potpisala prihvaćanje ove deklaracije 2001. godine.

Europa znanja ustraje u kreiranju jedinstvenog prostora visokog obrazovanja, nužnog za promicanje mobilnosti građana i njihovo zapošljavanje, te za sveukupni razvoj cijelog kontinenta. Vitalnost i djelotvornost svake civilizacije može se mjeriti privlačnošću njezine kulture drugim zemljama. Zbog toga je potrebno osigurati da europski sustav visokog obrazovanja postane privlačan širom svijeta, sukladno njegovoj izvanrednoj kulturnoj i znanstvenoj tradiciji. Potreba za reformom ovog sustava prvenstveno proizlazi iz shvaćanja da su europski studiji predugi, preskupi i nedovoljno učinkoviti, odnosno da ne daju dovoljno osposobljenosti visokoškolski obrazovanim stručnjaci-

Magna Charta Universitatum – the fundamental document of the Bologne Process

Significant changes that are happening during the last few years in the European higher education system have influenced the overall education reform on all faculties of Croatian universities. The starting point of the reform is the Bologne Declaration with the basic mission of the establishment of the European Higher Education and Research Area. This objective should be accomplished by the year 2010.

In today's globalized world of knowledge and research, the right results can be obtained only by a cooperation that is based on clearly defined principles, acceptable by every European nation and country. The future increasingly depends on cultural, scientific and technical development that is created in the centres of the culture, science and research, such as universities are.

"*Magna charta universitatum*" is a charter based on such standings and the principles of development of European Universities are set in it. On the rector meeting in Bologna 1998, on the 9th centennial of the University of Bologna, the oldest European university, it was decided that the Universities must enforce their 9 century old basic mission to safeguard perseveringly the knowledge, which has been gathered for a long time and now is being widened and completed or substituted with the new ones and is critically transmitted to the generations to come. For safeguarding and transmitting knowledge libraries are not sufficient, either traditional or electronic. Live human critical ability is needed, a continuous checking and researching where the achievements of the new times and experiences meet the inheritance of the predecessors.

It is important to see that the Bologne Declaration is an academic but also a political project. The European Community member countries have recognised the importance and the need of the overall integration as a precondition for creating a better and more influential Europe, able to participate equally in a global process of construction and strengthening of intellectual, cultural, social, scientific and technological values of the new world. By signing the Declaration on 19th of June 1999 in Bologna, the governments of 29 countries took over the responsibility to support and enable the global transformation of the own higher education structure. Our country signed and accepted the Declaration in 2001.

A Europe of Knowledge persists in creating a unique higher education area, important for promoting citizen mobility and their employment, and for the overall development of the continent. Vitality and efficiency of every civilisation can be measured by the fact how attractive its culture is to the other countries. Thus it is important to ensure that the European higher education system becomes attractive all over the world, in accordance to its exceptional cultural and scientific tradition. The need for

ma. Studiranje mora postati brže i jeftinije, a studenti se nakon završetka studija moraju brže i lakše uklapati u radne sredine. No, iako su ovi ciljevi vrlo jednostavni i jasni, put do njihovog ostvarenja je složen, nesiguran i izuzetno zahtjevan, pa traži visok stupanj koordinacije i zalaganja svih čimbenika uključenih u visokoškolsko obrazovanje. Reforma kojom bi se promijenila efikasnost studiranja daleko je kompleksnija od jednostavnog proširivanja studijskih programa. Ona duboko zadire u načine izvođenja nastave, pa i u samu svrhu obrazovnog procesa. Današnje školovanje studentu daje *znanje*. Sutrašnje bi ga trebalo opskrbiti *znanjem, vještinama i kompetencijama*.

Ovakvo promišljanje čini osnovu Bolonjske deklaracije, koja je formulirana kao:

1. *Prihvaćanje sustava lako prepoznatljivih i usporedivih akademskih stupnjeva* i uvođenje posebnog dodatka diplomi koji sadrži cjeloviti popis odslušanih predmeta, znanja i sposobnosti stečenih na studiju (*Diploma Supplement)*.
2. *Prihvaćanje sustava visokog obrazovanja temeljenog na trima glavnim ciklusima: preddiplomskom, diplomskom i doktorskom*. Prvi ciklus ima dvije namjene, obrazovanje pristupnika za profesionalni rad na poslovima ograničene samostalnosti, ili nastavak studiranja na diplomskom studiju. Drugi ciklus vodi k akademskom zvanju magistra struke i osposobljava za samostalno rješavanje problema u interdisciplinarnom okruženju. Ova shema ima izuzetaka koji se prvenstveno odnose na biomedicinsko područje, gdje su svi studiji prihvatili jedinstvenu organizaciju integriranog preddiplomskog i diplomskog studija u trajanju od pet ili šest godina. Poslijediplomski doktorski studij vodi do akademskog stupnja doktora znanosti.
3. *Uvođenje ECTS sustava (Europski sustav prijenosa bodova)* koji će omogućiti lako prepoznavanje ostvarenih obrazovnih stupnjeva. Kreditni ECTS bodovi su vrijednost koja se pripisuje studijskoj jedinici (predmetu ili modulu) i odražavaju studentsko opterećenje potrebno da bi se ona dovršila - oni izražavaju ukupnu količinu rada za svaki pojedini predmet u odnosu na ukupnu količinu rada potrebnu za završetak pune akademske godine u nekoj instituciji, što uključuje predavanja, seminare, praktični rad, osobni rad izvan institucije te pripremu i sudjelovanje na ispitima i sl.
4. *Promicanje mobilnosti studenata i nastavnika*.
5. *Promicanje europske suradnje u osiguravanju kvalitete* sa ciljem razvijanja usporedivih kriterija i metodologija.
6. *Promicanje europskih vrijednosti u visokom školstvu*.
7. *Razvijanje koncepta cjeloživotnog obrazovanja*.
8. *Naglašavanje uloge studenata u razvijanju i upravljanju visokim obrazovanjem*. Sveučilište je usmjereno prema studentima jer se nastavni plan temelji na opterećenju studenta, a ne nastavnika, a vrednuju se rezultati

a reform of the educational system arises primarily out of understanding that the European university studies last too long, they are too expensive and not efficient enough, they do not provide enough qualification for higher educated specialists. Studying must become faster and cheaper and the students should fit faster and easier into working environment after finishing studies. However, although those objectives are very simple and clear, the road to their implementation is very complicated, insecure and extremely demanding, so it requires a high level of coordination and dedication of all factors involved in higher education. The reform which would change the efficiency of the studying is far more complex than simple curriculum widening. It reaches deep into the methods of teaching performance, and to the ultimate goal of the educational process. The today's education provides students the *knowledge*. The tomorrow's education should provide them the *knowledge*, *skills* and *competences*.

Such consideration makes the fundament of the Bologne Declaration, which is formulated as follows:

1. *Acceptance of a system of easy readable and comparable academic degrees* and introducing a special supplement to higher education diploma that contains the complete list of audited subjects, knowledge and competencies achieved during the study period (*Diploma Supplement).*
2. *Acceptance of higher education system based on the three cycle structure (bachelor, master and doctorate).* The first cycle has two aims: education of undergraduates for a professional work on tasks of limited independence or for continuation of graduate study. The second cycle leads to the academic degree of magister of science in profession and qualifies for independent problem solving in interdisciplinary environment. There are exceptions to this scheme primarily related to biochemical area, where all studies have accepted the unique structure of integrated undergraduate and graduate studies that last five to six years. Postgraduate doctor studies lead to degree of doctor of science.
3. *Establishment of ECTS system* (*European Credit Transfer System – system of credits*) that should allow an easy recognition of accomplished educational level The ECTS credits represent a value that is assigned to a studies unit (subject or module) and reflects student's work in order to successfully complete it – it expresses the overall work for each subject needed to complete the full academic year in an institution, what includes lectures, seminars, practical work (training), individual work outside the institution and preparation and participating in examinations and similar.
4. *Promotion of student and teacher mobility.*
5. *Promotion of European co-operation in quality assurance* with a goal of developing comparable criteria and methodologies.

učenja, a ne sadržaji. Metode rada stavljaju studenta u središte nastavnog procesa, jer mu se kroz slobodni izbor većeg broja izbornih predmeta omogućuje da sam kreira vlastiti put kroz studij i tako započinje svoje cjeloživotno učenje i buduće zapošljavanje.

Svi navedeni ciljevi su usmjereni ka promicanju privlačnosti europskog prostora visokog obrazovanja u smislu njegove globalne konkurentnosti. Pojedine zemlje moraju djelovati na internacionalizaciji vlastitih obrazovnih sustava promicanjem *kompatibilnosti i komparabilnosti* studija s onima u Europi, ali uz obvezu čuvanja posebitosti vlastitog obrazovanja i autonomije obrazovnih institucija.

Kvalifikacije i kompetencije u Europskom prostoru visokog obrazovanja

Integriranje europskog prostora visokog obrazovanja zahtijeva da sve zemlje potpisnice Bolonjske deklaracije izrade nacionalni okvir kvalifikacija u vlastitim sustavima visokog obrazovanja. Tim će se okvirom opisati kvalifikacije u terminima nastavnog opterećenja, razine, ishoda učenja, kompetencija i profila. Uz to je potrebno jasno definirati krovni okvir kvalifikacija, tako da svaki stupanj obrazovanja ima različiti, definirani ishod učenja - odnosno skup znanja i vještina koje završeni student razumije, ili je sposoban raditi na kraju razdoblja učenja. Prvi i drugi ciklus, prvostupnik i magistar, moraju imati različite profile, da bi mogli ispuniti raznolike individualne i akademske potrebe, te potrebe tržišta rada. Ovakva organizacija stvara preduvjete za priznavanje inozemnih kvalifikacija i pospješuje mobilnost studenata. U Tablici 1. su pregledno izneseni kriteriji koje je potrebno zadovoljiti za postizanje pojedinog stupnja.

Usporedivost i priznavanje kvalifikacija na europskoj i nacionalnoj razini

Usporedivost kvalifikacija je preduvjet osiguranja mobilnosti studenata i završenih stručnjaka u europskom prostoru. Za ispunjenje toga cilja potrebno je uspostaviti sustav jasnih i usporedivih stupnjeva što omogućuje priznavanje kvalifikacija stečenih na različitim sveučilištima i u drugim zemljama.

Pitanje priznavanja može se odnositi na:

- priznavanje institucija na nacionalnoj razini,
- priznavanje visoko-obrazovnih programa,
- priznavanje stečenih kvalifikacija na nacionalnoj ili europskoj razini.

Priznavanja se provode na akademskoj ili profesionalnoj razini.

Pod akademskim priznavanjem podrazumijeva se prihvaćanje odslušanih ili položenih predmeta, stečenih kvalifikacija, tj. diploma na nekom stranom sveučilištu, zbog

6. *Promotion of European values in higher education.*
7. *Development of the lifelong education concept.*
8. *Emphasis on the role of students in developing and managing of higher education.* The University is focused on students because the curriculum is based on work and achievements of students and not teachers. Similar to that the learning result and not the content is being evaluated. Working methods put students into the centre of the teaching process, because through a larger choice of optional subjects they have the opportunity to create their own way through the study and so start their lifelong studying and future employment.

All mentioned aims are set to promote the attractiveness of the European higher education area towards global competition. Some countries must work on the internationalisation of their own educational systems by promoting *compatibility* and *comparability* of its studies to the European ones, but with an obligation of keeping their own educational specifics and their educational institution autonomy.

Qualifications and competencies in the European higher education area

Integration of European higher education area requires from all Bologna Declaration signatory countries to prepare a national framework in their own higher education systems. This framework will describe qualifications in terms of teaching achievement requirements, levels, learning results, competencies and profiles. It is also required to define clearly qualification frame, so that each education level has its own_defined learning result – a set of knowledge and skills that a student can understand or is able to perform at the end of a learning period. The first and the second cycle, bachelor and master, must have different profiles in order to fulfil different individual and academic needs and the needs of the labour market. Such organisation creates fundaments for recognition of international qualifications and improves student mobility. Criteria that have to be satisfied in order to accomplish each level are presented in table 1.

Comparability and recognition of qualifications at European and national level

Comparability of qualifications is a precondition of student mobility assurance and graduated specialists in the European higher education area. To achieve that aim a system of clear and comparable (transparent) levels has to be established. That enables the recognition of qualifications acquired on different universities and in different countries.

Tablica 1. Kriteriji po kojima se opisuju pojedini stupnjevi u obrazovanju

Table 1. Criteria for description of degrees in higher education

	Bachelor-BSc	Master-MSc/Ma	Doctor-PhD
Knowledge and understanding	Knowledge and understanding only from the area of the studies, it connects to the high school education and includes some aspects of modern knowledge	Knowledge and understanding from the first cycle is being further extended and depend and offers fundaments for original development and for application of original ideas within the area of the studies	Knowledge sufficient for creating and interpreting of a new knowledge, original research and publishing of own results, systematic understanding of the essence of a scientific and applied professional research
Application of knowledge and understanding	Qualification for application in a profession-specific way and competencies for problem solving in the area of the studies	Qualification for application in problem solving in new and unknown situations, in interdisciplinary context connected to the area of the studies	Qualification for application of new concepts and making and implementation of projects that will generate new knowledge verified through the publishing within the profession
Conclusion and judgement making – decision	Skills for collecting and interpreting of relevant data and making conclusions	Ability to integrate knowledge and to manage complexity, conclusion formulation on the grounds of incomplete or limited information, with ethical and social responsibility	Ability of critical analysis, evaluation and synthesis of new, complex ideas, with relevant, scientific, social and ethical responsibility
Presentations	Presentations of information and problems with their solutions offered to the professional and general public	Presentations of own conclusions, knowledge and relevant arguments to the professional and general public in non equivocate manner	Presentations of own conclusions, and results in a clear and non equivocate manner
Learning skills	Possession of learning skills required for lifelong learning and studies continuation on the master studies	Possession of learning skills required for lifelong learning, formal and individual education	Possession of qualities and generic skills required for employment and constant advancing

nastavka obrazovanja, ili želje da se akademska karijera ostvari na stranoj instituciji.

Profesionalno priznavanje podrazumijeva pravo na rad i stjecanje profesionalnog statusa u skladu sa stečenom kvalifikacijom. Glavni dokument kojim je regulirano akademsko priznavane u Europi jest UNESCO-ov dokument *„Konvencija o priznavanju kvalifikacija u visokom obrazovanju"* kojim se naglašava nužnost usmjeravanja na globalnu procjenu razine i profila kvalifikacije te uspoređivanje ishoda učenja i stečenih sposobnosti, namjesto isključivog uspoređivanja obilježja programa.

Za uspješnu provedbu reforme visokog obrazovanja Ministarstvo znanosti, obrazovanja i športa RH je donijelo niz propisa i zakona kojima se reguliraju nacionalni obrazovni okviri i opisuju stupnjevi obrazovanja i njihova međusobna povezanost. Na slici 1. je grafički prikazana shema obrazovnih stupnjeva u sveučilišnim i stručnim studijima. U učinkovitom i dobro organiziranom društvu svaki od navedenih stupnjeva morao bi imati definiranu ulogu u društvu.

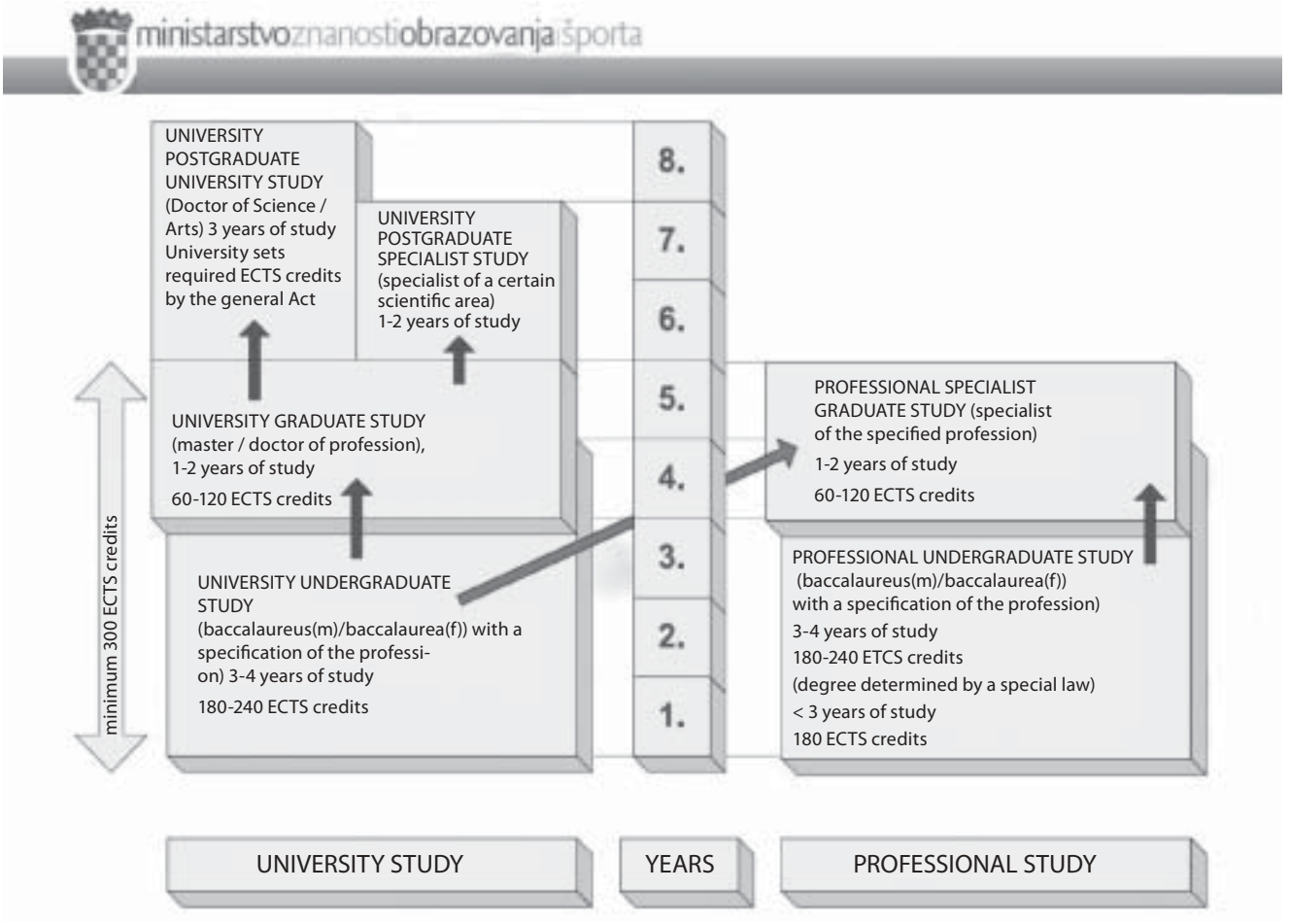
The recognition issue can relate to:

- recognition of institution at national level
- Recognition of higher education programmes (curriculum)
- Recognition of acquired qualifications at national and European level

Recognitions are implemented at the academic and professional level.

Academic recognition understands acceptance of audited and completed subjects, acquired qualifications and diplomas from a foreign university, needed for continuation of the study or out of wish to make an academic career at a foreign institution.

Professional recognition implies the right to work and acquiring of a professional status in accordance with acquired qualification. The fundamental document that regulates the academic recognition in Europe is UNESCO's document *"Convention on the Recognition of Qualifications concerning Higher Education in the European Region"* that emphasizes the necessity of directing to glo-



Slika 1. Shema strukture obrazovnih stupnjeva u sveučilišnim i stručnim studijima (prema mrežnoj stranici MZOS, 2008.)

Figure 1. Scheme of the structure of educational levels in university and professional studies (according to network websites of the MZOS, 2008)

Kako se u ove kriterije uklapaju Farmaceutsko-biokemijski fakultet i Studij medicinske biokemije ?

Reforma programa Studija medicinske biokemije temelji se na kriterijima koji su prihvaćeni u većini zemalja Europe za rad u medicinsko-biokemijskim laboratorijima, a koji je obuhvaćen u dokumentu "*European Syllabus for the training in Clinical Chemistry*". Programom je predviđena akademska edukacija (4-5 godina), koja mora biti upotpunjena boravkom u kliničko-biokemijskim laboratorijima i poslijediplomskom specijalizacijom u trajanju od 4 godine. Europski forum EC4 predviđa zadržavanje preddiplomsko-diplomske edukacije koja je razvijena u pojedinoj zemlji, a detaljna pravila harmonizacije propisuje za program specijalizacije.

Nastavnim programom Farmaceutsko-biokemijskog fakulteta predviđen je petogodišnji ciklus edukacije koji,

bal estimation of the qualification level and profile and comparing the learning results and acquired abilities, instead of pure comparison of programme characteristics

For a successful higher education reform implementation The Ministry of Science, Education and Sports (MZOS) has enforced a number of provisions and bills that regulate the national educational framework and describe educational levels and their mutual correlations. A scheme of educational levels in university and professional studies is shown at figure 1. In an efficient and well organised society each of the mentioned levels should have a defined role in the society.

How do the Faculty of pharmacy and biochemistry and the medical biochemistry studies fit into these criteria?

The reform of medical biochemistry studies is based on the criteria accepted in the majority of the European

va titulom *magistra medicinske biokemije*. Jedan cjeloviti obrazovni ciklus su predvidjeli i svi ostali fakulteti unutar biomedicinske grupacije. Studij je zamišljen tako da su stručni predmeti uključeni u program već od prve nastavne godine, uz ponudu velikog broja izbornih predmeta. U ukupnom petogodišnjem studiju predmeti su organizirani tako da se nudi:

- 28 % temeljnih
- 12% biomedicinskih
- 45% stručnih i
- 15% izbornih predmeta

Program se izvodi uz maksimalno povezivanje osnovnih i stručnih predmeta, a stručna praksa se provodi već od prve nastavne godine. Predmeti su ocijenjeni prema ECTS sustavu bodova i mogu se prenositi s jednog visokog učilišta na drugo. Tako student može dio svog studija obaviti i na nekom drugom sveučilištu što bi trebalo rezultirati većom pokretljivošću studenata, ali i nastavnika. Predloženi nastavni plan se izvodi u suradnji s nastavnim bazama Fakulteta. Posebno se to odnosi na *Stručnu praksu* i *Integrirani kolegij laboratorijske dijagnostike* koji će se u trajanju cijelog 9. semestra organizirati u kliničkim laboratorijima. U nastavnim bazama će se izvoditi dio praktične nastave, a dio predavanja je predviđen i za nastavnike s klinika koji intenzivno surađuju s Farmaceutsko-biokemijskim fakultetom.

Sastavljanje programa Studija medicinske biokemije rukovođeno je načelom da se struka razvija unutar interdisciplinarnog područja čije se znanstvene spoznaje primjenjuju u sustavu zdravstva sa ciljem uspješne dijagnostike, praćenja te prevencije bolesti. Suvremena medicina, tijesno povezana s razvojem znanosti i tehnologije, nezamisliva je bez dobre medicinsko-biokemijske dijagnostike.

Medicinska biokemija integrira spoznaje *opće i analitičke biokemije* te *stanične i molekularne biologije* s *fiziološkim i patofiziološkim* procesima, omogućujući razumijevanje patoloških procesa na molekularnoj razini kao i *iznalaženje novih dijagnostičkih i prognostičkih pokazatelja bolesti*.

Studij medicinske biokemije je interdisciplinaran te se stječu:

- *temeljna znanja* (matematika, kemija, fizika, statistika, biokemija, biologija, molekularna biologija);
- *biomedicinska znanja* (anatomija, fiziologija, patofiziologija, histologija i citologija, imunologija, genetika, mikrobiologija i parazitologija, farmakologija, toksikologija i hematologija);
- *stručna medicinsko biokemijska znanja* (opća i patološka klinička biokemija, hematologija s koagulacijom i imunohematologijom, klinička imunologija, transfuziologija, klinička citologija, mikrobiologija, analitička toksikologija, molekularna dijagnostika, laboratorijska dijagnostika hitnih stanja, dijagnostika uz bolesničku postelju, racionalna laboratorijska dijagnostika, i sl.);
- *znanja i vještine iz komunikacijskih disciplina, laboratorijskog menadžmenta*, automatizacije, elektroničke ob-

countries for employment in laboratories of medical biochemistry, which can be found in a document "*European Syllabus for Post graduate for the training in Clinical Chemistry*". The programme includes an academic education (4-5 years) completed with an obligatory training in clinical biochemical laboratories and postgraduate specialisation that lasts 4 years. The European Forum EC4 implies keeping the existing undergraduate education developed in each country, and it regulates the detailed harmonisation regulations for the specialisation curriculum.

The Curriculum of the Faculty of Pharmacy and Biochemistry predicts a five-year education cycle which leads in accordance with the Law on Science and Higher Education to a degree of *Master of Science in Medical Biochemistry*. All other faculties within the biomedical group planed such integral educational cycle. The studies are conceived so that professional subjects are included into the Curriculum already in the first year and a large number of elective subjects are offered. In the five-year education the Curriculum subjects are organised into following relative proportions:

- 28% fundamental natural sciences
- 12% biomedical
- 45% professional
- 15% elective (optional) subjects

The fundamental and professional subjects of the Curriculum are intensively correlated and the training in the hospital laboratory starts already during the first year. The ECTS credits are assigned to the each subject and are transmittable among different faculties. Due to that fact students can continue their studies on another faculty, what should encourage student mobility, but also the mobility of teachers. The suggested Curriculum is performed in cooperation with teaching hospitals of the Faculty. This refers especially to the courses of Integral Laboratory Diagnostics and professional Laboratory Practice, which ill be organised in clinical laboratories during the 9th semester. The practical part of teaching will be performed in the teaching hospitals and a part of lectures will be held by teachers from the clinical departments that cooperate intensively with the Faculty.

The Curriculum setting for the Medical Biochemistry studies is led by a principle to develop the profession within the scope of interdisciplinary area, whose scientific knowledge is applied in the health care system aiming for successful diagnostics, monitoring and prevention of illness. The modern medicine, closely connected to development of science and technology, is unthinkable without good medical biochemical diagnostics. Medical Biochemistry integrates the knowledge of *general and analytical biochemistry* and *cellular and molecular biology with physiological and pathophysiological* processes, and it enables the understanding of pathological processes at the molecular level as well as *obtaining new diagnostic and prognostic illness indexes*.

rade podataka, organizacija i upravljanje medicinsko biokemijskim laboratorijem, te informatizacije laboratorijskog sustava.

Ovako zamišljen program studija omogućava diplomiranom stručnjaku da kompetentno interpretira rezultate laboratorijskih pretraga čineći ga *bitnim članom stručnog medicinskog tima koji zbrinjava bolesnika,* ili *znanstvenog tima koji razvija i istražuje nove znanstvene spoznaje*. Diplomirani stručnjaci, magistri medicinske biokemije, nakon završenog 10-semestralnog studija mogu obavljati zdravstvenu djelatnost na svim razinama laboratorijske zdravstvene skrbi i tako opravdati svoje mjesto u laboratorijskom timu kako u velikim laboratorijima kliničkih bolnica, tako i u drugim tipovima bolnica, ili u primarnoj zdravstvenoj zaštiti. Suvremeno obrazovanje medicinskih biokemičara s dosta znanja iz citologije, mikrobiologije, imunologije i transfuziologije omogućuje uspješno sudjelovanje u razvoju struke koji je usmjeren prema sveobuhvatnim laboratorijskim znanostima, medicinskoj biokemiji i laboratorijskoj medicini. Primjenom biokemijskih, hematoloških, molekularno-bioloških i kemijskih postupaka, tehnika i tehnologija ispitivanja bioloških materijala oni uspješno pridonose utvrđivanju uzroka bolesti, održavanju zdravlja, prevenciji bolesti, praćenju uspjeha liječenja kao i novim znanstvenim spoznajama.

Program Studija medicinske biokemije na Farmaceutsko-biokemijskom fakultetu Sveučilišta u Zagrebu usporediv je sa sličnim programima u Češkoj, Poljskoj, Mađarskoj i Izraelu.

Poslijediplomski doktorski studij

Farmaceutsko-biokemijski fakultet je predložio i dobio potvrdnicu za provođenje poslijediplomskog doktorskog studija iz Farmaceutsko-biokemijskih znanosti kojim se stječe akademski stupanj *doktora znanosti* u znanstvenom području *Biomedicine i zdravstva*. Studij se organizira u dva modula: Farmaceutske znanosti i Medicinsko-biokemijske znanosti. Cilj doktorskog studija je obrazovanje pristupnika za samostalni istraživački rad u znanstveno-istraživačkim institucijama i kliničkoj praksi, te pruža temeljito istraživačko iskustvo u specifičnim područjima medicinske biokemije.

Studij je namijenjen medicinskim biokemičarima, farmaceutima, te drugim stručnjacima iz područja *Biomedicine i zdravstva* i područja *Prirodnih znanosti*.

Inovativnost doktorskog programa

Prijedlog doktorskog programa je izrazito interdisciplinaran, ali je postignuta integracija ispreplitanjem sadržaja iz područja prirodnih, temeljnih i primijenjenih kliničkih znanosti, te vrlo važnih informacijskih i komunikacijskih znanosti. Izvođenje programa temelji se na raznovrsnosti

The Medical Biochemistry studies are interdisciplinary and students acquire:

- *fundamental knowledge* (mathematics, chemistry, physics, statistics, biochemistry, biology, molecular biology);
- *biomedicine knowledge* (anatomy, physiology, pathophysiology, histology and cytology, immunology, genetics, microbiology and parasitology, pharmacology, toxicology and haematology);
- *professional medical biochemical knowledge* (general and pathological clinical biochemistry, haematology with coagulation and immunohaematology, clinical immunology, blood banking, clinical cytology, microbiology, analytical toxicology, molecular diagnostics, emergency laboratory medicine, point of care laboratory testing, rational laboratory diagnostics, etc.);
- *knowledge, competences and skills in communication, laboratory management*, automatsation, electronic data processing, organisation and managing of laboratory of medical biochemistry and informatization of laboratory system.

The studies curriculum like this enables a graduate to make competent interpretations of laboratory test results and makes him/her an *important member of a professional medical team for patient management* or a *member of a scientific team that develops and researches new scientific knowledge*. After they successfully complete the 10th semester of their studies the graduates, Masters of Science in Medical Biochemistry can work in their health care area at all levels of laboratory health care justifying their position in a laboratory team as well in big clinical hospitals as in other type of hospitals or in the basic health care. The modern education of medical biochemists with a lot of knowledge of cytology, microbiology, immunology and blood banking provides a successful participation in development of the profession that aims towards an overall laboratory science, Medical Biochemistry and Laboratory Medicine. By applying biochemical, haematological, molecular biological and chemical methods and examination techniques and technologies of biological materials they will successfully contribute to stating the cause of an illness, to better health maintenance, to illness prevention, to treatment monitoring as well as to new scientific knowledge. The Curriculum of the Medical biochemistry studies on the Faculty of Pharmacy and Biochemistry is comparable with those in the Czech Republic, Poland, Hungary and Israel.

Postgraduate doctor studies

The Faculty of Pharmacy and Biochemistry proposed and received an acceptation for implementing of postgraduate doctor studies in the "*Pharmacy and Biochemistry*" sciences, which leads to a degree of *Doctor of Science* in

istraživačkih projekata na Farmaceutsko-biokemijskom fakultetu, suradnji s nizom znanstveno-nastavnih suradnih ustanova te suradnjom s klinikama, industrijom i poslovnim sektorom. Nužno je kroz znanstveni rad osnažiti inovativnost i omogućiti prijenos tehnologija, te istraživačkom i obrazovnom aktivnošću sustavno povezivati znanost i kliničku praksu.

Nastava se organizira uz sudjelovanje znanstvenika iz brojnih suradnih ustanova kao što su: Institut Ruđer Bošković, nastavne baze Farmaceutsko-biokemijskog fakulteta (KBC „Zagreb", KB „Sestre milosrdnice", KB „Dubrava"), te gostujući nastavnici iz znanstvenih i istraživačkih instituta i fakulteta iz zemlje i iz inozemstva.

Studij uključuje *organiziranu nastavu* - obvezne, modularne, metodološke i izborne predmete *i aktivno bavljenje znanstveno-istraživačkim radom,* a završava polaganjem ispita, pozitivnom procjenom znanstvene aktivnosti, pozitivnom ocjenom i obranom doktorskog rada. Doktorski studij primjenjuje ECTS sustav bodovanja sukladan europskom sustavu. Udio organizirane nastave u studiju je najmanje 20% dok se oko 80% ukupnog udjela odnosi na znanstvenu aktivnost pristupnika.

Predmeti su predloženi kroz 4 bodovne skupine:

- prvu bodovnu skupinu čine temeljni predmeti, zajednički za oba modula doktorskog studija. Cilj je ovih kolegija upoznati polaznika s temeljima znanstvenog rada u cjelini te pružiti polaznicima potrebna znanja za svladavanje modularnih, metodoloških i izbornih kolegija, znanstvenu aktivnost i izradu doktorskog rada.
- drugu bodovnu skupinu čine modularni predmeti koji odgovaraju znanstvenim interesima polaznika, odnosno imaju za cilj uvesti polaznika u znanstvene spoznaje užih područja istraživanja pojedinog modula doktorskog studija.
- u trećoj bodovnoj skupini su metodološki predmeti čiji je cilj upoznati polaznika s tehnološkim postupcima i metodama u pojedinim istraživačkim područjima, a u svrhu izrade praktičnog dijela doktorskog rada.
- četvrtu bodovnu skupinu čine izborni predmeti iz širokog izbora ponuđenih predmeta studija, ali to mogu biti predmeti predviđenih specijalističkih poslijediplomskih studija Farmaceutsko-biokemijskog fakulteta i predmeti drugih doktorskih studija. Prijedlozi za izborne predmete stalno se proširuju.

Poslijediplomski specijalistički studij

Farmaceutsko-biokemijski fakultet je predložio i 4 poslijediplomska specijalistička studija iz područja Medicinske biokemije, Molekularne dijagnostike, Farmakogenomike i Analitičke toksikologije. Ovi programi se nalaze u završnoj fazi procesa prihvaćanja.

area *Biomedicine* and *Health Care*. The studies are organised into two modules: *Pharmacy sciences* and *Biomedical sciences*. The objective of the doctor studies is to educate a graduate for an independent research work in scientific research institutions and in clinical practice and to offer a thorough research experience in specific areas of medical biochemistry.

The studies are designed for medical biochemists, pharmacists and other experts from the area of *Biomedicine and health care* and other *Natural sciences*.

Innovation of the Doctor Curriculum

The Curriculum proposal is extremely interdisciplinary. However, the integration is achieved by interlacing contents of natural, fundamental and applied clinical sciences, and very important information and communication sciences. The Curriculum teaching is based on diversity of research projects on the Faculty of Pharmacy and Biochemistry in cooperation with numerous scientific educational cooperative institutions and with clinical departments, industry and business sector. Through the scientific work it is necessary to strengthen innovation, to enable technology transmission and through research and educational activity it is important systematically to connect science with clinical practice. Teaching is organised with participation of cooperative institutions such as Ruđer Bošković Institute, teaching hospitals of the Faculty of Pharmacy and Biochemistry (Clinical Hospital Centre "Zagreb", University Hospital "Sestre Milosrdnice", University Hospital "Dubrava") and guest teachers from the scientific and research institutes and faculties from Croatia and the world.

The studies include *organised teaching* – with obligatory, modular, methodological and elective subjects and *active scientific and research work* and finishes with a successful completion of examinations, positive evaluation of scientific activity, positive grade in the final doctor examination. The ECTS credit system is applied and it is compatible with the European. The organised teaching takes 20% of the overall teaching and the rest 80% refers to the scientific activity of graduates. The subjects are divided into four credit groups:

- 1st credit group represents fundamental subjects and characteristics for both models of the doctor studies. The objective of these courses is to introduce the graduate with the basics of the scientific work and to provide necessary knowledge to overcome modular, methodological and elective courses, scientific activity and writing of the doctor thesis (doctorate)
- 2nd credit group represents modular subjects according to the interest of the graduates. Their objective is to introduce the graduate with scientific knowledge of a narrow research area of a certain module in the doctor studies.

Iskustva u provedbi reformiranog studija

U novoj koncepciji studija stručni predmeti se uvode već na prvoj godini, a značajni opseg satnice je usmjeren na boravak u zdravstvenim ustanovama. Studenti su vrlo dobro prihvatili provođenje organizirane stručne prakse tijekom redovitog studija. Studentska praksa je organizirana stupnjevito, tako da se stečeno teorijsko znanje uspoređuje sa suštinom i opsegom rada u laboratorijima zdravstvenih ustanova.

I godina: Posjet medicinsko-biokemijskom laboratoriju primarne zdravstvene zaštite te medicinsko-biokemijskom laboratoriju kliničke bolnice. Studenti provode po jedan radni dan u svakom tipu laboratorija, pri čemu dobiju uvid u organizaciju laboratorija primarne zdravstvene zaštite, odnosno kliničke bolnice. Na seminarskom dijelu nastave razmatraju prostorno uređenje laboratorija, strukturu zaposlenog stručnog osoblja, vrste opreme i opseg pretraga.

II godina: Stručna praksa u citološkom i histološkom laboratoriju. Studenti provode jedan radni dan u citološko-histološkom laboratoriju kliničke bolnice pri čemu nauče osnove o citokemijskim i imunocitokemijskim pretragama

III godina: Stručna praksa u kliničkom mikrobiološkom laboratoriju.

IV godina: Stručna praksa u hematološkom laboratoriju.

V godina: Stručna praksa u kliničko-biokemijskom laboratoriju koja obuhvaća laboratorijske metode za ispitivanje elektrolita, kiselinsko-bazične ravnoteže, proteina, neproteinskih dušikovih spojeva, porfirina, ugljikohidrata, lipida i lipoproteina, enzima i izoenzima, hormona te mikroelemenata u tjelesnim tekućinama. Upoznavanje s radom instrumenata i automatskih analizatora te metodama molekularne dijagnostike. Stručna praksa uključuje rad u specijalističkim laboratorijima za endokrinologiju, dijagnostiku krvlju prenosivih bolesti te laboratoriju za biološko-toksikološka vještačenja.

Osnovni princip Bolonjske deklaracije je rad sa studentima u malim grupama tako da se intenzivira individualni rad studenata. Kako se broj studenata Studija medicinske biokemije već duže vremena kreće oko 20 polaznika godišnje, to su se ovi principi provodili i u dosadašnjem radu. Sustavni rad studenata se potiče kroz kontinuiranu provjeru znanja i brojne seminarske radove i vlastite prezentacije, što je dalo vrlo dobre rezultate.

Posebno je mnogo učinjeno na aktivnom podupiranju mobilnosti studenata, i to u okvirima CEEPUS programa - „Centralno-europski program razmjene sveučilišnih studija". Program omogućuje razmjenu studenata i podržava mobilnost nastavnog osoblja u cilju stvaranje mreže centralno-europskih sveučilišta. Kroz ovaj program je tijekom desetak godina, na specijalizirane projekte Farmaceutsko-biokemijskog fakulteta, došlo preko 100 studenata iz zemalja Europe, dok su brojni studenti i nastavnici Fa-

- 3rd credit group represents methodological subjects whose objective I to introduce the graduate with technological procedures and methods in different research areas for the purpose of making a practical part of the doctor thesis.
- 4th credit group represents elective subjects from a wide selection of curriculum subjects. However these could be also subjects planned for the postgraduate specialist studies on the Faculty of Pharmacy and Biochemistry and subjects from other doctor studies. There are constantly more proposals for elective subjects.

Postgraduate specialist studies

The Faculty of Pharmacy and Biochemistry proposed four postgraduate specialist studies from the area of Medical Biochemistry, Molecular Diagnostics, Pharmacology and Analytical Toxicology. These programmes are in the final phase of acceptance.

Experiences in implementation of the reformed studies

In the new concept of the studies professional subjects are introduced already in the first year and a lot of time is spent in the health care institutions doing practical work. The students have successfully accepted the organised practical training during the regular studies. The student's practical training is organised in levels, which enables the comparison of the acquired theoretical knowledge with an essence and volume of the laboratory work in health care institutions.

1st year: Visit to a laboratory of medical biochemistry of a basic health care institution and to a laboratory of medical biochemistry in a clinical hospital. The students spend one working day in each of the laboratories, where they get an insight in laboratory organisation of each laboratory type. In the seminars students examine the environmental design (physical planning) of laboratory, the structure of employed professional experts, the types of the equipment and the range of tests.

2nd year: Training in a cytology and histology laboratory. Students spend one working day in a cytology and histology laboratory in a clinical hospital where they learn the basics of cytology and immunocytochemistry tests.

3rd year: Training in a clinical microbiology laboratory.

4th year: Training in a haematology laboratory

5th year: Training in a clinical biochemical laboratory that includes laboratory methods for examining of electrolyte, acid base balance, proteins, nonprotein nitrogen compounds, porphyrins, carbohydrates, lipids and lipoproteins, enzymes and isoenzymes, hormones and microelements in body fluids. Furthermore, it includes an introduction with performance of equipment and auto

kulteta gostovali na sveučilišnim klinikama i sveučilištima u zemljama središnje Europe.

Kao zaključak možemo reći da su učinjeni mnogi važni koraci u usavršavanju Studijskog programa medicinske biokemije. No, istodobno ostaje još dosta toga što treba razriješiti u suradnji sa Sveučilištem, Ministarstvom znanosti, visokog obrazovanja i športa, Ministarstvom zdravstva i socijalne skrbi, uz aktivno sudjelovanje struke da bismo se kvalitetno prilagodili europskoj dimenziji laboratorijske djelatnosti.

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analyzer and with the methods of molecular diagnostics. Practical training also includes work in specialized laboratories for endocrinology, diagnostics of blood transmitted diseases and in the laboratory for biological toxicology expertise.

The fundamental principle of the Bologne Declaration is working with students in small groups in order to intensify the individual work of students. As the number of students on the Medical Biochemistry studies for many years counts around 20 per year, these principles were already implemented in previous practice. Systematic work of students is stimulated by constant knowledge examination, numerous seminars and presentations, what has given very good results.

A lot was done on the field of active promotion of student mobility in the scope of CEEPUS (Central European Exchange Program for University Studies). The program enables student exchange and supports teaching personnel mobility with objective to create a network of Central European Universities. Due to that program more than 100 students from Central Europe have come to specialised projects on the Faculty of Pharmacy and Biochemistry during the last ten years and numerous teachers and students from the faculty visited university clinics and universities in the Central European countries.

As a conclusion we can say that big steps have been done in improvement of the Medical Biochemistry studies. However, there are still a lot of issues that have to be discussed and solved in cooperation with the university of Zagreb, Ministry of Science, Education and Sport and Ministry of Health and Social Welfare with active participation of the experts, so that we could adequately adjust to the European dimension of laboratory service.

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